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Hyperspectral Signatures (400 to 2500 nm) of Vegetation, Minerals, Soils, Rocks, and Cultural Features: Laboratory and Field Measurements

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The objective of this catalog was to document the visible near-infrared reflectance spectra (400-2500nm) of vegetation, soils, rocks, and man-made materials, and to provide information about their unique physical and chemical properties. Spectra were taken of representative samples of a particular plant species or soil type and selected conditions so that a specific feature could be evaluated. Seasonal differences in vegetation spectra were measured for tree, shrub, herbaceous, and grass species. Soils having different textures and moisture potentials were measured. These spectra summarize results of ongoing research in different environments, although many of the field spectra were taken in semiarid and arid environments.

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PREFACE

The objective of this study was to document the visible - near infrared reflectance spectra (400 nm to 2500 nm) of vegetation, soils, rocks, and man-made materials and provide information about their unique physical and chemical properties.

These reflectance spectra were taken as part of on-going spectral signatures research. Many of the spectra represent in situ surfaces from semi-arid and arid environments. Other spectra were taken of samples collected in these environments and analyzed in the laboratory. The spectra were taken with several instruments having different spectral ranges and resolutions. All spectra are presented in the same graphic format so that comparisons between spectra are easier to make.

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I. SUMMARY

The objective of this catalog was to document the visible near-infrared reflectance spectra (400-2500 nm) of vegetation, soils, rocks, and man-made materials, and to provide information about their unique physical and chemical properties. Hyperspectral signatures were taken of a number of vegetation, soils, rocks, minerals, and cultural features, over the 400 to 2500 nanometer (nm) region of the spectrum. The features were representative of the dominant material covering a sample site. Spectra were also taken of representative samples of a particular species or condition so that different factors affecting a particular feature could be evaluated. For example, the seasonal differences in vegetation required the spectra of a species in the leaf-off, the full green leaf-on, and the senesced leaf-on conditions. Similarly, the variable nature of soil moisture required the spectra of a soil at different soil moisture conditions, i.e. 0.1, 1.0 and 15 bar moisture potentials as well as the air dry condition.

Spectral measurements were made using different spectroradiometers and a spectrophotometer. Inherent instrument differences in spectral range and spectral resolution, and their operating environment, necessitates a common format for data presentation and documentation. Associated ancillary data describes some of the physical and chemical properties of each sample or feature and the conditions at the collection site. These data should permit a better understanding of spectral differences and similarities between features.

This catalog is divided into five categories: vegetation, soils, rocks, minerals, and cultural features. Some of these categories are further divided into smaller units. Descriptions of the major and minor categories were provided so that future spectral data can be inserted into the catalog where appropriate. This can be easily accomplished because the sheets are numbered sequentially. Some subcategories, particularly the soil category, may require reorganization as additional spectra are included. It is uncertain whether soil texture should be the basis for subdividing this group or whether some other factor should be used. Regardless, the present arrangement permits easy access by general feature, then by more specific factor so that the entire catalog does not have to be searched.

II. INTRODUCTION

Many different remote sensing technologies have been used to characterize the earth's surface. Laboratory and field studies

have described the spectral signatures of many natural and man-made features, and have characterized various factors affecting a feature's spectral signature. The results are often summarized in published literature by a few broad waveband values or an algebraic transformation, thereby loosing the detailed spectral information contained in the original data.

Future airborne and satellite remote sensing systems will have higher spatial and spectral resolutions than do present systems, such as the Landsat Thematic Mapper 4 and 5 satellite systems. This being the case, there will be a need for high resolution spectral data that is a basis for predicting whether a surface feature can be detected and identified.

This process is highly dependent upon the waveband images selected for achieving maximum feature detection. The analyst must have some knowledge of the feature and background spectral characteristics in order to select the proper waveband images for expedient image exploitation.

III. OBJECTIVE

The purposes of this catalog are to document the reflectance spectra (400 nm to 2500 nm) of vegetation, soils, rocks and man-made materials, to provide ancillary information describing the radiometric procedures, and to provide the major physical and chemical properties of the surface or feature.

IV. DESCRIPTIONS OF CATEGORIES AND THE FACTORS AFFECTING THEIR SPECTRAL SIGNATURES

Most spectral measurements have been made on surfaces that are assemblages of different materials. For instance, soils and rocks are composed of different minerals, and a plant canopy is comprised of an assemblage of leaves, twigs, stems and branches; each of which may have its own characteristic spectral signature. This catalog places each surface feature into one of five categories, each of which can be subdivided according to identifiable unique properties. We used general classification systems from the fields of botany, mineralogy, soil science, geology and geography. These categories group similar, but not necessarily identical, features. Each sheet entry within a minor category is numbered consecutively. The categories given in Table 1 are preliminary and may be expanded or adjusted as future work dictates.

Vegetation (V) is divided according to the physiognomic features of the plant cover; e.g. trees have the classification

symbol VT; shrubs, VS; grasses, VG; and other herbaceous plants and plant material, VH. Minerals (M) are not subcategorized because of the limited number of spectra presently available. In the future, this category will be subdivided by composition; oxides, MO; carbonates, MC; silicates, MS. Soils (S) are grouped together, although each soil is classified according to the U.S. Department of Agriculture soil textural classification system (SCS, 1951). Minor categories were not identified because further study is necessary to identify minor categories applicable to remote sensing techniques. Rocks (R) are categorized by type: igneous, RI; sedimentary, RS; or metamorphic, RM. Cultural and Man-made (C) features are divided into the following categories; roads, CR; buildings, CB; and man-made materials, CM, which includes paints, fabrics, etc.

Table 1
Major and Minor Categories for Grouping Surface Materials

Symbol		Description
V		Vegetation
	VT	Trees
	VS	Shrubs
	VG	Grasses and graminoid plants
	VH	Herbaceous plants, debris, litter
M		Minerals
	MO	Oxides
	MC	Carbonates
	MS	Silicates
S		Soils
R		Rocks
	RI	Igneous rocks
	RS	Sedimentary Rocks
	RM	Metamorphic Rocks
C		Cultural and Man-made Features
	CR	Roads
	CB	Buildings
	CM	Materials (paints, fabrics, metals)

Each catalog page is a separate spectral signature sheet, that includes analytical methods and procedures used and a plot of the spectral signature data. The information is of sufficient detail so that each sheet can be separated from the catalog. A more detailed description of the laboratory and field data collection procedures, and the methods for describing the surface or materials is provided in the following pages. Many investigations have addressed various factors and their effects on the spectra of the different surfaces (Gausman, et al., 1970; Stoner and Baumgardner, 1981; Satterwhite and Henley, 1985.) The more obvious factors for each major category are listed in Table 2. Other factors should be added as their spectral effects are described and spectral data sheets become available. Each major category and its factors are discussed below.

Table 2
Major Surface Categories and Factors Affecting Their Spectral Signatures

A. Vegetation

1. Pigmentation
2. Cover
3. Leaf area index
4. Leaf water

B. Minerals

C. Soil

1. Soil texture
2. Soil moisture
3. Salts
4. Iron oxide
5. Organic matter
6. Shadows
7. Clay minerals

D. Rocks

E. Cultural Features

A. Vegetation (V)

Vegetation affects the appearance and general character of the land surface and contributes to the spectrum of the terrain surface. Vegetation, as a generic term, means the total plant cover of a region, area or place. This assemblage of plants and plant communities can differ in composition as a consequence of complex interactions between the plants, the environmental factors, and the nature and frequency of natural and man-induced disturbances.

Vegetation can be divided according to its physiognomic features. Woody-stemmed plants are divided into trees (VT) and shrubs (VS), and herbaceous plants are divided into grasses and graminoid plants (VG) and other herbaceous plants, plant debris and leaf litter (VH). However, green leaves of tree species are not necessarily spectrally different from the green leaves of shrub species or grass species. Spectra may in fact be sufficiently similar to warrant placing all green leaf plants in one group, but such re-arrangement is left for the user based on his needs and his specific use of this catalog. The major subdivisions of vegetation are given in Table 1. The spectra signature sheets are arranged by major subdivision in Section IX.

Trees (VT) are woody stemmed plants more than 5 meters tall with a diameter >2.5 cm, measured at 1.5 meters above the ground surface. Shrubs (VS) are woody-stemmed plants less than 5 meters tall. The conventional criteria that shrubs be woody, multiple stemmed plants are not appropriate because some plants can be multiple stemmed with each stem satisfying the height and stem diameter criteria for a tree. In other instances some individuals are woody, single stemmed plants <5 meters tall. Both of these conditions compromise the conventional descriptions for a tree and a shrub. Herbaceous plants annually produce aboveground parts with or without under ground stems. The aboveground stems are generally soft and are usually less than 1 meter high, although some species can attain greater heights. Large herbaceous plants such as banana would be classified as a tree if the plant satisfied the height and stem diameter criteria, even though they do not have woody stems.

Most plants have a "typical" annual growth cycle, the steps of which are generally recognized as vegetative, flowering, fruiting and senescence. The vegetative stage begins with a period of new growth during which the leaves and shoots develop from persistent plant structures or from seeds. Most plants keep their leaves for some time following flowering and fruit production. The vegetative and flowering stages can occur in reversed order. The vegetative stage can be variable because different species have specialized plant parts capable of photosynthesis;

e.g. in the stems of cacti, in the bark of the young stems and branches of paloverde, or in the inconspicuous microphylls of Ephedra.

The spectral characteristics of vegetation will change as it progresses through the stages of young leaves - mature leaves - senescing leaves - senesced leaves. Leaf senescence is typically associated with the loss of leaf pigmentation and leaf detachment. For some species, the senesced leaves may remain attached to the plant but the leaves are no longer capable of photosynthesis. Even tropical rainforest species have an annual senescence period, although not all rainforest trees senesce at the same time, as is usually the case for the broadleaf tree species in temperate regions, e.g. the Eastern deciduous forest.

The assemblage of all plant species provides the vegetation contribution to the spectrum of the terrain. A species may be described spectrally by the spectrum of its in situ canopy. This can also be approximated by laboratory spectra of excised leaves. Laboratory spectra of single leaves are important for understanding plant reflectance characteristics but cannot be compared directly to field canopy measurements because many factors affecting the canopy spectra are not taken into consideration in the laboratory. These factors include solar illumination, leaf orientation, and in-canopy shadows. For each vegetation subcategory in the catalog, the spectra are illustrated for in situ plant canopies as well as individual leaves.

Much of our understanding of vegetation spectra and related factors has been derived from studies of agriculturally important species (Loomis, 1910; Gates, et al., 1965; Gausman, et al., 1970; and Thomas and Gausman, 1977). Spectral studies of shrub and grass species show these relations to be also applicable to plants found in semi-arid and arid environments (Satterwhite and Henley, 1986).

1. Pigmentation. Leaf pigments of plants, i.e. chlorophylls, carotenoids, xanthophylls, and anthocyanins, very efficiently absorb ultraviolet and visible light (Gates, et al., 1965; Gates, 1970; Knipling, 1970). The percentage of these pigments in a leaf varies between species, and between plant growth stages (Gausman, et al., 1970; Thomas, 1977). The pigments all absorb strongly in the blue region, whereas the chlorophylls also absorb in the red region. Chlorophyll-a has two absorption peaks, at 430 nm and 680 nm; chlorophyll-b absorbs at 460 nm and 660 nm. Xanthophylls and carotenoids absorb in the 410 to 580 nm region. The materials comprising a leaf are slightly transparent to light at 540 nm. The maximum reflectance of a healthy green-colored leaf is about 10% to 20% in the visible region (400-700nm). In the visible region, photon absorption causes electron transitions to occur within the

complex pigment molecules, a process that provides energy for the photosynthesis process.

In the near infrared (NIR), absorptance is about 3% to 5% in the 700 nm to 1300 nm region and is about 30% to 50% in the 1300 nm to 2500 nm region. The absorption is related to water and the vibrational and rotational processes of the water molecule (H-O-H). Absorptions at 980 nm, 1190 nm, 1730 nm, 2100nm and 2300 nm are correlated with combined water in the leaf; and absorption at 1470 nm and 1970 nm are related to free water in the leaf. The region of greatest reflectance is from 750 nm to 1200 nm. The reflectance in the NIR is caused by the internal cellular structure with about 40% to 60% being scattered upward and the remainder being scattered downward, i.e. transmitted. The leaf is highly transparent in the 700 to 2500 nm spectrum, although transmissivity differences occur over this region.

The color changes associated with leaf senescence involve the fading or bleaching of the original leaf pigments. In some situations different pigments can be formed within the leaf. In many plants, leaf senescence is a process in which the green-colored leaves gradually loose their green pigmentation and turn a yellow color, before leaf drop. The yellow pigments (carotenes) are present in the leaf all the time, but they are hidden by the somewhat larger amounts of green pigments (chlorophyll a and b). Both the yellow and green pigments absorb blue and violet light. The green pigments also absorb in the red region. Consequently, the yellow pigments do not markedly change the visible color of the mature, healthy leaf. This is why they cannot be seen during the peak growth periods. During leaf senescence the chlorophylls begin to bleach, which is a consequence of the breakdown of proteins in the leaf cells, and the yellow pigments become visible. Another senescence sequence leads from green- to red-colored leaves. The red pigments must translocated into or be produced in the senescing leaf because they are not present in the typical green-colored leaf. Many young leaves form red pigments in the spring but lose them as they mature. This class of pigments is called anthocyanins and includes certain blue, purple, and red pigments. Anthocyanins differ from green and yellow pigments in that they are fully water soluble and occur in the water sap of the plant. These pigments absorb in the green region, masking both the yellow pigments and green pigments.

2. Vegetative Cover is the percentage of the ground surface obscured by vegetation when viewed vertically (see Figure 1). A complete vegetative cover (100%) means the vertical view of the ground surface is entirely filled with vegetation (Satterwhite, et al., 1982). Many plant canopies, even dense canopies, have spaces in the canopy through which light can pass to lower segments or to the ground surface. These spaces appear as shadowed

areas because the light intensity reflected from them is much less than that from the surrounding sunlit leaves. In reconnaissance field studies, we estimated the canopy cover in the radiometer's field of view (FOV) at the time the canopy spectrum was taken. The species percent cover at the sample site was also estimated. More intensive studies would use conventional phytosociological sampling techniques for determining species cover.

3. Leaf Area Index (LAI) is a measure of the number of leaf layers in a plant canopy. It is a ratio of the total leaf area to the sample area (see Figure 1). For example, a plant canopy that covers a ground area of 1.0 square meter and has a leaf area of 2.0 square meters would have a leaf area index of 2.0. The number of leaf layers in the plant canopy affects reflectance in those spectral regions in which the leaves have high transmittance, i.e. the near infrared region (Gausman, et al., 1976). LAI of the plant canopy is not usually measured during field reconnaissance studies because it is a labor-intensive task. Results from test plot studies have described the plant canopy LAI and its associated reflectance spectra (Daughtry, et al., 1980; Holben, et al., 1980). The effect of LAI on canopy spectra must be considered as it and canopy cover are significant factors in the NIR reflectance differences between spectra of the same plant species (Satterwhite and Henley, 1982, 1986).

Laboratory and test plot studies have described the relations between multiple leaf layers and spectral reflectance of the Stacked leaves (Gausman, et al., 1976; Satterwhite and Henley, 1982). In the visible region, the first layer of healthy leaves absorbs approximately 80 percent to 95 percent of the incident visible light. The remaining visible light is reflected from the leaf surface. In the NIR, the first leaf absorbs less than 10 percent of the incident light. The remaining incident NIR light is about evenly transmitted and reflected. The transmitted light and the scattered specular light penetrating the plant canopy are attenuated by each leaf layer encountered. The level of attenuation depends on the species leaf characteristics and cell arrangement. Seven or eight fresh corn leaf layers, two dry, dead corn leaf layers (Gausman, et al., 1976) or four layers of geranium leaves (Satterwhite, 1982) attenuated the NIR reflectance under field conditions. The visible and NIR reflectance of canopies have been correlated with LAI and form the basis of using spectral reflectance measurements for monitoring crop growth (Daughtry, et al., 1980; Wiegand, et al., 1979).

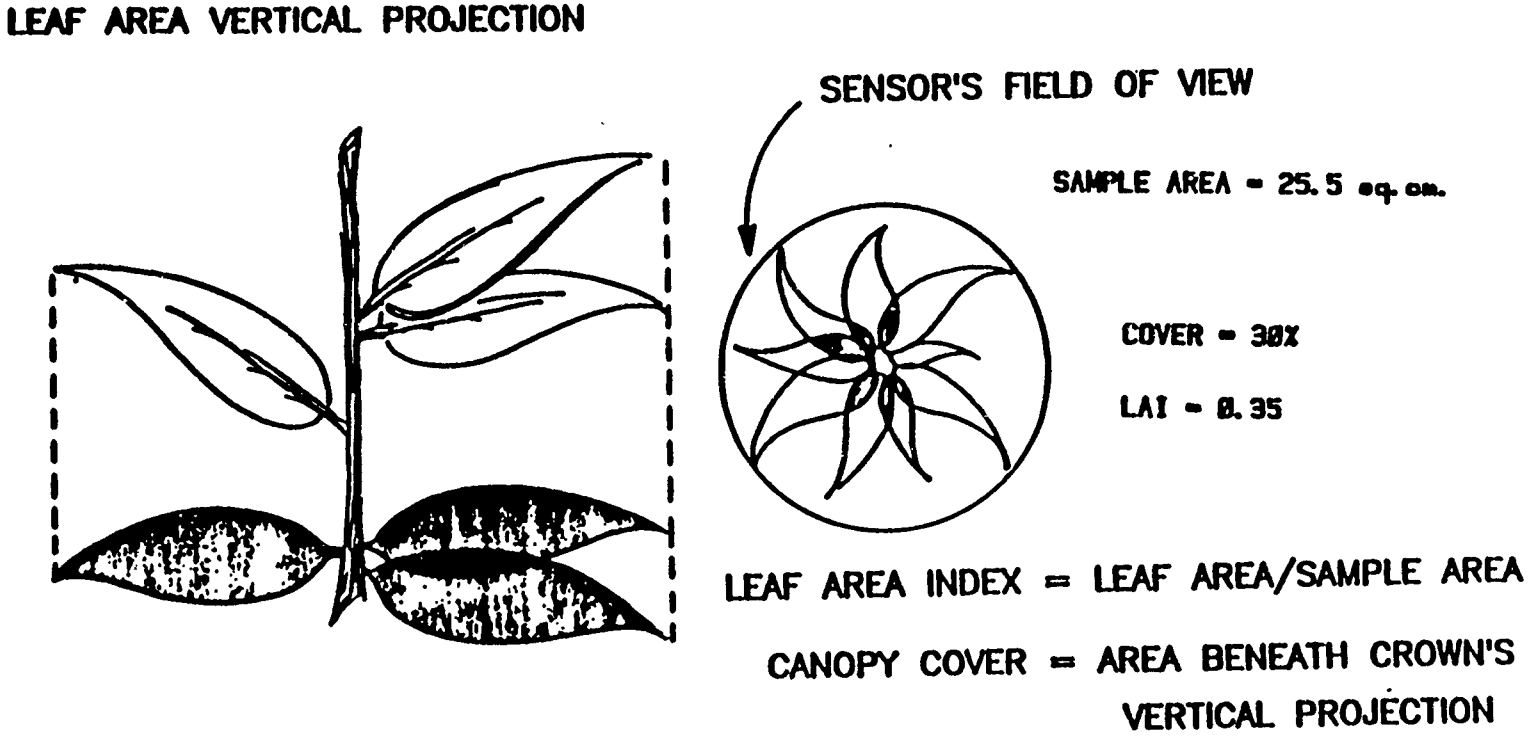

Figure 1. An Illustration of Leaf Area Index and Canopy Cover in a Field of View

A plant's LAI value is not constant, but increases from early plant growth, peaks, then decreases as the leaves senesce during flowering and fruit development. This is a common plant growth process that has been studied most thoroughly for agricultural crops (Kanemasu, 1974). The variation in leaf area over the growth cycle and the LAI and NIR reflectance relations indicate that the canopy's NIR reflectance will change over the growth cycle. A major difficulty encountered when conducting such plant growth studies is determining whether the reflectance differences are due to changes in the plant cover or to changes in LAI while cover remained constant.

4. Leaf Water Content. Reflectance spectra of most mature leaves for a species are similar unless some external factor changes the pigmentation, the mesophyll cell structure, the water content or the leaf surface. Plant response is most sensitive to the loss of pigmentation, which can result from nutrient deficiency, from toxic chemicals or from pathogens. Change in leaf mesophyll structure can result from severe dehydration, but normally no structural changes occur in response to small changes in leaf water content. Severe dehydration alters the mesophyll air-water relation and substantial increases the NIR reflectance of the leaf.

B. Minerals (M)

Minerals are naturally occurring inorganic, crystalline solids. They are electrically neutral chemical compounds that are expressed as empirical chemical formulae. The variety of mineral nomenclature and identification results from the interchangeability of different atoms within a mineral's crystal lattice. This is possible as long as the structure and electrical charge within the mineral remains unchanged. The mineral name is based on the ratio of different elements occupying the crystal lattice. Minerals are rarely pure and usually have trace elements and other impurities trapped in their crystal lattices. These impurities and trace elements can have a strong effect on the spectral characteristics of a sample, especially in the visible region where many different colors can be caused by very small amounts of impurities or trace elements.

The VIS-NIR-MIR spectral features of a mineral are of electronic or vibrational origin. Electronic processes involve broad wavebands in the ultraviolet and visible regions. In this region almost all the electronic features in the spectrum of a geologic sample are due to iron transitions. A good explanation of the electrical-optical absorption is given by Hunt and Salisbury (1970).

Vibrational processes produce very sharp bands in the mid-infrared (MIR). Features observed in the visible to near-infrared (400 nm to 2500 nm) spectrum are all overtones or combination tones of fundamental vibrational modes occurring in wavebands >2500 nm. The most common and readily detected absorptions caused by vibrational processes are those due to water, H-O-H, and the hydroxyl ion, OH. In minerals, water can occur in several ways: as free water trapped in pockets as in milky quartz; as integral parts of the crystal lattice, e.g. in hydrates such as gypsum and some clay minerals; and as molecules adsorbed on the surface of mineral grains. The major water bands occur at 960 nm, 1100 nm, 1400 nm and 1900 nm. The presence of both the 1400 nm and the 1900 nm bands is diagnostic of undissociated water in the crystal structure, such as water of hydration in the lattice of gypsum. Free water alone is associated with the 1900 nm band. The hydroxyl ion is indicated by the presence of only the 1400 nm absorption band. The hydroxyl ion shares the 1400 nm band with water. The hydroxyl ion also has absorption bands at 2200 nm and 2300 nm.

The mineral spectra shown in this catalog are classed according to anion groups, for example, as oxides, carbonates, and silicates. More detailed information about chemical composition and resulting absorptions will be given in the individual spectral sheets.

C. Soils (S)

Soil is a well-defined biologically and chemically weathered portion of the regolith (parent material) which has undergone such changes that it has recognizable characteristics and properties different from its parent material. Organic matter may be added, cations and anions deposited and clays formed to alter the parent material to a soil. The term "the soil" is a collective term meaning all soils and the term "a soil" refers to a specific soil with discrete characteristics.

The spectral characteristics of a soil are determined by its physical and chemical properties, e.g. particle size, particle composition, precipitated salts, iron oxides, organic matter, and moisture content.

Soils can be stratified vertically and the subsurface properties can be different from the surface properties that are observed by a remote sensing system. Analyses have shown the spectra of many soils to be quite similar (Condit, 1976; Stoner and Baumgartner, 1981; Satterwhite and Henley, 1987), suggesting that there may be only a small number of typical soil spectral

curves defined by shape and amplitude. Factors affecting a soil's spectrum are discussed in the following sections. The index of spectral signature sheets for the soil samples is found in Section IX.

1. Soil texture is defined by the proportions of various sized particles in a soil. The percentages of sand, silt and clay size particles are used to determined the textural name according to the U.S. Department of Agriculture soil classification system (see Figure 2). The coarsest sand particles often are fragments of rocks as well as minerals. Quartz commonly dominates the finer grades of sand as well as the silt separate. Variable quantities of feldspars and micas are also common. Gibbsite, hematite, and goethite are found as coatings on quartz grains. Hematite, goethite and limonite impart various shades of red, yellow, and brown to the soil if present in sufficient quantities. For dry soils, the brightness varies inversely with particle size, i.e. the smaller-sized particles are brighter than the larger-sized particles. The major brightness differences are found between separates that are >250 micrometers (μm), 74-250 μm and <74 μm.

Particle size affects the amount of water held in the soil as well as water movement through and within a soil. In this regard, a sandy soil holds less water than does a clay soil and water will drain faster from a sandy soil than from a clay soil.

2. Soil moisture. The presence of hygroscopic and capillary water lowers the brightness in all wavebands. For many soils, water content and soil brightness vary inversely with each other. Major water absorption bands are centered at 1400 nm and 1900 nm, with a small absorption band centered at 960 nm. The hydroxyl ion (O-H) has absorption bands at 2200 nm and 2300 nm.

3. Salts are often deposited on the soil surface as a salt crust or powder-like precipitate, particularly in soils with high water tables. These salts can be highly reflective in the visible region, even when wet. The salts are usually chlorides and sulfates of sodium, calcium, and magnesium.

4. Iron oxides often cause broad band absorption features in the ultraviolet and visible regions. Ferric iron absorption occurs at 400 nm and 700 nm and ferrous iron at about 1000 nm to 1100 nm.

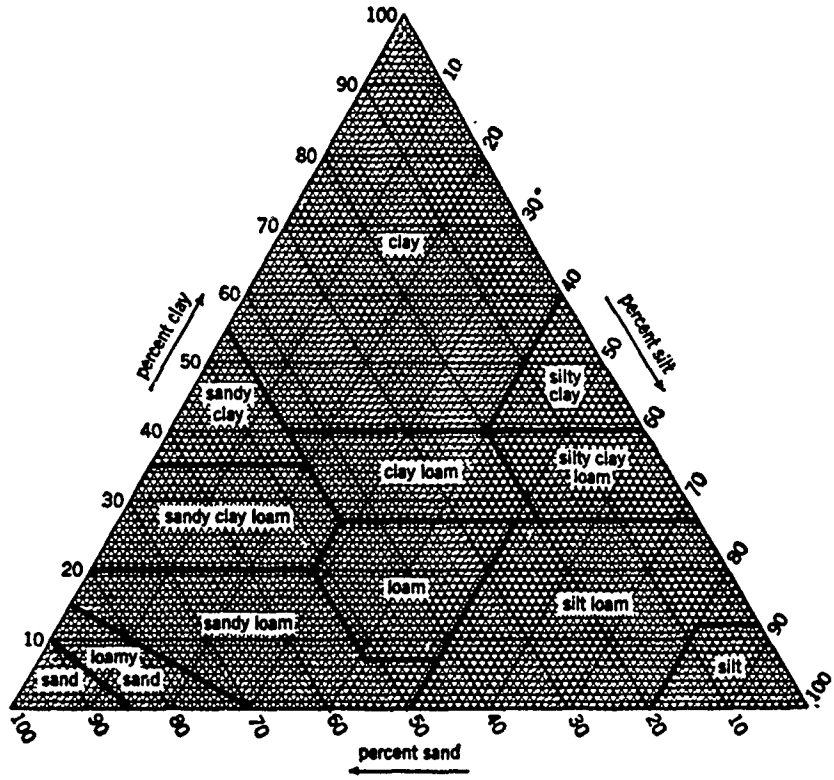

Figure 2. Soil Textural Classes (SCS-USDA, 1951).

5. Organic matter in the soil varies from 2% to 6% by weight. It consists of original plant tissue, such as undecomposed roots and parts of higher plants, humus (non-recognizable organics), and black or brown organics, usually of colloidal size. Organics can lower the overall reflectance of some soils.

6. Shadows. The low reflectance of a shaded soil is related in part to the low intensity of skylight or diffuse sunlight, that falls on shaded soil. The reflectance of most shaded soils is about 2% to 4% of the incident light over the 400 nm to 2500 nm spectrum.

7. Clay minerals in the soil can add spectral features to soil reflectance due to the type and structure of the clay minerals. These are due to the water and hydroxyl molecules in the clay structure. These features can be masked by water absorptions not related to clay minerals.

D. Rocks (R)

Rocks are naturally formed consolidated materials composed of one or more minerals, and have some degree of mineralogical or chemical constancy. The index of rock samples is found in Section IX.

Rocks are classified as igneous (RI), sedimentary (RS), or metamorphic (RM) based on their mode of formation. Igneous rocks are formed from molten or partly molten material. Characteristics of igneous rocks are determined by the chemical composition of the source magma and the rate of cooling. Sedimentary rocks are formed by the consolidation of sediments that have accumulated in layers. These sediments may consist of mechanically-formed fragments of old rock transported from its source and deposited by a fluid medium; sandstone is an example of a rock so formed. Some sediments can be formed by chemical precipitation from solution, e.g. oolitic limestone, or from accumulation of secretions by plants and animals, e.g. chalk or diatomaceous earth. Metamorphic rocks are derived from preexisting rocks and result from changes caused by temperature and pressure at depth in the earth's crust.

The reflectance properties of rocks depend on chemical composition, particle size and opacity and the illumination geometry. Spectral features, usually absorption bands, can result from different processes but any feature may be categorized as being either of electronic or vibrational origin. These refer to the behavior of the molecules in the crystal structure of the material in response to electromagnetic energy (in this case visible and infrared radiation).

For rocks and minerals, electronic processes produce very broad band absorption features in the ultraviolet and visible regions but rarely in the infrared region. Almost all of these features are due to iron in some form; the most common strong feature is caused by ferrous iron at about 1000 nm to 1100 nm. Other iron features are caused by ferric iron at 400 nm and 700 nm, leaving a reflectance maximum at about 520 nm, which causes the green color in some iron-containing compounds.

Vibrational processes produce sharp, narrow, absorption bands. Visible and near infrared bands are overtones and harmonics of the fundamental vibrational modes of the materials, which occur in the mid- and far-infrared regions. The most common absorption features seen in the near infrared spectra are those associated with the water molecule (H-O-H) and the hydroxyl ion (O-H). Water can occur in minerals and the rocks formed from them as free water molecules in small inclusions and pockets, or as part of the crystal lattice as in various hydrates. Water can also be physically adsorbed on the surfaces of mineral grains. There are two characteristic water absorption bands, one at 1400 nm and the other at 1900 nm. The presence of both bands indicates undissociated water molecules in the rock structure, i.e. water of hydration or water in the crystal lattice. The appearance of the 1400 nm band alone indicates the presence of only the hydroxyl ion in the mineral and not the water molecule. The hydroxyl ion also produces absorption bands at 2200 nm and 2300 nm such as seen in some hydrated alteration minerals formed from acidic igneous rocks.

In general, increased reflectance and decreased spectral contrast will result from decreasing particle size. This is observed in rocks composed of very fine mineral particles. Opaque minerals such as dark-toned magnetite, if finely disseminated through the rock, can mask spectral features and produce flat, featureless reflectance spectra.

Reflectance spectra were measured on both weathered exterior surfaces and freshly broken interior surfaces of rock samples. Reflectance differences between these two surfaces of the same sample can be significant. The fresh surface is composed of relatively unaltered mineral grains, while the weathered surface can be composed of additional minerals such as clays, caused by the alteration of the host rock. In addition, it may have coatings of airborne dust, organic covers such as lichen or moss, or chemical/biological coatings such as desert varnish. Weathered surfaces would be more likely viewed in remote sensing situations.

1. Igneous Rocks (RI).

   a. Granitic rocks are coarse grained and light-toned.

They are composed of quartz and feldspars in various amounts with small amounts of dark-toned and accessory minerals, primarily biotite. These rocks cooled very slowly at about 20 km below the earth's surface. Slow cooling produced the coarse crystalline texture. If these magmas, which are rich in silicon, calcium and aluminum, are extruded on the surface they cool rapidly and produce fine-grained, but compositionally identical rocks such as rhyolites and dacites. The most common spectral features of granitic rocks are the water absorption bands at 1400 nm, 1900 nm and the hydroxyl absorption bands at 2200 nm and 2300 nm. Free water is commonly found as inclusions in the quartz grains formed from magmas rich in water vapor. The alteration of feldspars to clay minerals can result in the presence of the hydroxyl bands.

b. Basic and basaltic rocks are dark in color and contain no quartz. They consist mainly of pyroxenes such as augite, sodic feldspar, and amphiboles such as hornblende. If these rocks cool slowly they will be coarse textured like the granite rocks; e.g. gabbro. If they are extruded on the surface, they cool rapidly and form fine grained rock, e.g. basalt. These rocks contain magnesium and iron (mafic), rather than silicon and aluminum sialic, and lack quartz which can contain water. Many basic rocks contain magnetite or other opaque minerals that quench the water and hydroxyl absorption bands producing rather featureless reflectance spectra. In arid regions a coating of desert varnish can be common on basic rocks. This dark covering will also mask any spectral features of the host rock.

2. Sedimentary Rocks (RS).

a. Clastic rocks, such as sandstone and shale, are the most common sedimentary rocks. They are formed of particles derived from previously existing rocks. The particles are usually transported some distance by fluvial or eolian media and then deposited, usually in water. As more and more sediment is deposited, the weight of the overlying material causes the sediment atdepth to become solid rock. Because the sediment is often transported from great distances, only the more resistant minerals, such as quartz, rather than biotite or calcic plagioclase, are common in clastic rocks. Clastic rocks are classified according to particle size: coarse-grained rocks are conglomerates, followed in decreasing order of particle size, by sandstones, siltstones, shales and mudstone. Sedimentary rock spectra will be dependent on the minerals from which they are derived. Quartz sandstones will have a similar spectra to quartz and a clay rich shale will show the characteristics of clay minerals.

b. Precipitated rocks are formed in water by chemical precipitation. The most common is limestone. Not all limestones are precipitated since some are composed of cemented shell

fragments and as such they would be clastic rocks although their composition is more similar to precipitated limestone. Limestone has a characteristic absorption around 2350 nm due to the carbonate radical.

c. Organic rocks are the third type of sedimentary rock. Coal is the most common. It is produced by the burial of vegetable matter, followed by chemical changes induced by increased temperature and pressure. Coral reefs are also organic rocks, as is guano.

3. Metamorphic Rocks (RM).

Metamorphic rocks are the most complicated of the three major rock types. They are formed in the solid state by changes in temperature and pressure at depth within the earth. They are classified either by their texture or by their mineralogy. The textural classification is the more effective field tool. The rocks are described as gneiss, schist, slate or phyllite. This list represents decreasing pressure and temperature of formation. Gniessic rocks are banded whereas the other three types are fissile, i.e. they are composed of flat mineral grains that are usually parallel to each other. Micas are common. Schists may have large crystals within a finer-grained matrix.

The mineralogical classification is based on a microscopic evaluation of the rock in which mineral phase changes resulting from temperature and pressure effects are identified. Temperature and pressure can bring about the disappearance or appearance of certain minerals. The rocks formed, in increasing temperature, are greenschist, amphibolite, and granulite. Greenschist and amphibolite facies rocks are often schistose; granulite facies rocks are usually gneissic in texture.

E. Cultural and Man-made Features (C).

Spectra related to features or objects produced by human activity are included in this section. Such features are composed of natural materials that have been fabricated into objects that do not occur naturally; e.g. a concrete roadway composed of cement (limestone) and gravel and sand aggregate, or a house roof made from palm leaves or wood shingles. Each feature is categorized as a cultural feature rather than as a material. Dirt roads are categorized as cultural features rather than as soil. An agricultural field, however, would not be a cultural feature but would be categorized as either vegetation (if a plant surface) or a soil (if the barren soil surface is exposed). Further study may require a classification system for the man-made features, which is similar to the land use - land cover system proposed by Anderson, et al. (1976). The present

system only addresses specific components found within the human cultural environment or specifically man-made such as:

1. Roads (CR)
2. Buildings (CB)
3. Materials (CM) (Fabrics, Metals, Paints)

V. SOIL ANALYTICAL PROCEDURES

A. Soil Collection.

Soil samples were usually taken from the 0 to 2.0 cm or 0 to 10.0 cm horizon. This characterizes the in situ soil surface materials that would be viewed by a radiometer or an airborne scanning or imaging system. Each sample was air dried in the laboratory. Samples were then passed through a 20.3 cm diameter soil sieve with openings of 2000 micrometers (μm). The sample fraction passing this sieve was mixed thoroughly and used in the various tests described below. The percentage of material held on the 2000 μm sieve, i.e. the gravel, was determined but this fraction was not analyzed further.

B. Particle Size Analysis.

The percentages of sand, silt and clay in each sample were determined using the hydrometer method. Each soil was classified according to U.S. Department of Agriculture soil texture classification system (Soil Survey Staff, 1951) and the Unified Classification system. For the saline soils, the percentages of sand and fines (silt + clay) were determined by wet sieving. The soil textural class was then determined using the soil textural triangle (see Figure 2).

C. Soil Salinity.

Soil salinity was determined with a electrical conductivity meter. Soils with conductivities greater than 4.0 mmhos/cm at 25 degrees Celsius were classified as being saline. High soil salinity, >11 mmhos/cm, adversely affected the hydrometer method for particle size analysis. For this reason the textural classes of saline soils were estimated where possible from the wet sieve data or no textural class was assigned.

D. Soil Aggregates.

Some soil samples were evaluated for the effect of aggregate size on soil reflectance. A 100 g to 200 g subsample was placed on a nested series of 20.3 cm diameter soil sieves having openings of 500, 210, and 74 μm, and the pan. The subsample was shaken for 3 to 5 minutes using a CENCO No. 1840 mechanical sieve shaker. The portion held on a specific sieve was removed and placed into a labeled, 6 cm diameter, tared weighing dish. Each sieved portion had the same range of particle or aggregate size, hence it was viewed as a soil separate although it was a mixture of soil particles and aggregates of smaller soil particles. Twenty gram to 30 g subsamples of the fraction passing the sieve with 2000 μm opening were weighted in a labeled, 6 cm diameter weighing dish. These are the composite samples. Fragments of organic matter/debris were removed from the composites and sieved separates. Care was taken not to break up the soil aggregates within a separate.

E. Soil Moisture.

Selected soil moisture conditions were created in the laboratory for many of the soil samples. The air-dried samples were created by allowing the sieved soil sample to dry on the laboratory bench at room temperature for 10 days or more. A Soil Moisture Inc. pressure plate apparatus was used to create the 0.1, 1.0 and 15 bar soil moisture potentials. Duplicates of each soil sample were analyzed. Each subsample was placed on a ceramic plate and allowed to equilibrate in de-ionized water for 24 hours. They were then placed in the pressure chamber and the selected pressure applied for a 24-hour period. The wet weight of the subsamples was determined. Samples were immediately placed into a closed humidity chamber to minimize water evaporation prior to weighing. The subsamples were removed in turn from the humid chamber and their reflectance spectra were measured using the GER-IRIS Mark IV spectroradiometer. The percent moisture for each subsample was determined gravimetrically on an oven-dry-weight basis after drying for 24 hours at 105 degrees Celsius.

For a few soil samples, the wet soil condition was created by slowly applying small amounts of de-ionized water to each air dried sample until the sample visually appeared "wet," i.e. the sample did not contain enough water to make it glisten. The wet sample was covered and allowed to equilibrate for approximately 6 hours before its spectrum was taken. The percent moisture of the wet soil sample was then determined gravimetrically on an oven-dry weight basis.

F. Chemical Analysis.

Chemical analyses were made on selected soil samples by emission spectrographic analysis at the U.S. Geological Survey, Reston, Virginia. Analyses were performed on the <125 micrometer

sieve fraction. Soil analyses for other mineral constituents and for clay minerals were performed using standard analytical techniques.

G. Geomorphic Unit.

The geomorphic unit or landform from which the sample was taken is given for each soil. While this parameter may not have direct bearing on the reflectance of a soil, there are relations between landforms, rocks, soils and vegetation which may be useful in the overall spectral analysis of a region. Generally, soil particle size decreases down slope from the source, e.g. the upper parts of an alluvial fan would be composed of coarser-grained materials than the lower parts of the alluvial fan and the basin floor. This gradation of particle size and surface slope results in zonation of vegetation, moisture and salinity. Knowledge of these relations aids the prediction of surface material types and spectral characteristics.

The landforms were generally classified by origin as either erosional or depositional. Erosional landform are created by the wearing away of materials from a mass, leaving sculpted features such as bedrock surfaces, hills and mountains, or valleys and canyons. Depositional landforms are formed by deposition of materials previously eroded and transported from their source either by gravity or some fluid medium. These landforms include alluvial fans, talus slopes, sand dunes, flood plains and playas.

The depositional surfaces are usually formed of unconsolidated particulate material while the erosional surfaces are usually more consolidated and massive. Soil formation on the surfaces of landforms can mask the spectral characteristics of the original materials making up the original surface.

Table 3
General Landform Categories

A. Erosional surfaces

1. Bedrock Surfaces
2. Inselbergs, Hills, Mountains
3. Valleys, Canyons, Gorges

B. Depositional surfaces

1. Alluvial fans
2. Talus slopes
3. Dunes, Hills
4. Floodplains
5. Playas

VI. SPECTRORADIOMETRIC PROCEDURES

A number of instruments were used to take the laboratory and field reflectance spectra. The spectrophotometer was used only in the laboratory. Smaller and highly mobile spectroradiometers were used in both the laboratory and field environments. Procedures for the mobile systems varied slightly between the field and laboratory. The major procedural differences were associated with the sample and the light source, e.g. whether in situ soil surfaces or disturbed soil samples were measured, or whether plant canopies or excised leaves were measured. When the same instrument was used in both environments, it was necessary to describe only the procedural differences and not repeat the instrument characteristics.

Most spectra were taken at a nadir radiometer viewing angle. The reference standard was a 25.4 cm x 25.4 cm x 1.0 cm pressed Halon "Spectralon" plate that was backed by a 0.5 cm aluminum or plastic plate. The reference standard was placed horizontally and normal to the radiometer. A bubble level was used to ensure the standard was level. The "Spectralon" reference standard was commercially available from Labsphere, North Sutton, New Hampshire, model 5R5-99-100. The standard's calibration curve is relatively flat across the 300 nm to 2500 nm spectrum. It reflects approximately 97% to 99% of the incident light. A gypsiferous sand sample collected near the White Sands National Monument, New Mexico, was often used as a control sample for checking the spectroradiometers wavelength calibration.

A. Laboratory Measurements

Light Source: Lowel Tota lamp, 500 watt, tungsten-halogen lamp, model FDN, at a color temperature of 3200 degrees Kelvin.

IRIS Model Mark IV Spectroradiometer

Supplier: Geophysical Environmental Research, Inc., New York, New York.

Dual-beam, continuous scan, grating type spectroradiometer

Field of view: 4 degrees

Spectral range: 360-2500 nm

IRIS Model Mark IV Spectroradiometer (cont'd)

Spectral resolution: 1.5 nm in the 360-1300 nm region;

3.5-4.5 nm in 1300-2500 nm region;

Detector: Si-PbS

Scan time: 1 minute over the spectral range

Nadir radiometer viewing angle

Viewing height: 48.5 cm

Light source: Loweltota lamp

Reference Standard: Halon plate

Using a rotating mirror device, the sample and the Halon reference standard were essentially viewed simultaneously at each waveband increment. The radiance spectra of the sample and the Halon were automatically recorded in the radiometer's internal bubble memory. After a spectrum was recorded, the data were analyzed using a Zenith PC computer to compute the sample's reflectance using vendor-supplied software. This procedure includes applying the instrument's detector calibration functions and dark current adjustments to the data. User-written software with a curve slope fitting algorithm was used to remove noise from the spectrum that was associated with a detector change at 1150 nm. Data overlaps between gratings were removed by user-written software. The spectral data were smoothed using a five point weighted average simplified least squares curve fitting procedure (Savitzky and Golay, 1964). The reflectance spectrum was resampled at 5 nm waveband increments over the spectral range. The resulting file contains 421 data points.

Spectrofax Model AA440 Spectroradiometer

Supplier: Daedalus Enterprises, Inc., Ann Arbor, Michigan.

Single beam continuous scanning spectroradiometer, that uses a circular variable filter (CVF)

FOV: 1.5 degrees

Spectral Range: 450-2435 nm

Spectrofax Model AA440 Spectroradiometer (cont'd)

Spectral Resolution: 2% to 3% of wavelength

Detector: Si-PbS

Scan Time: 4 seconds over the spectral range

Nadir viewing angle

Viewing height: 100 cm

Light Source: Loweltota lamp

Reference Standard: Halon plate

Sample spectra were collected automatically using vendor-supplied software. The instrument gain was set at the beginning of a sampling secession to achieve maximum digital count for the Halon reference standard without saturating the detector. Sample spectra were taken using the same instrument settings. Three sets of measurements of each sample were averaged to give a final spectrum. These radiance spectra were normalized against a Halon reflectance standard to obtain the sample reflectance spectrum. Noise associated with the detector change at about 1100 nm was removed by a linear curve fitting algorithm. Data overlaps associated with the filter sectors were removed by user-written software. Each spectrum was smoothed using a five point weighted average algorithm (Savitzky and Golay, 1964) and resampled at 5 nm increments across the spectral range.

Perkin-Elmer Model 330 Spectrophotometer

Supplier: Perkin-Elmer Corp., Norwalk, Connecticut.

Split beam, continuous scan, grating type spectrophotometer

Integrating sphere, 60 mm diameter, barium sulfate coated

Spectral range: 200-2000 nm

Spectral resolution: 3 nm centered on 5 nm increments

Detector: Photomultipler tube for 200-878 nm
PbS detector for 878-2000 nm region

Scan Time: 4 minutes over the spectral range

Perkin-Elmer Model 330 Spectrophotometer (cont'd)

Light source: WI lamp for the 200-360 nm
Deuterium lamp for the 360-2000 nm

Reference Standard: BaSO4 disk or Halon in a quartz cuvette

Samples were measured by holding them against the sample port of the integrating sphere. Excised leaves were mounted in a holder, which pressed the leaf surface against the sphere's sample port. Light transmitted through the leaf was trapped in the sample chamber and did not pass back into the integrating sphere. For soils, a subsample of the air-dried sieved soil was gently packed into a quartz cuvette which was held against the sample port. The reference standard for soil samples was powered Halon that had been gently packed into an optically neutral quartz cuvette and placed against the reference port of the sphere.

Data noise in the 1700 to 2000 nm region was reduced by taking triplicate spectra over this region and computing the mean reflectance. Data noise associated with the detector change at 878 nm was removed by a linear curve fitting algorithm. Each spectrum was smoothed using a five point weighted average simplified - least squares curve fitting procedure (Savitzky and Golay, 1964)

B. Field Measurements

Field spectra were taken using highly portable, spectro-radiometer systems. The radiometer head was tripod mounted and positioned over the sample surface at such a viewing height that the surface more than filled the instrument's FOV. The systems were operable using self-contained batteries or using a 12 VDC car battery and a DC-AC inverter. Spectra were usually taken between 1000 and 1400 true solar time, which reduced the shadow effect within the plant canopy or shadows associated with cracks in the soil surface. Spectra taken outside of this time period are directed toward specific-purpose projects.

The characteristics of the spectroradiometric system influenced how the system was operated and the type of surface that was measured. The EG&G model 550 spectroradiometer was used for surfaces, e.g. a plant canopy, that required a large FOV. The IRIS mark IV and the Spectrofax AA440 spectroradiometers were used for surfaces for which a broader spectral region, 400nm to 2500 nm, was required and a small FOV was sufficient, e.g. a soil surface or a leaf surface.

EG&G Model 550 Spectroradiometer

Supplier: EG&G-Gamma Scientific, San Diego, California

Single beam continuous scan, grating type spectroradiometer

Field of view: 15 degrees

Spectral range: 360-1100 nm

Spectral resolution: 10 nm

Detector: Si

Scan time: 4 minutes

Nadir viewing angle

Viewing height: 75 cm to 120 cm

Reference standard: Halon plate

Sample and the reference standard were viewed in turn. The radiometer was manually "zeroed" by the user before each spectrum. This reduced the dark current correction to less than 0.5% for any waveband over the spectral range. The sample's radiance spectrum was obtained by adjusting the detector's output by a dark current correction, then applying a calibration factor. The calibration factor was determined from a 1000-watt calibration lamp, traceable to a National Bureau of Standards lamp. The reflectance spectrum was calculated by normalizing the sample radiance spectrum to that of the Halon reference standard. User-written software automated data collection, processing and storage.

IRIS Model Mark IV Spectroradiometer

The characteristics of this instrument were described previously. In the field environment, the radiometer's optical head was mounted on a tripod and the light source was the sun. The viewing height was 80 cm to 100 cm above the sample surface. Other operational procedures are the same as those described for the laboratory spectroradiometric procedures.

VII. SPECTRAL DATA SOFT COPY FORMAT

The spectral data described in this catalog are available by request.

Note: Individuals requesting these spectral data, must provide two (2) unformatted 1.44 Mbyte, 3.5 inch or 1.2 Mbyte, 5.25 inch, high density double-sided diskettes for PC computer.

Address correspondence to either author: USAETL-RI-RSD, Bldg. 2592, Fort Belvoir, VA, 22060-5546. Each disk will be formatted in the Zenith 386, MS-DOS environment. Each spectrum data will be stored in an ASCII file in a standard format describe in Table 4. This format was necessary because the data were taken with different spectroradiometers and photometers each with its own spectral resolution and spectral range. Many spectra are reported in 5 nm increments over the spectral range of the radiometer, although the EG&G spectrometric data which are stored in 10 nm increments. A computer program written in GWBASIC computer language can be provided in order to display the data on the CRT of 286 or 386 PC computers. The original, high density spectra have been archived by the authers. These data are not routinely provided because the data formats are not standard between the radiometers, and each radiometer requires its own wavelength and calibration files and associated processing software in order to process the instrument DN values to reflectance values.

Table 4
Soft Copy Format of Catalog Spectral Data

Space (bin)	Parameter	Format
-	File Name / Header	Line H$
1	Spectrum Number	####.##
2	Starting Wavelength (nm)	####.##
3	Ending Wavelength (nm)	####.##
4	Wavelength Increment (nm)	####.##
5	Scan Index Number (hr)	####.##
6	True Solar Time (hr)	####.##
7	Solar Altitude (degrees)	####.##
8	Solar Azimuth (degrees)	####.##
9	---- open ---	---
10	First Waveband Datum (%)	####.##
11	Second Waveband Datum (%)	####.##
.	.	.
.	.	.
N	N-th Waveband Datum (%)	####.##

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IX. CATALOG OF REFLECTANCE SPECTRA

Category	Subcategory	Surface Type
V		Vegetation
	VT	Trees
	VS	Shrubs
	VG	Grasses and graminoid plants
	VH	Herbaceous plants, debris, litter
M		Minerals
	MO	Oxides
	MC	Carbonates
	MS	Silicates
S		Soils
R		Rocks
	RI	Igneous rocks
	RS	Sedimentary rocks
	RM	Metamorphic rocks
C		Cultural and Man-made Features
	CR	Roads
	CB	Buildings
	CM	Materials (paints, fabrics, metals)

Index of Reflectance Spectra for Vegetation Samples (Trees)

SPECIES	SHEET NUMBER	SPECTRUM NUMBER
Sweet Gum	VT.0001	G-GUM.MEN
	VT.0002	G-GUM.MEN, Y-GUM.MEN R-GUM.MEN, BK-GUM.MEN, FLEAV.51
	VT.0003	SULEV.08, .09
	VT.0004	FALL87.01, .02, .03, .04
Pin Oak	VT.0005	GR-PINOK.MEN
	VT.0006	GR-PINOK.MEN, YG-PINOK.MEN R-PINOK.MEN, FLEAV.14
	VT.0007	SULEV.36, .37
Red Maple	VT.0008	GR-SIMAP.MEN
	VT.0009	GR-SIMAP.MEN, YG-SIMAP.MEN GY-SIMAP.MEN, Y-SIMAP.MEN RE-SIMAP.MEN
	VT.0010	SULEV.05, .06
Japanese Maple	VT.0011	R-MAP.MEN
	VT.0012	SULEV.02, .03
	VT.0013	SULEV.02, .04, .30, .31
Willow	VT.0014	SULEV.18
Sassafras	VT.0015	SULEV.19
Black Locust	VT.0016	SULEV.22
White Oak	VT.0017	FLEAV.01, .05, .07, .08

Laboratory Reflectance Spectra of Vegetation

Plant Name: Sweet gum Date Collected: 13 Nov 1986
Specific Name: Liquidamber styraciflua L.
Spectrum No.: G-GUM.MEN, Y-GUM.MEN, R-GUM.MEN, BK-GUM.MEN, FLEAV.51.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate;barium sulfate reference standard.

Sample: Mature, senescing "sun" leaves were taken from a sweet gum tree canopy. These leaves had been exposed to direct sunlight. The leaves selected were representative of the various leaf colors. The leaves were placed into a plastic bag to minimize water loss. The lower 1/3 of the leaf blade was measured but the leaf's midrib was not part of the sampled leaf surface. A color name was assigned by visual assessment, e.g. green (#1), yellow-green (#5), yellow (#2), red (#3) and dark purple or black (#4). A mean spectrum was calculated for each leaf color type from replicate samples. The replicates were not statistically different at the 95% confidence level.

Physical & Chemical Properties:

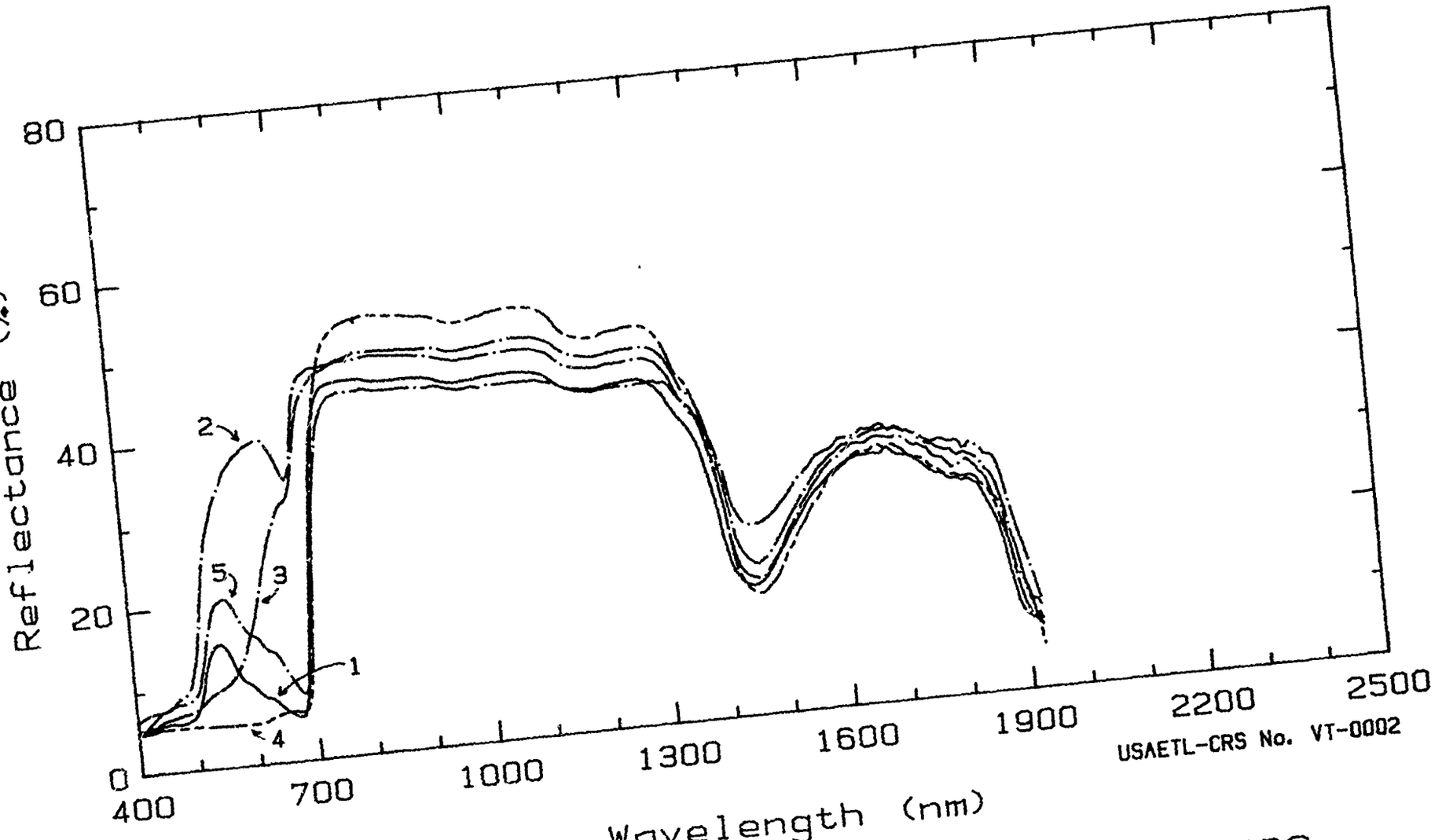
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 10 m Crown diameter: 8 m
Water content: 57% to 71%, mean 57.9% (wet weight basis).

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.8	12.6	6.5	45.7	29.5	
2	10.9	31.8	37.5	48.4	31.1	
3	7.1	10.9	29.9	48.9	32.0	
4	5.2	5.0	6.0	53.0	29.6	
5	8.9	18.1	10.9	44.4	32.7	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0002.



Spectra of Senescing Sweet Gum Leaves.
Ft. Belvoir, Fairfax Co., VA; Nov., 1986.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Sweet gum Date Collected: 15 Jun 1987
Specific Name: Liquidamber styraciflua L.
Spectrum No.: SULEV.08, ^9.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330; spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature, green "sun" leaf was taken from a tree canopy. The leaf had received direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The spectra of the top (adaxial) and bottom (abaxial) surfaces were measured, #8 and #9 respectively. The lower 1/3 of the leaf blade was measured but the leaf midrib was not part of the sample.

Physical & Chemical Properties:

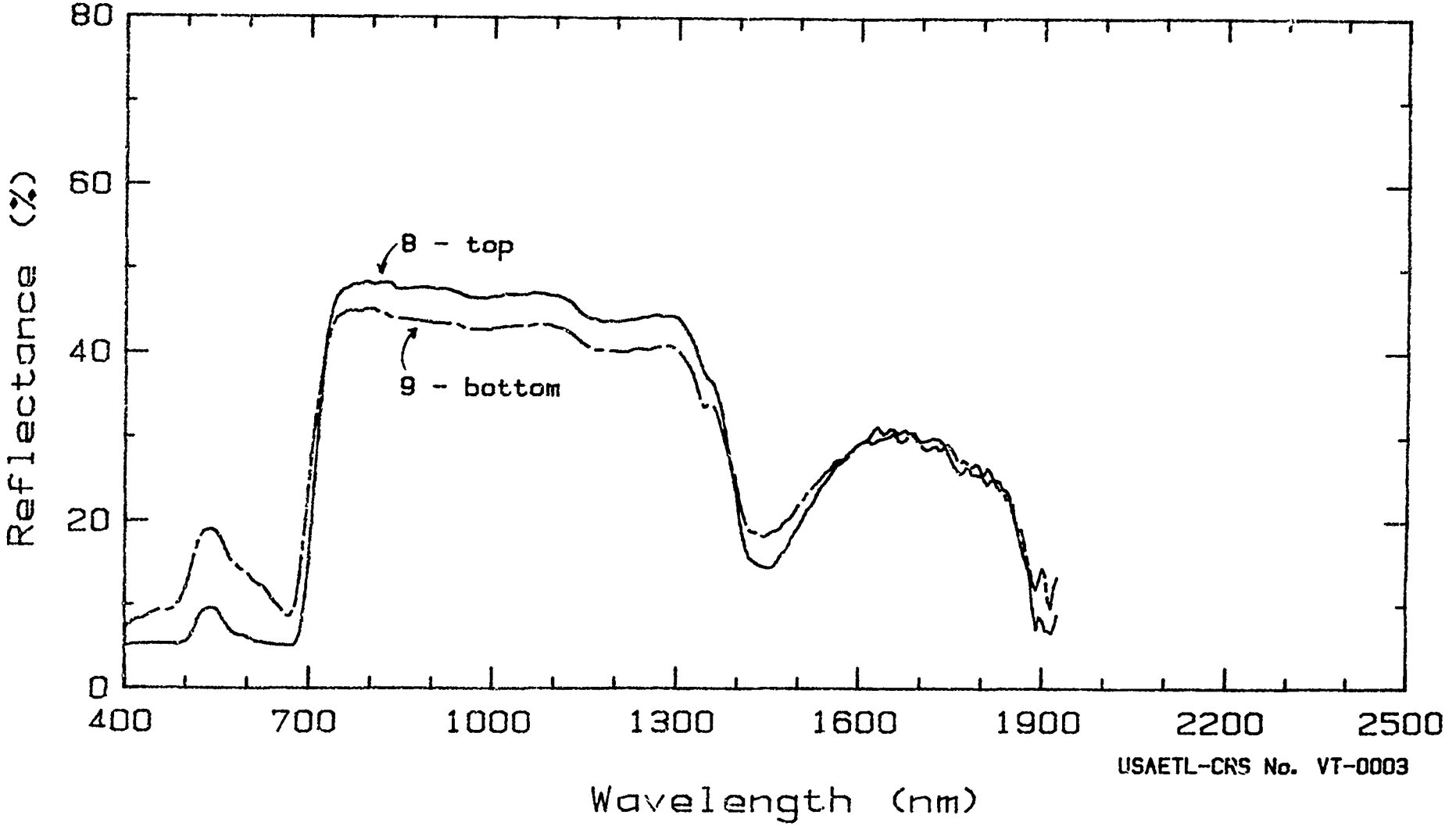
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 10 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.8	8.0	5.5	48.0	29.1	
2	11.4	16.8	10.7	44.4	29.0	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0003.



Spectra of Sweet Gum Leaf Surfaces.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Sweet gum Date Collected: 16 Sep 1987
Specific Name: Liquidamber styraciflua L.
Spectrum No.: FALL87.01, .02, .03, .04

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; a barium sulfate reference standard.

Sample: Mature "sun" leaves, those that routinely received direct sunlight, were taken from the tree canopy. Leaves were placed into a plastic bag to minimize water loss. The spectra were taken of stacks of leaves having 1 (#1), 2 (#2), 4 (#3) or 6 (#4) leaf layers. The leaves were added to the back of the stack, so leaf #1 was always the first leaf in the stack. Each spectrum was taken in the lower 1/3 of the leaf blades and did not include the leaf midrib.

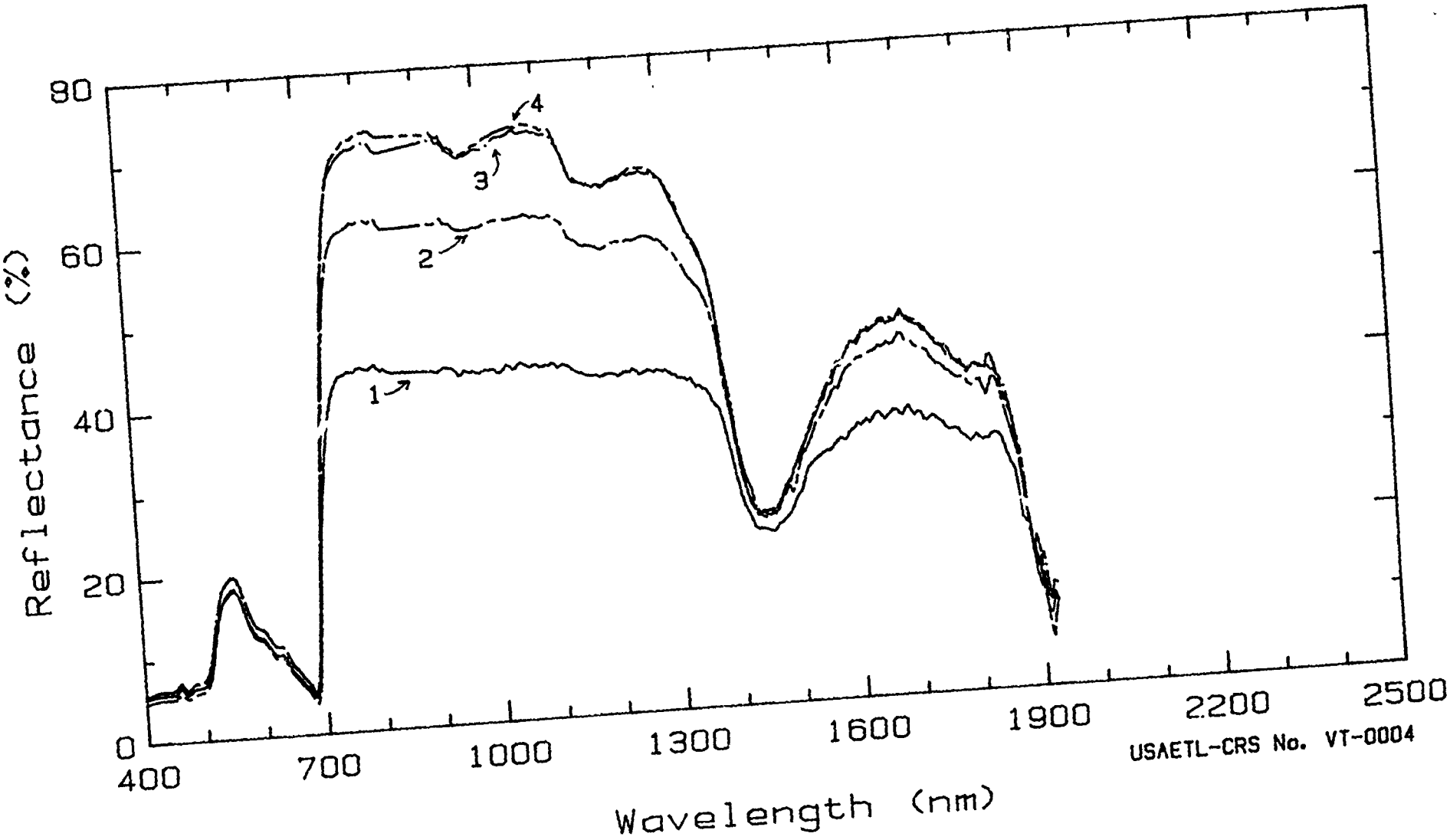
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 10 m Crown diameter: 8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	7.1	15.1	7.0	43.7	33.5	
2	7.7	16.5	7.8	61.3	41.1	
3	7.7	16.5	7.8	70.6	43.5	
4	6.5	15.0	6.5	71.9	43.7	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0004.
USAETL-RI-RDS



Spectra of Layered Sweet Gum Leaves.
Ft. Belvoir, Fairfax Co., VA; Sep., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Pin oak Date Collected: 5 May to 16 Sep 1987
Specific Name: Quercus palustris Muench.
Spectrum No.: GR-PINOK.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, dual beam, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature "sun" leaves were taken periodically from a tree canopy. Leaves were exposed to direct sunlight. They were placed into a plastic bag to minimize water loss. The spectrum of each leaf was taken in the lower 1/3 of the leaf blade, but the leaf's midrib was not part of the surface. The eleven leaves were not statistically different from the group's mean spectrum at the 95% confidence level. The mean curve (#1) and those (#2 & #3) representing one standard deviation of the mean curve are shown.

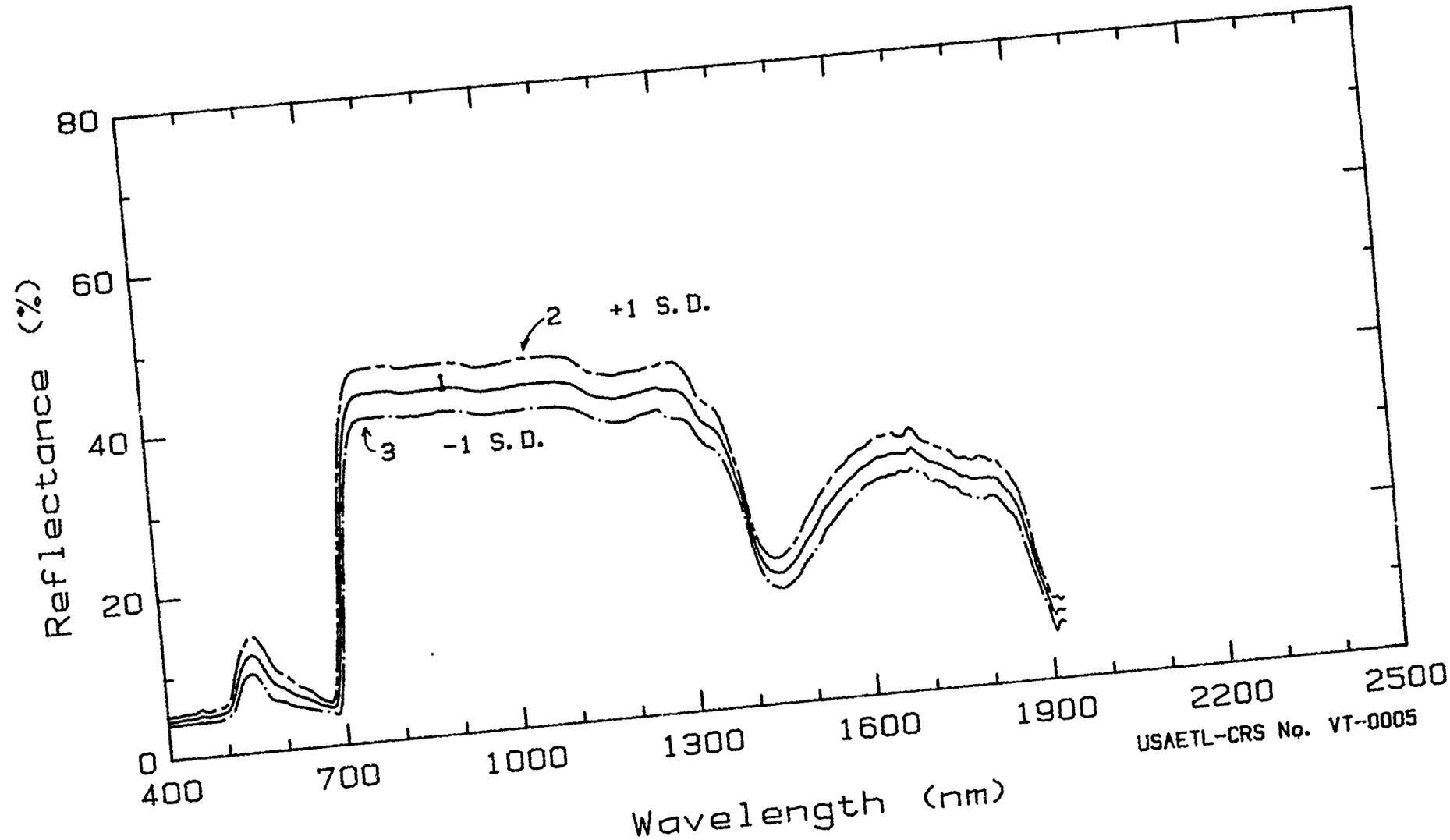
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.6	10.0	5.5	43.3	28.5	
2	6.4	12.2	6.6	46.4	31.0	
3	4.7	7.9	4.5	40.2	26.1	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0005.
USAETL-RI-RSD



Spectra of Pin Oak Leaves.
Ft. Belvoir, Fairfax Co., VA; May-Sep., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Pin oak Date Collected: 13 Nov 1986
Specific Name: Quercus palustris Muench.
Spectrum No.: GR-PINOK.MEN, YG-PINOK.MEN, R-PINOK.MEN, FLEAV.14.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, senescing "sun" leaves were taken from a tree canopy. The leaves were losing their green pigmentation, so leaves were selected that were representative of the various tree leaf colors. Leaves were placed into a plastic bag to minimize water loss. Each spectrum was taken in the lower 1/3 of the leaf blade and did not include the leaf's midrib. A color name was assigned by visual assessement of the leaf color, i.e., green (#1), yellow-green (#2), red (#3), or yellow (#4).

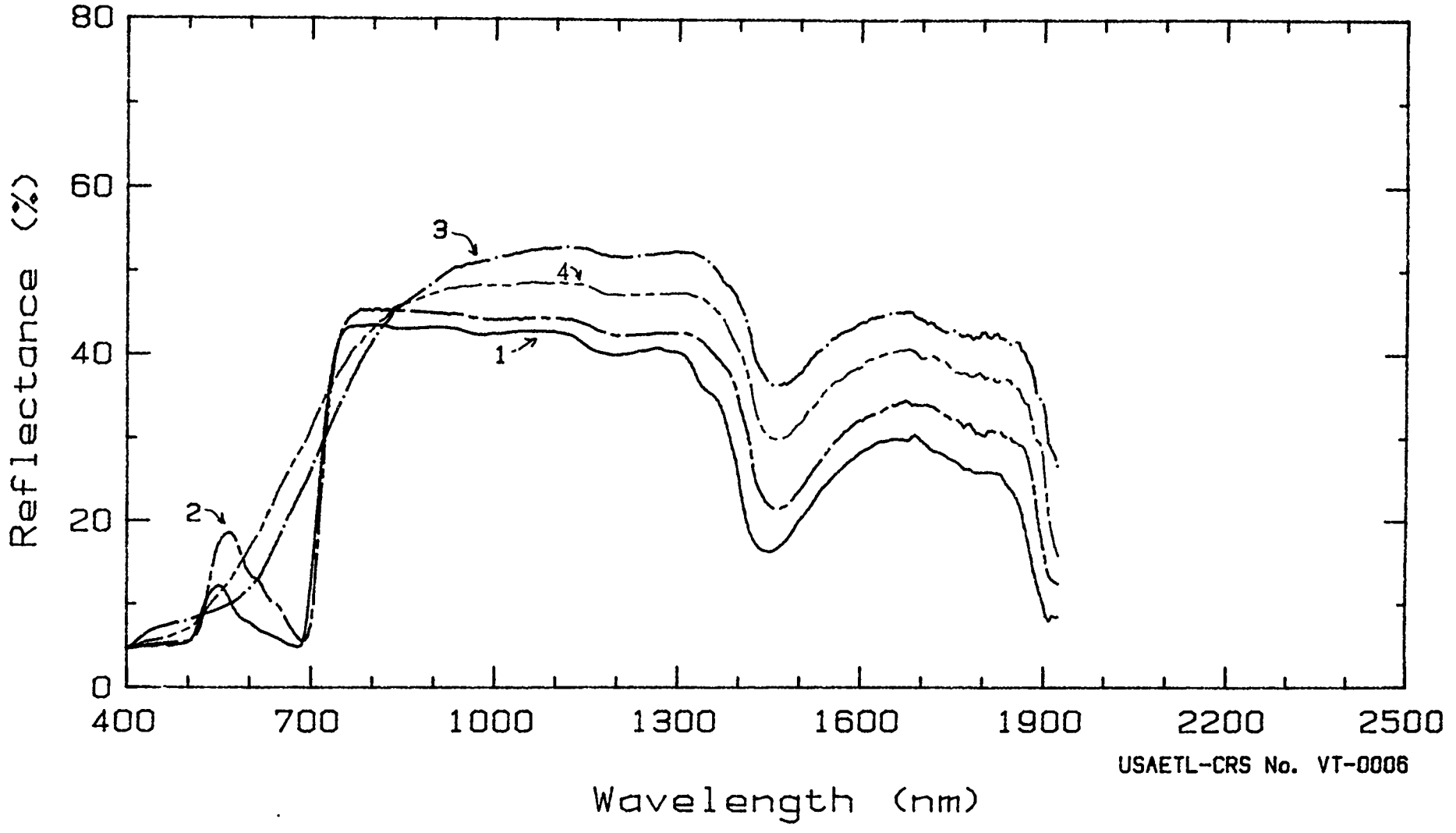
Physical & Chemical Properties:

Phenological stage: vegetative, senescing.
Sample cover in the FOV: 100%
Plant height: 10 m Crown diameter: 8 m
Water content: 49.1% to 55.9%, mean 53.4% (wet weight basis).

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.6	10.0	5.5	43.3	28.5	
2	5.6	15.0	8.1	45.2	32.8	
3	7 8	9.9	19.8	43.7	43.9	
4	6.7	12.3	25.4	44 4	39.2	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0006.
USAETL-RI-RSD



Spectra of Senescing Pin Oak Leaves.
Ft. Belvoir, Fairfax Co., VA; Jul., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Pin oak Date Collected: 24 Jul 1987
Specific Name: Quercus palustris Muench.
Spectrum No.: SULEV.36, .37.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature "sun" leaf (#1) which was exposed to direct sunlight was taken from the tree canopy. A mature "shaded" leaf (#2), one which receives little or no direct sunlight, was also taken. The leaves were placed into a plastic bag to minimize water loss. A leaf's spectrum was taken in the lower 1/3 of the leaf blade and did not include the leaf midrib.

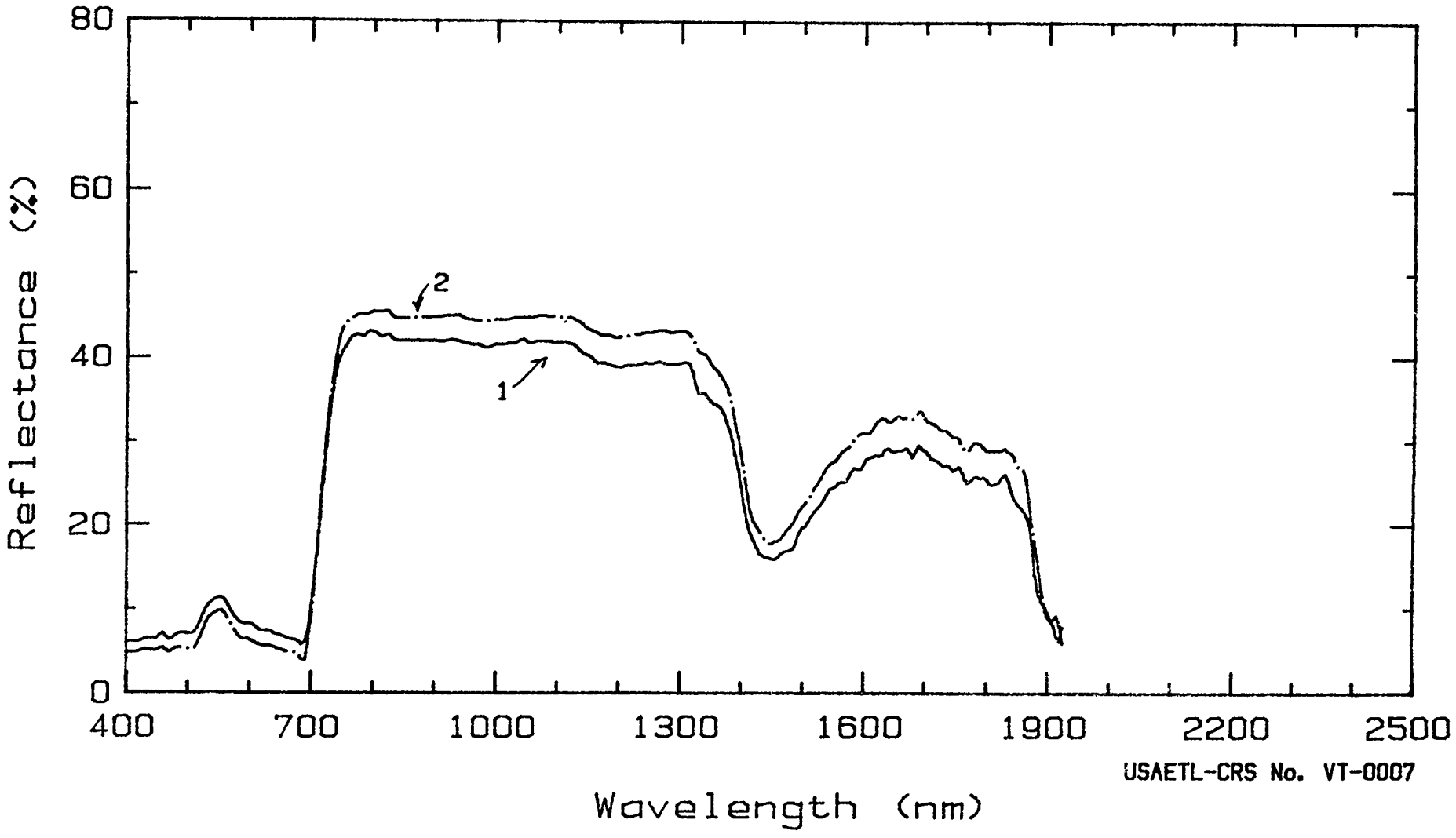
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	7.0	9.8	6.6	42.4	27.7	
2	5.3	8.0	4.9	45.0	31.5	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0007.
USAETL-RI-RSD



Spectra of Pin Oak Sun and Shade Leaves.
Ft. Belvoir, Fairfax Co., VA; Jul., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Red maple Date Collected: May to Sep 1987
Specific Name: Acer rubrum L.
Spectrum No.: GR-SIMAP.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature "sun" leaves were taken periodically from a red maple tree canopy. All leaves had been exposed to direct sunlight. Leaves were placed into a plastic bag to minimize water loss. The spectrum of each leaf was taken of the lower 1/3 of the leaf blade and did not include the leaf's midrib. The spectra of the 12 leaf samples were not statistically different from the group's mean spectrum, at the 95% confidence level. The mean curve (#1) and those (#2 & #3) representing one standard deviation from the mean curve are shown.

Physical & Chemical Properties:

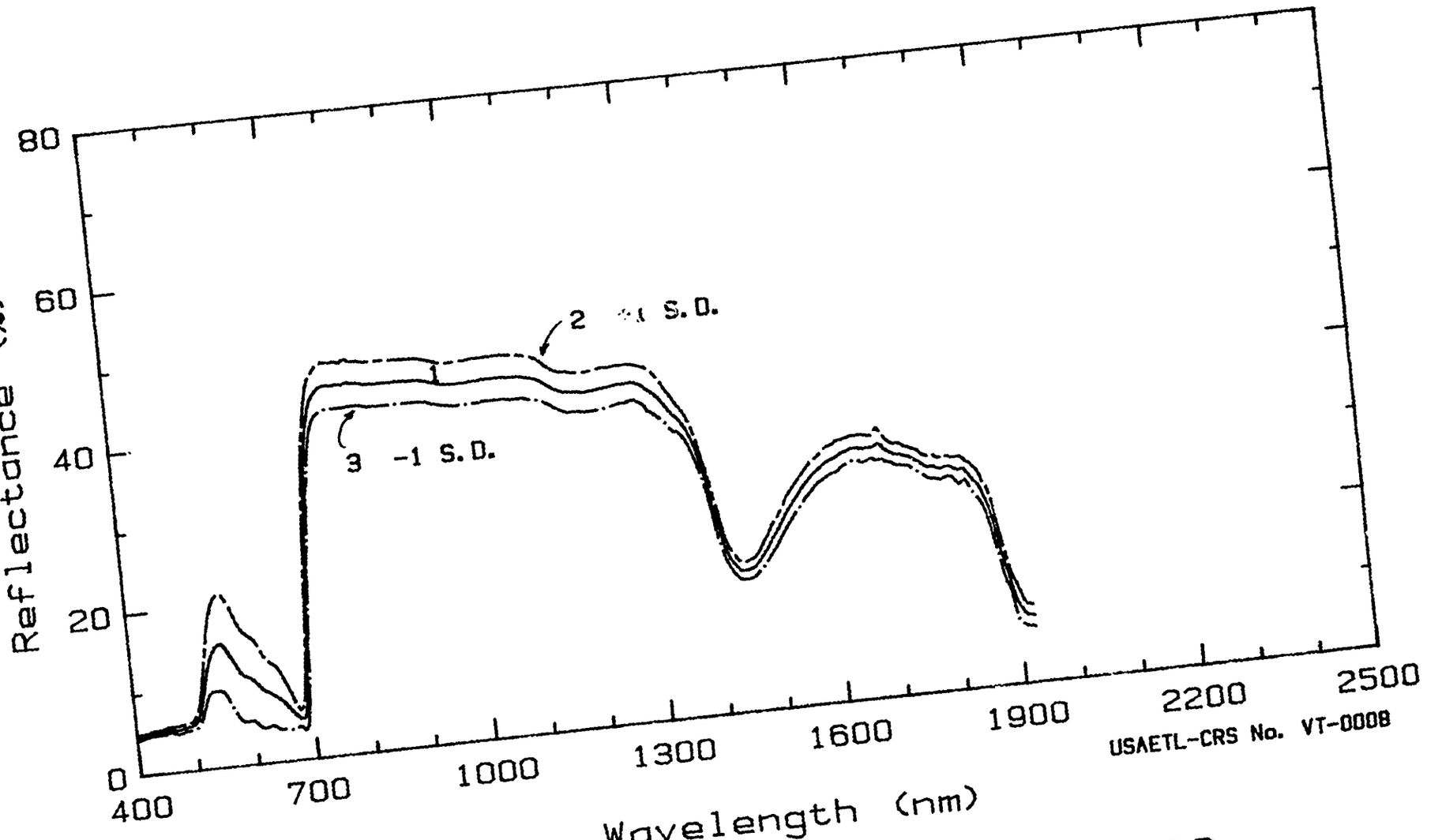
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.9	12.8	6.8	45.7	30.1	
2	6.6	18.1	9.5	48.5	31.6	
3	5.3	7.6	4.1	42.9	28.5	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0008.



Spectra of Red Maple Leaves.
Ft. Belvoir, Fairfax Co., VA; May-Sep., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Red maple Date Collected: 13 Nov 1986
Specific Name: Acer rubrum L.
Spectrum No.: GR-SIMAP.MEN,YG-SIMAP.MEN, GY-SIMAP.MEN, Y-SIMAP.MEN, R-SIMAP.MEN.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA. 38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, senescing "sun" leaves were taken from a tree canopy. All leaves had been exposed to direct sunlight. The selected leaves were representative of the various leaf colors. Leaves were placed into a plastic bag to minimize water loss. Each leaf's spectrum was of the lower 1/3 of the leaf blade and did not include the leaf's midrib. A color name was assigned by visual assessment of the leaf color, i.e. green (#1), yellow-green (#2), green-yellow (#3), yellow (#4), or red (#5). Triplicates of each leaf colored type were measured. These were not statistically different at the 95% confidence level.

Physical & Chemical Properties:

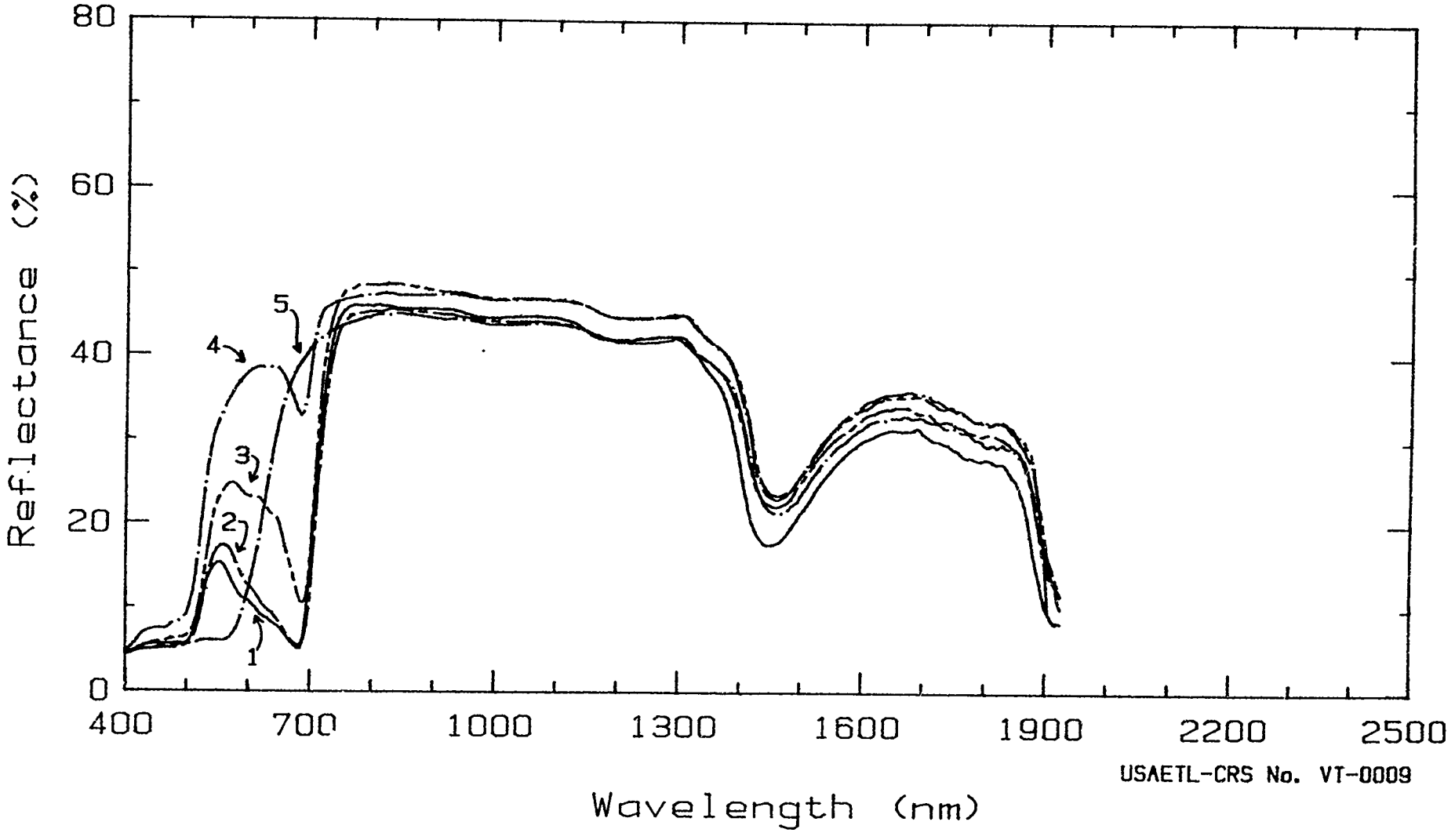
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m
Water content: 38% to 56%; mean of 53% (wet weight basis).

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.9	12.9	6.8	45.7	30.1	
2	5.6	14.5	7.3	45.1	32.7	
3	6.7	21.0	16.7	48.2	34.2	
4	9.3	31.5	36.5	47.2	34.5	
5	5.6	7.1	33.7	44.6	31.8	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0009.



Spectra of Senescing Red Maple Leaves.
Ft. Belvoir, Fairfax Co., VA; Nov., 1986.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Red maple Date Collected: 15 Jun 1987
Specific Name: Acer rubrum L.
Spectrum No.: SULEV.05, .06.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature, green "sun" leaf was taken from a tree canopy, one which had received direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The top (adaxial) and bottom (abaxial) surfaces were measured. The spectrum of each surface was taken in the lower 1/3 of the leaf blade and did not include the leaf's midrib.

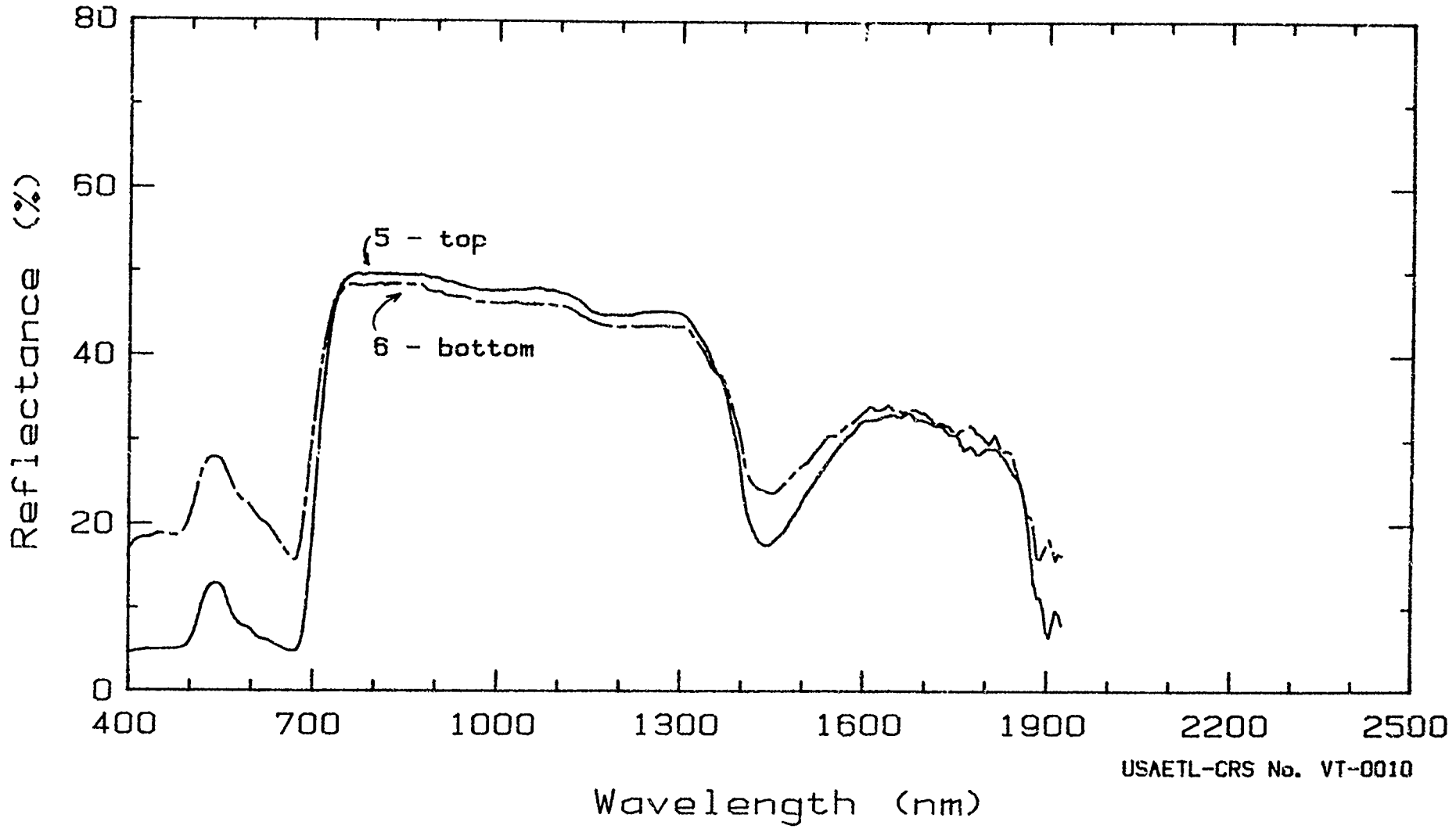
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.1	10.4	5.7	49.6	31.8	
2	20.5	25.5	18.1	48.3	32.7	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0010.
USAETL-RI-RSD



Spectra of Red Maple Leaf Surfaces.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Japanese maple Date Collected: May to Sep 1987
Specific Name: Acer palmatum atropurpurem
Spectrum No.: R-MAP.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature "sun" leaves were taken from the tree canopy over the late spring to early fall growth period. The leaves had been exposed to direct sunlight. Leaves were placed into a plastic bag to minimize water loss. A leaf's spectrum was taken in the lower 1/3 of the leaf blade. The spectra of 16 leaf samples were not statistically different from the group's mean spectrum, at the 95% confidence level. The mean curve (#1) and those representing one standard deviation (#2 & #3) from the mean curve are shown.

Physical & Chemical Properties:

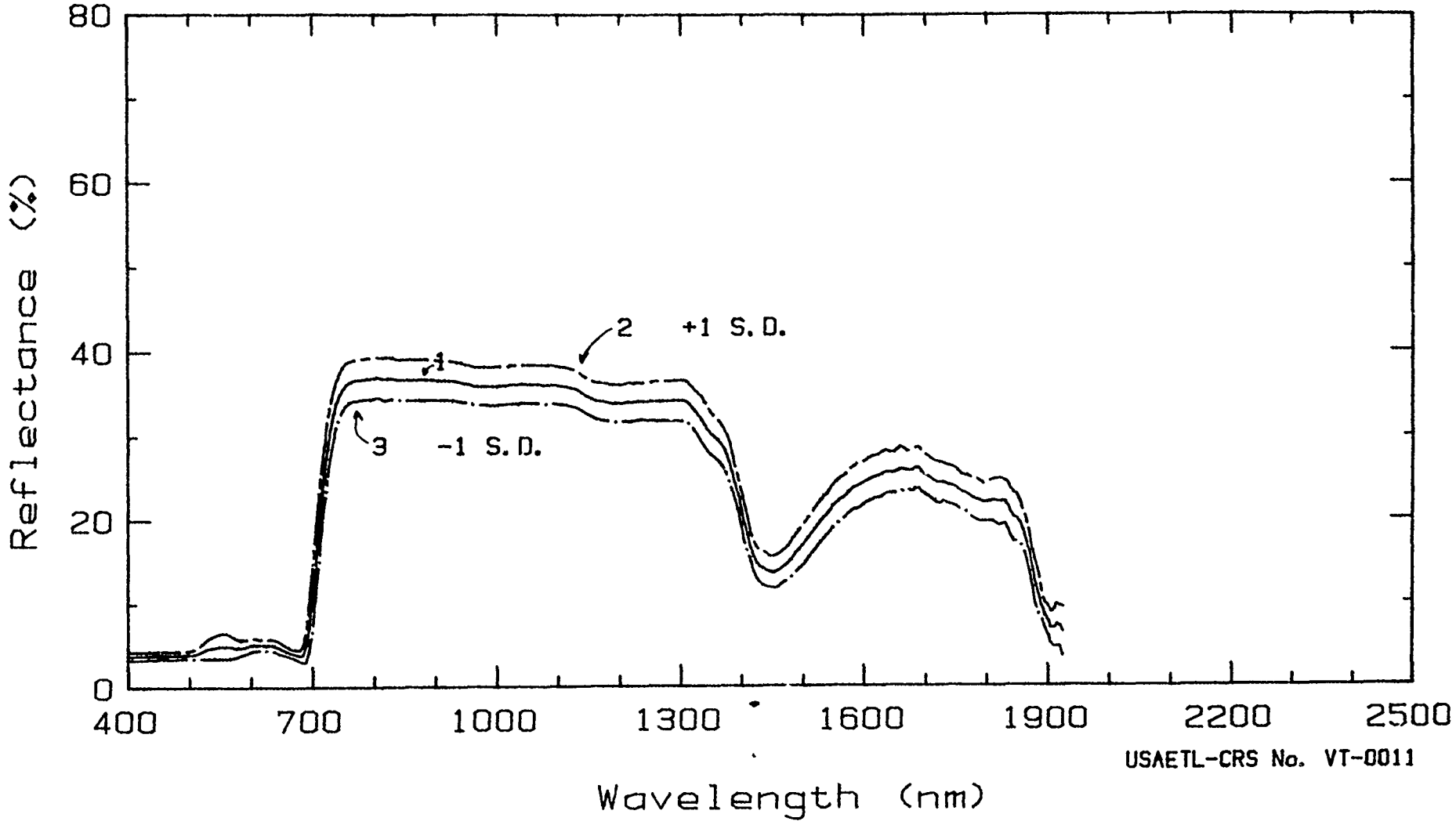
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 5 m Crown diameter: > 6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	4.0	4.8	4.4	36.8	24.6	
2	4.5	6.0	5.2	39.2	27.1	
3	3.5	3.6	3.7	34.4	22.1	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0011.



Spectra of Japanese Maple Leaves.
Ft. Belvoir, Fairfax Co., VA; May-Sep., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Japanese maple Date Collected: 15 Jun 1987
Specific Name: Acer palmatum atropurpurem
Spectrum No.: SULEV.02, .03.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 5 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature "sun" leaf was taken from a tree canopy, on which it had received direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The top (adaxial) and bottom (abaxial) surfaces were measured curves, #1 and #2, respectively. The spectrum of each surface was taken in the lower 1/3 of the leaf blade.

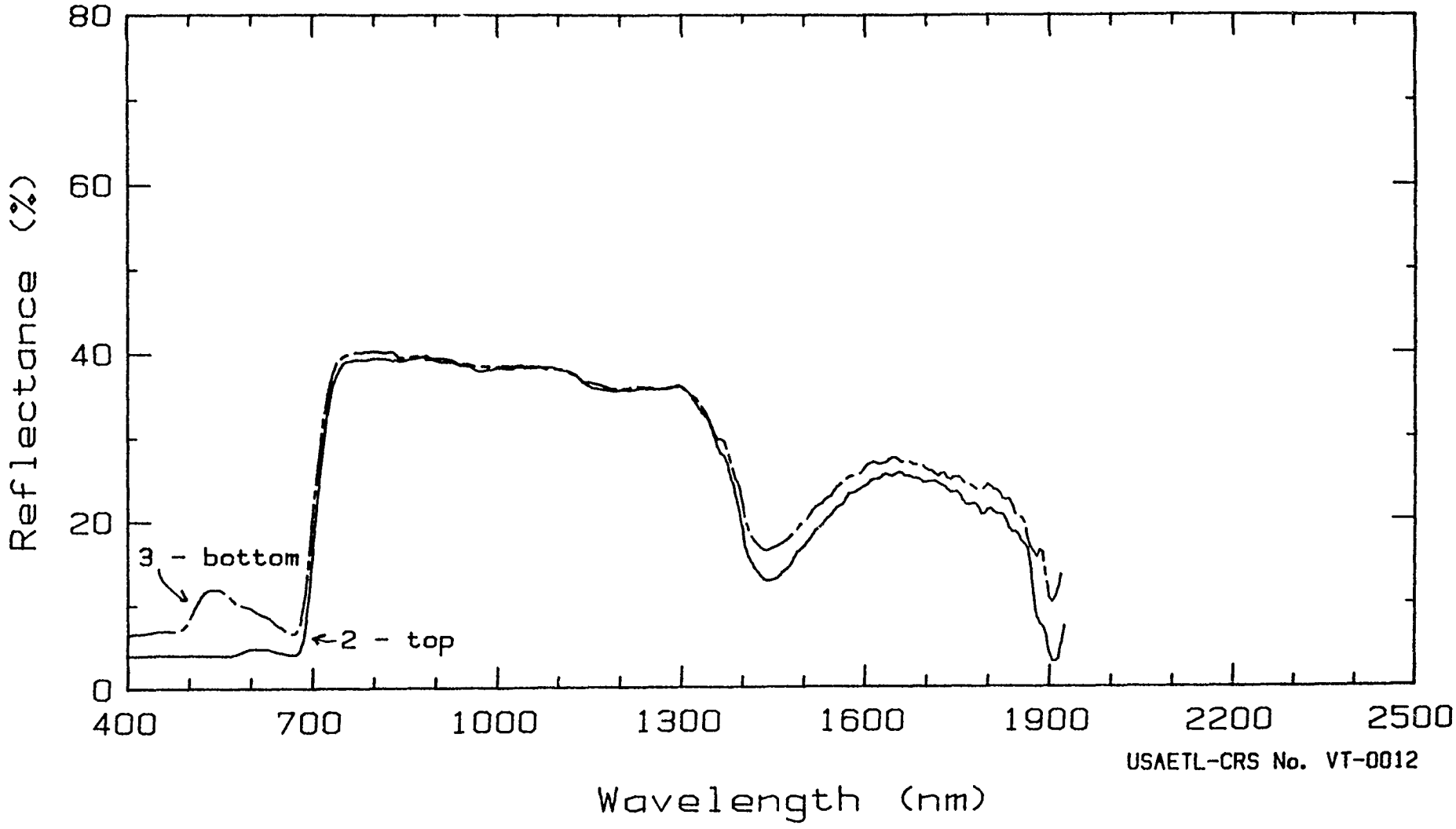
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 5 m Crown diameter: >6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	4.0	4.1	4.7	39.3	24.3	
2	7.9	10.9	7.8	39.9	26.0	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0012.
USAETL-RI-RSD



Spectra of Japanese Maple Leaf Surfaces.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Japanese maple Date Collected: 15 Jun 1987
Specific Name: Acer palmatum atropurpurem
Spectrum No.: SULEV.02, .04, .30, .31.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Two mature, green "sun" leaves (curves #1 & #4) were taken from a tree canopy which was exposed to direct sunlight. Mature, green "shaded" leaves (curves #2 & #4) had received little or no direct sunlight. The leaves were placed into a plastic bag to minimize water loss. The spectrum of each leaf was taken in the lower 1/3 of the leaf blade.

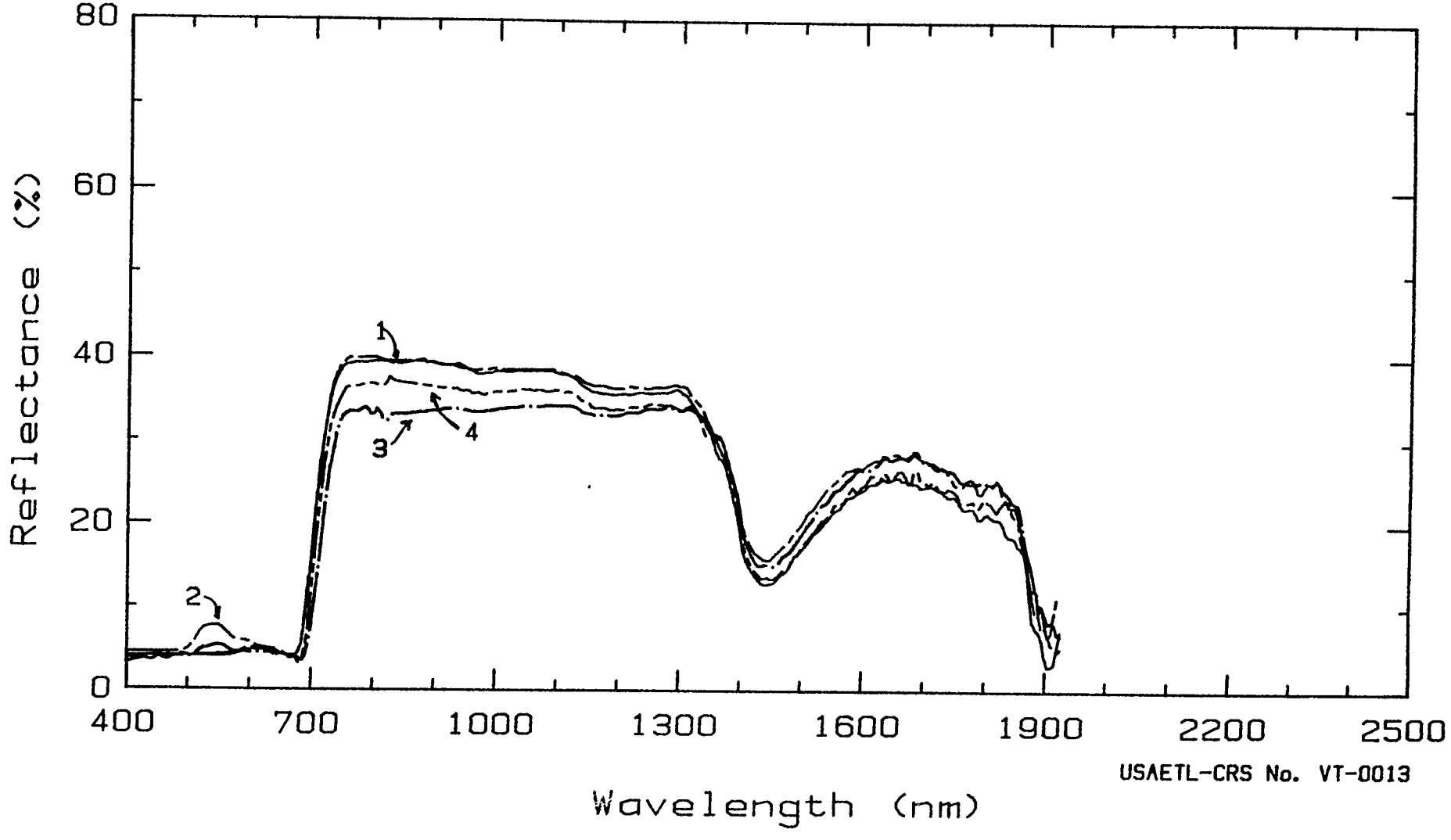
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 5 m Crown diameter. > 6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	4.0	4.1	4.7	39.3	24.2	
2	4.9	6.8	4.8	39.6	27.2	
3	4.0	4.9	4.1	33.4	27.0	
4	4.1	4.4	4.3	36.7	24.8	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0013.
USAETL-RI-RSD



Spectra of Japanese Maple Leaves.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Willow Date Collected: 19 Jun 1987
Specific Name: Salix sp.
Spectrum No.: SULEV.18

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature "sun" leaf was taken from a tree canopy. The leaf taken was exposed to direct sunlight. Leaves were placed into a plastic bag to minimize water loss. The leaf spectrum was taken in the middle 1/3 of the leaf blade.

Physical & Chemical Properties:

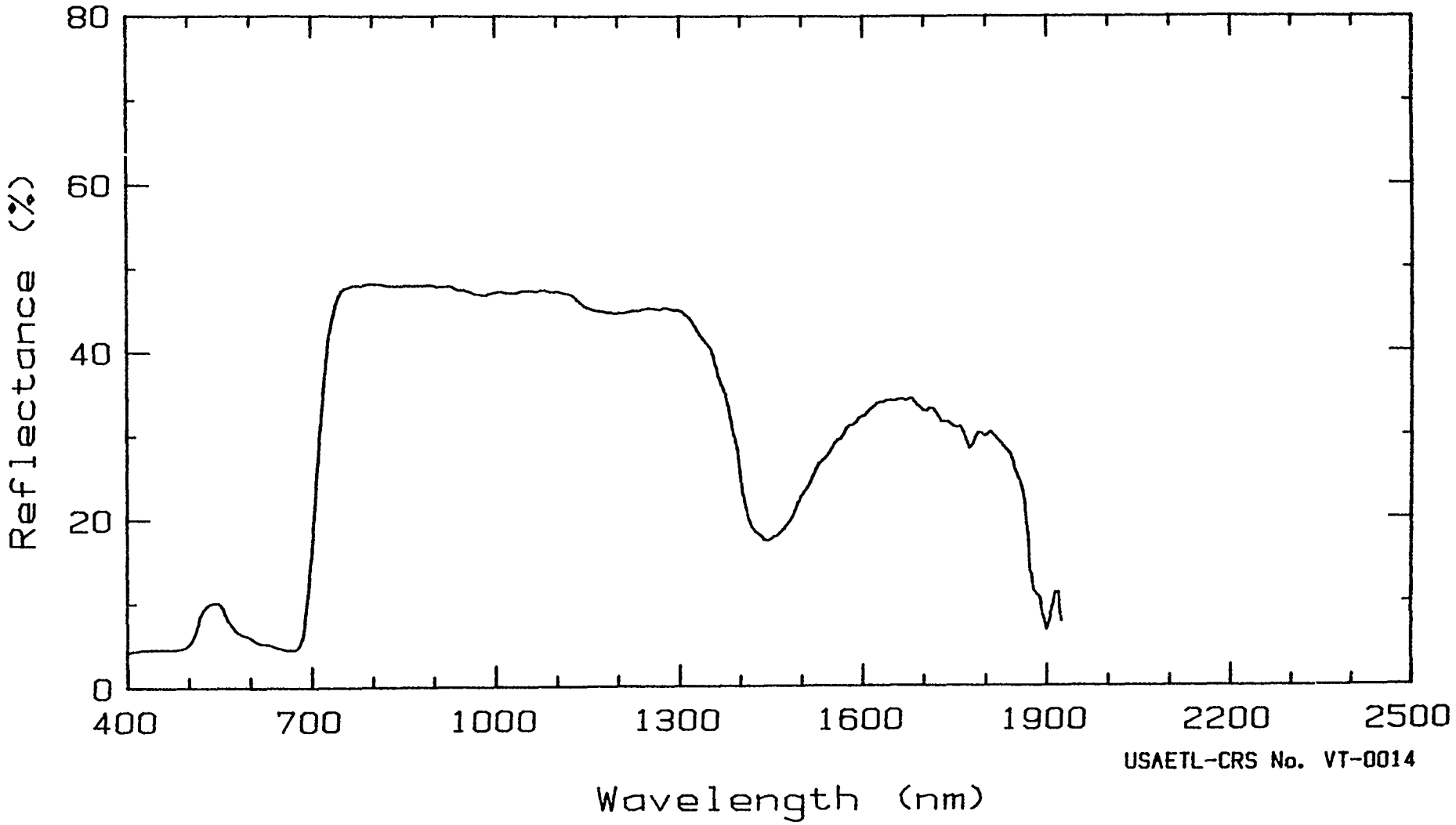
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.3	8.2	5.0	48.0	32.5	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RDS

Sheet No. VT-0014.



Spectra of a Willow Leaf.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Sassafras Date Collected: 19 Jun 1987
Specific Name: Sassafras albidum (Nutt.) Nees.
Spectrum No.: SULEV.19

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330; spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature "sun" leaf was taken from a tree canopy that was exposed to direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The leaf spectrum was taken in the lower 1/3 of the leaf blade, but the leaf's midrib was not part of the surface.

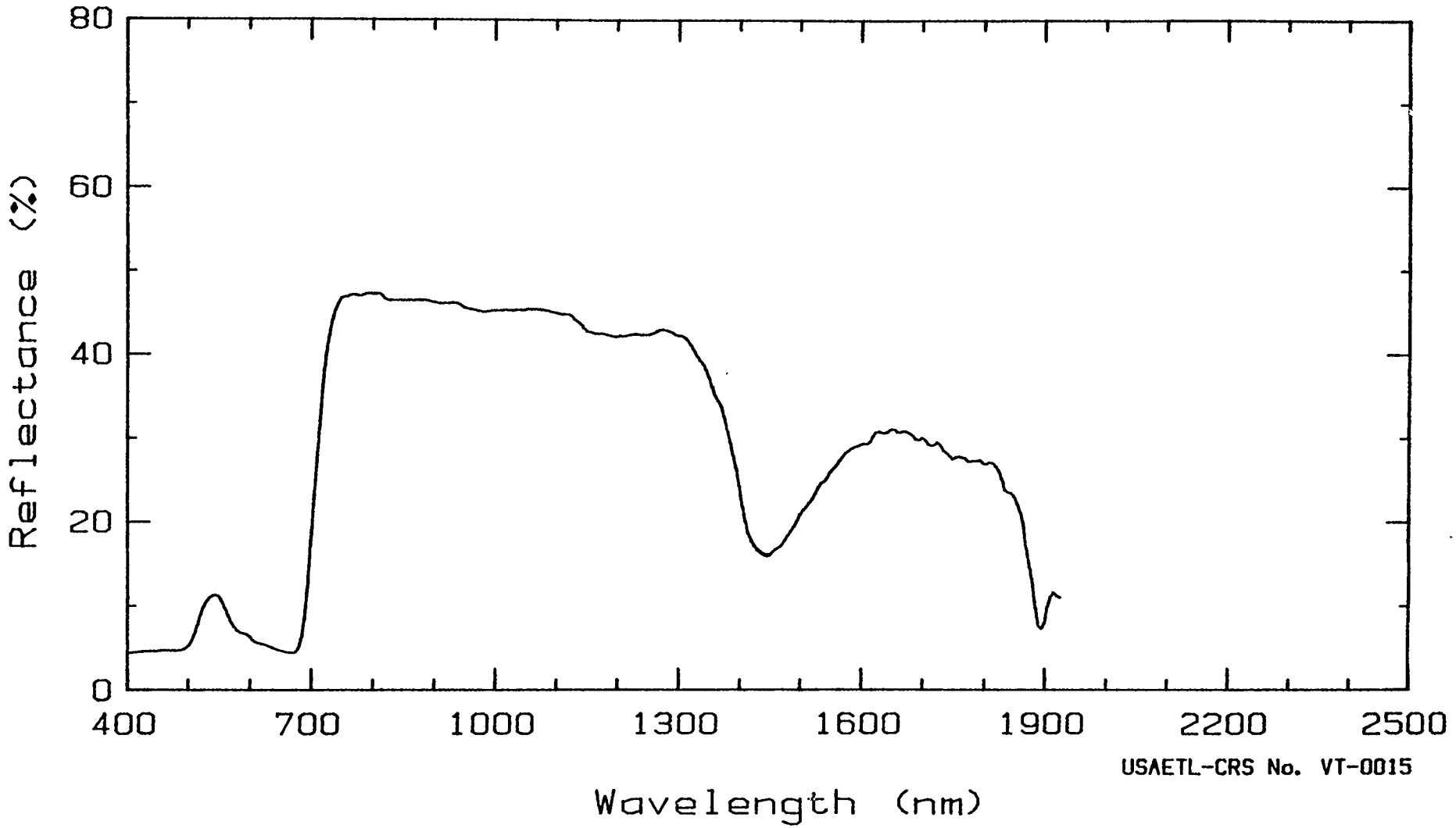
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.4	8.9	5.1	46.8	29.3	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0015.
USAETL-RI-CRS



Spectra of a Sassafras Leaf.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Black locust Date Collected: 19 Jun 1987
Specific Name: Robinia pseudo-acacia L.
Spectrum No.: SULEV.22

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330; spectral range 400-1900 nm; 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature "sun" leaf was taken from the tree canopy that was exposed to direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The leaf spectrum was taken in the lower 1/3 of the leaf blade.

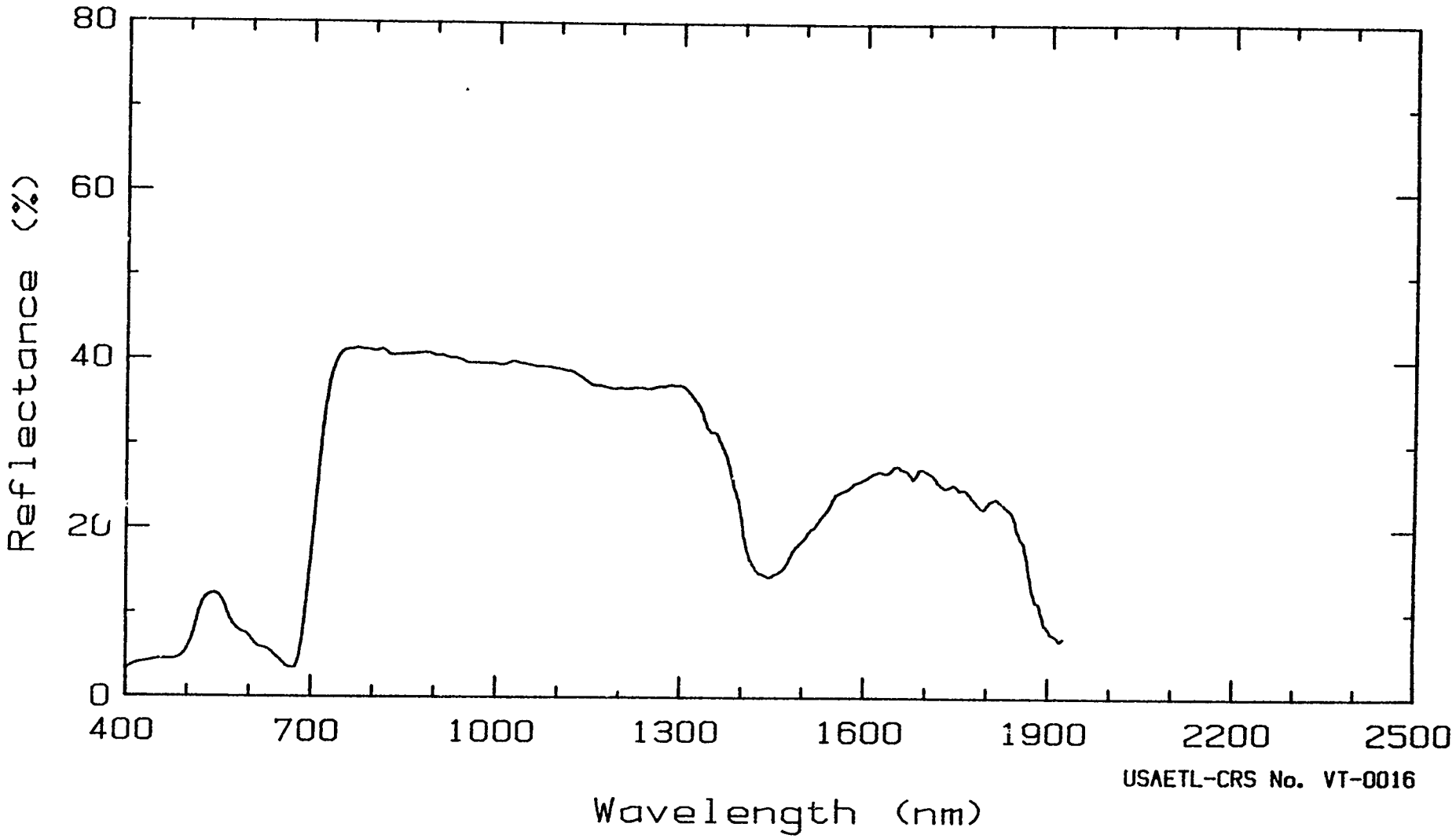
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 15 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.6	10.0	4.8	40.9	26.0	

Compiled by: Melvin B. Satterwhite Sheet No. VT-0016.
USAETL-RI-RSD



Spectra of a Black Locust Leaf.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: White oak Date Collected: 11 Nov 1986
Specific Name: Quercus alba L.
Spectrum No.: FLEAV.01, .05, .07, .08.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, senescing "sun" leaves were taken from a tree canopy. The leaves were selected to be representative of the various tree leaf colors. Leaves were placed into a plastic bag to minimize water loss. A leaf's spectrum was taken in the lower 1/3 of the leaf blade, and did not include the leaf's midrib. A color name was assigned by visual assessement of the leaf color, i.e. green (#1), brown (#2), yellowish-red (#3), and red (#4).

Physical & Chemical Properties:

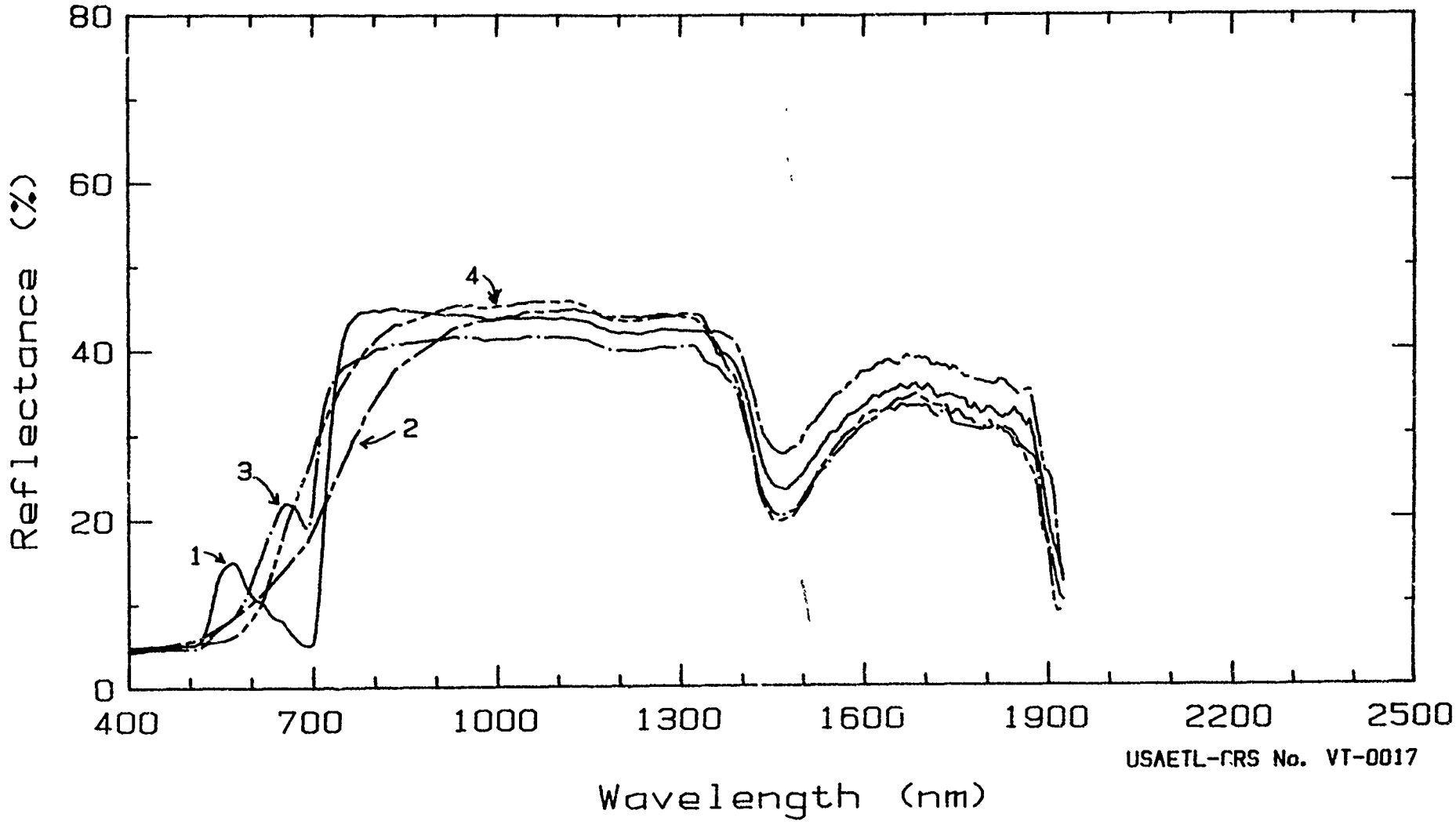
Phenological stage: vegetative, senescing.
Sample cover in the FOV: 100%
Plant height: >20 m Crown diameter: >10 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	5.2	12.0	6.9	44.6	34.2	
2	5.4	8.0	14.8	36.3	37.8	
3	4.7	8.1	20.6	40.4	31.8	
4	5.1	6.2	19.6	42 1	32.5	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0017.



Spectra of Red Oak Leaves.
Ft. Belvoir, Fairfax Co., VA; Nov., 1987.

Index of Reflectance Spectra for Vegetation Samples (Shrubs)

SPECIES	SHEET NUMBER	SPECTRUM NUMBER
Creosote Bush	VS.0001	87LCA.11
	VS.0002	87LCS.47, .48
	VS.0003	87YAA.12
	VS.0004	LYUM.25, .46, .47
	VS.0005	LJOR.67
Tarbush	VS.0006	87LCA.13, .14
	VS.0007	87LCS.49
	VS.0008	LJOR.69
Mesquite	VS.0009	87LCA.26, .28, .32, .52
	VS.0010	87LCS.02, .10, .18, .19
	VS.0011	LJOR.19, .22, .50
Bursage, Burro-Weed	VS.0012	87YAA.02, .03, .14, .26, .27
	VS.0013	LYUM.26, .27, .28, .41
Broom Snakeweed	VS.0014	87LCA.24, .25, .41, .42
	VS.0015	87LCS.07, .08, .15, .16, .36
		87LCS-38, .55
	VS.0016	LJOR.20, .59, .72, .74
Four-Wing Saltbrush	VS.0017	87LCS.20, .21, .22
	VS.0018	LJOR.23, .47
Yucca, Soaptree	VS.0019	87LCA.27, .29, .38, .39, .53,
	VS.0020	87LCS.06, .25, .26, .39, .40
	VS.0021	LJOR.53
Longleaf Ephedra	VS.0022	87LCA.02
	VS.0023	87LCS.43
	VS.0024	LJOR.104
Torrey Ephedra	VS.0025	87LCS.59
Wax Currant	VS.0026	87LCS.58
	VS.0027	LJOR.80

Field Reflectance Spectra of Vegetation

Plant Name: Creosote bush Date Collected: 5 Apr 1987
Specific Name: Larrea tridentata (DC.) Cov.
Spectrum No.: 87LCA.11

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view; spectral range 400 to 1100 nm, 10 nm spectral resolution, and a nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the plant canopy so its FOV was filled by vegetation.

Sample: The portion of the in situ plant canopy that was measured was densely leaved. The leaves were coated by a resinous material. The open canopy was formed by multiple gray colored stems radiating divertically from near ground level, with no well-defined trunk. Leaves were clustered on the upper 1/4 to 1/3 of the whip-like branches. Leaves, 5 to 10 mm long, persist throughout the year, although the older leaves are deciduous during drought. The canopy was an assemblage of sunlit and shaded glossy, olive-green to dark green-colored leaves and dark gray-colored branches. The openness of the canopy allows some shaded and sunlit soil to be seen through the holes in the canopy. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

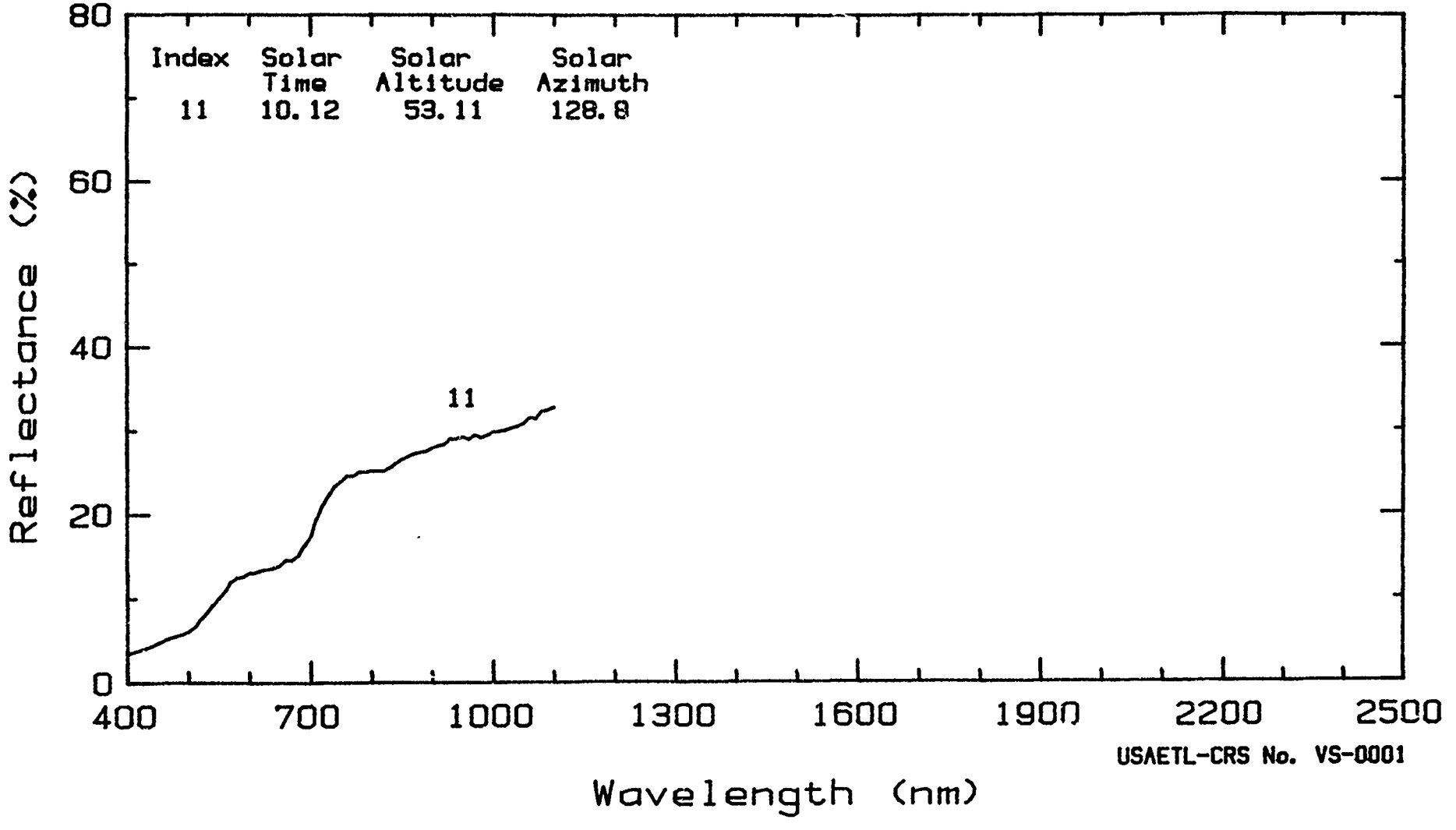
Physical & Chemical Properties:

Phenological stage: vegetative, green-colored leaves.
Crown cover in the FOV: 100% Canopy closure: 30 to 50%
Plant height: 0.53 m Crown Diameter: 1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
11	5.8	10.7	14.5	26.0		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0001.
USAETL-RI-RSD



Reflectance Spectra of Creosote Bush.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Creosote bush Date Collected: 31 Aug 1987
Specific Name: Larrea tridentata (DC.) Cov.
Spectrum No.: 87LCS.47, .48.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, spectral range 400 to 1100 nm, 10 nm spectral resolution, and a nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the plant canopy so its FOV was filled by vegetation.

Sample: The portion of the in situ plant canopies that was measured was densely leaved. The leaves were coated by a resinous material. The open canopies were formed by multiple gray-colored stems radiating divertically from near ground level, with no well-defined trunk. Leaves were clustered on the upper 1/4 to 1/3 of the whip-like branches. Leaves, 5 to 10 mm long, persist throughout the year, although the older leaves are deciduous during drought. The canopies were an assemblage of sunlit and shaded glossy, olive-green to dark green-colored leaves and dark gray-colored branches. The openness of the canopies will allow some shaded and sunlit soil to be seen through the holes in the canopies. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

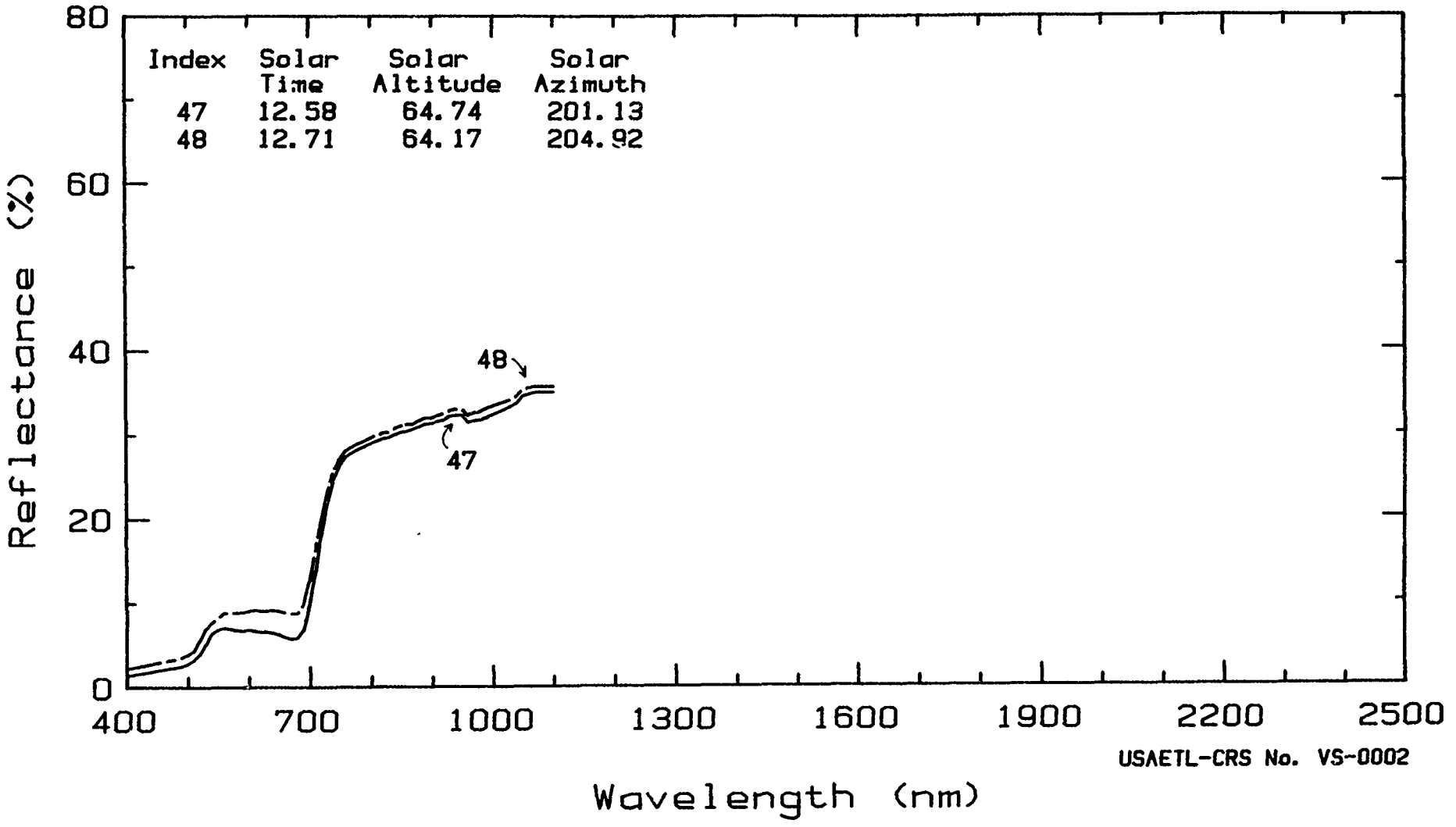
Phenological stage: vegetative, 'green' leaves.
Canopy cover in the FOV: 100% Crown closure : 30 to 40%
Plant Height: 0.6 m Crown Diameter: 0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
47	2.7	6.3	6.3	29.7		
48	3.8	8.2	9.1	30.4		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0002.



Reflectance Spectra of Creosote Bush.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Creosote bush Date Collected: 25 Aug 1987
Specific Name: Larrea tridentata (DC.) Cov.
Spectrum No.: 87YAA.12.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, spectral range 400 to 1100 nm, 10 nm spectral resolution, and a nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the plant canopy so its FOV was filled by vegetation.

Sample: The portion of the in situ plant canopy that was measured was densely leaved. The leaves were coated by a resinous material. The open canopy was formed by multiple gray-colored stems radiating divertically from near ground level, with no well-defined trunk. Leaves were clustered on the upper 1/4 to 1/3 of the whip-like branches. Leaves, 5 to 10 mm long, persist throughout the year, although the older leaves are deciduous during drought. The canopies were an assemblage of sunlit and shaded glossy, olive-green to dark green-colored leaves and dark gray-colored branches. The openness of the canopy allows some shaded and sunlit soil to be seen through the holes in the canopy. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

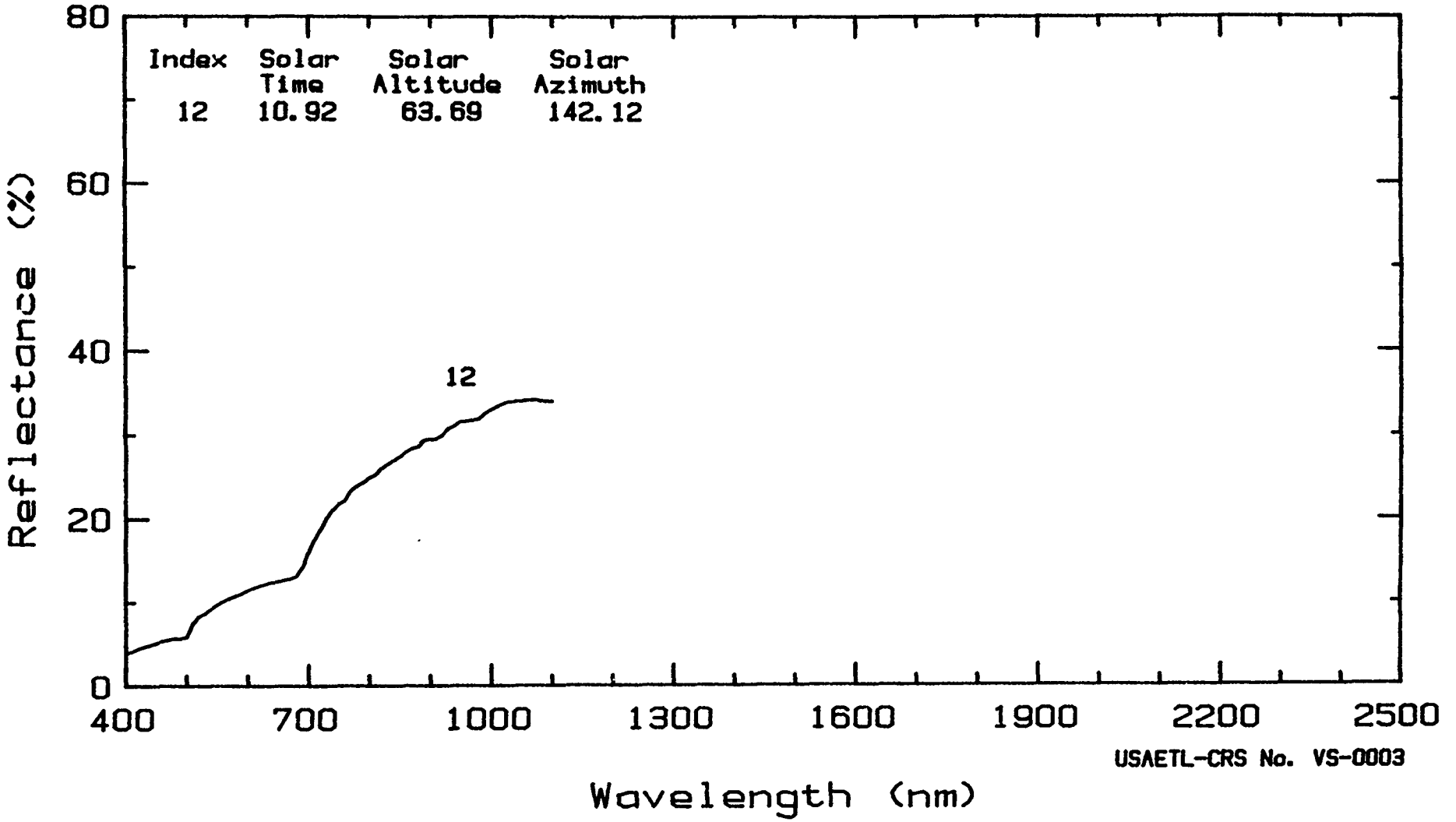
Physical & Chemical Properties:

Phenological stage: vegetative, semi-dormant w/'green' leaves.
Canopy cover in the FOV: 100% Crown closure: 30 to 40%;
Plant Height: 1.5 m Crown Diameter: 1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
12	6.2	10.0	12.9	26.4		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0003.
USAETL-RI-RSD



Reflectance Spectra of Creosote Bush.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Creosote bush Date Collected: 25 Aug 1987
Specific Name: Larrea tridentata (DC.) Cov.
Spectrum No.: LYUM.25, .46, .47.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The portion of the in situ plant canopy that was measured was densely leaved (25). Spectra were also taken of densely leaved branches piled in the FOV (46,47). The leaves were coated by a resinous material. The open canopy was formed by multiple gray-colored stems radiating divertically from near ground level, with no well-defined trunk. Leaves were clustered on the upper 1/4 to 1/3 of the whip-like branches. Leaves, 5 to 10 mm long, persist throughout the year, although the older leaves are deciduous during drought. The canopy was an assemblage of sunlit and shaded glossy, olive-green to dark green-colored leaves and dark gray-colored branches. The open canopy will allow some shaded and sunlit soil to be seen through the holes in the canopy. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve result from the low signal to noise ratio in these major atmospheric water absorption bands.

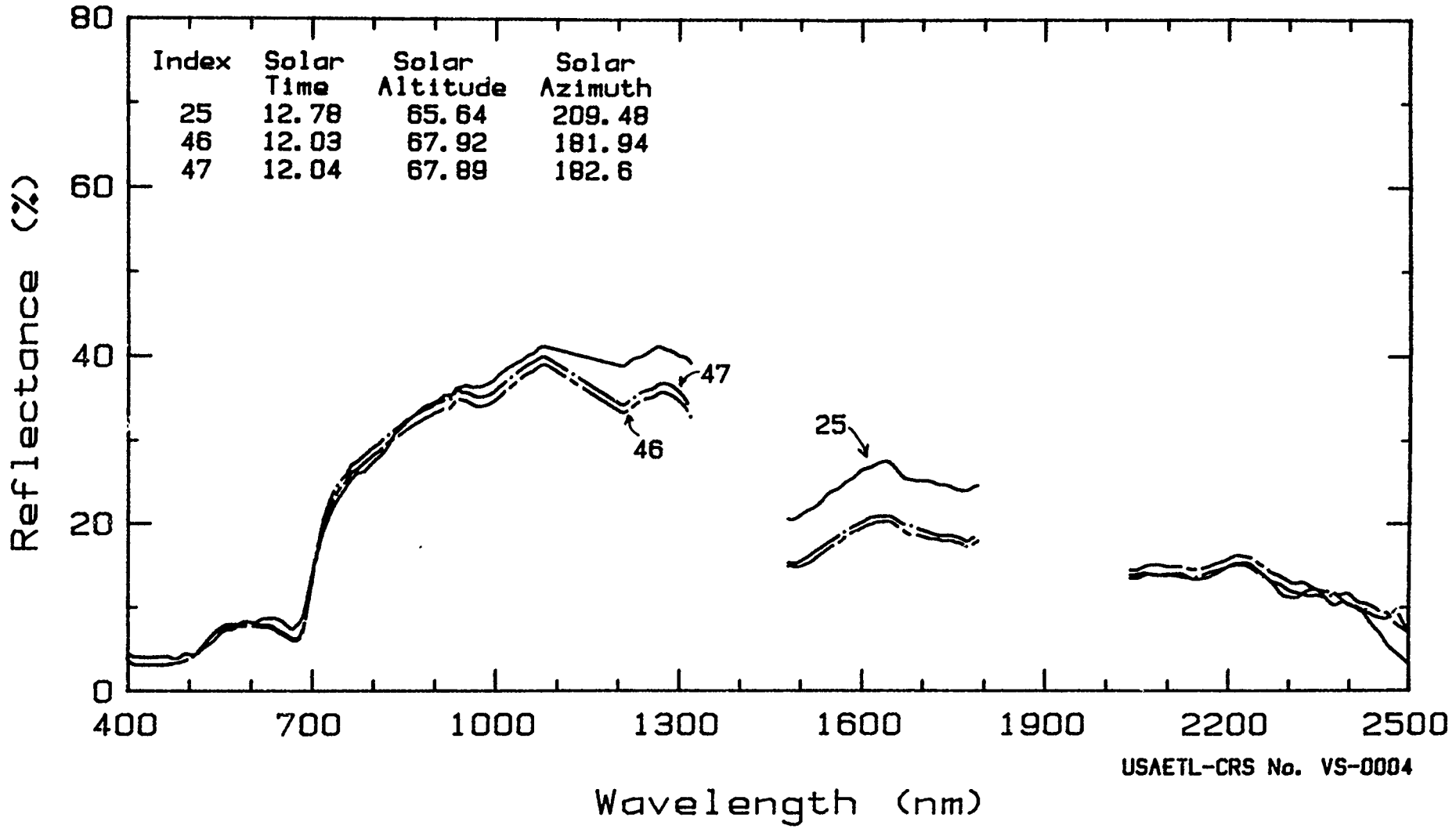
Physical & Chemical Properties:

Phenological stage: vegetative, olive-green leaves.
Canopy cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 1 to 1.5 m Crown Diameter: 1 to 2 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
25	4.2	6.9	8.4	30.0	25.6	13.5
46	3.6	7.2	6.9	29.8	18.9	14.6
47	3.7	7.3	7.1	30.8	19.6	13.5

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD
Sheet No.: VS-0004.



Reflectance Spectra of Creosote Bush.
Marine Air Station, Yuma Co., AZ; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Creosote bush Date Collected: 31 Aug 1987
Specific Name: Larrea tridentata (DC.) Cov.
Spectrum No.: LJOR.67

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The portion of the in situ plant canopy that was measured was densely leaved. The leaves were coated by a resinous material. The open canopy was formed by multiple gray-colored stems radiating divertically from near ground level, with no well-defined trunk. Leaves were clustered on the upper 1/4 to 1/3 of the whip-like branches. Leaves, 5 to 10 mm long, persist throughout the year, although the older leaves are deciduous during drought. The canopies were an assemblage of sunlit and shaded glossy, olive-green to dark green-colored leaves and dark gray-colored branches. The openness of the canopy will allow some shaded and sunlit soil to be seen through the holes in the canopy. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve are due to the low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

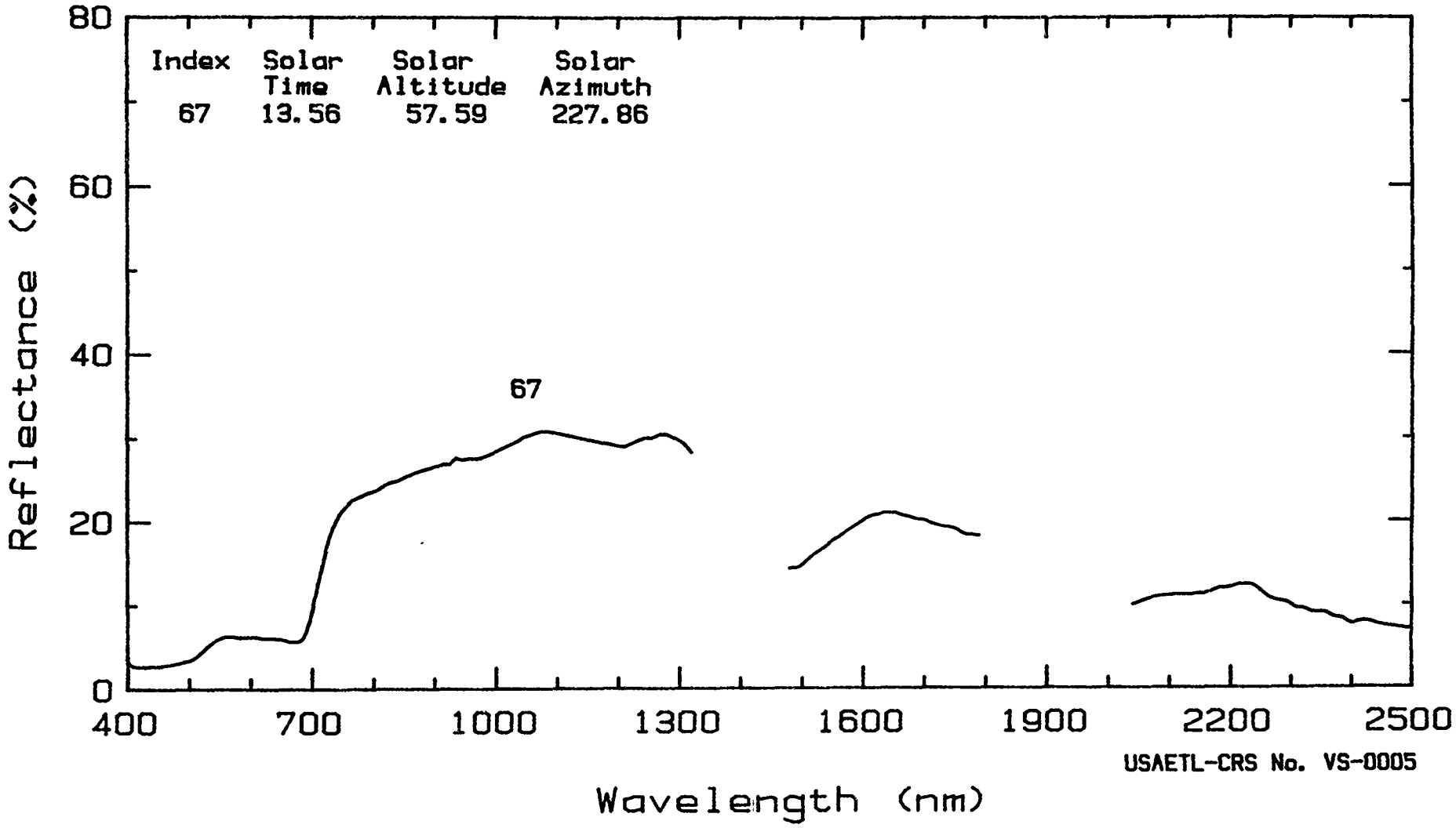
Phenological stage: vegetative, flowering
Canopy cover in FOV: 100% Crown closure (cover): 30-40%
Plant Height: 0.5 m Crown Diameter: 0.3 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
67	3.3	5.9	6.0	24.7	19.9	11.0

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0005.



Reflectance Spectra of Creosote Bush.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tarbush Date Collected: 6 Apr 1987
Specific Name: Flourensia cernua DC.
Spectra No.: 87LCA.13, .14

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The in situ plant canopies were dormant with only dark gray-colored branches forming the plant canopies. The branches were rather stiff and came from a single trunk near the ground surface. Most of the dried, tan-colored, senesced leaves had dropped from the branches. Typically the plant canopies were an assemblage of sunlit and shaded dark-toned branches and stems. Some sunlit or shaded soil was in the FOV.

Physical & Chemical Properties:

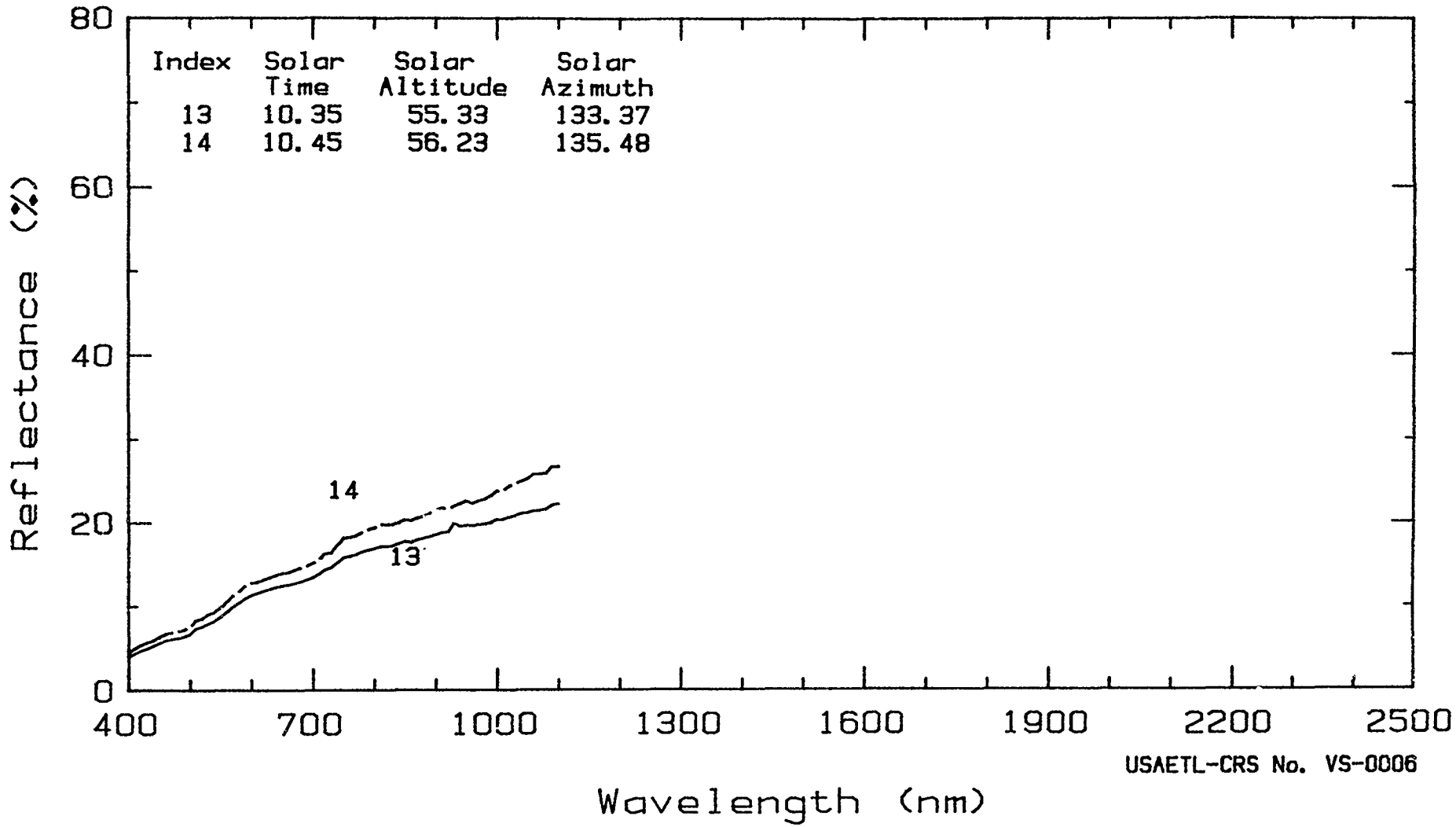
Phenological stage: dormant, leafless.
Canopy cover in the FOV: 20% Crown closure (cover): 20%
Plant Height: 0.7 m Crown Diameter: 1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
13	6.5	9.4	12.6	17.4		
14	7.3	10.6	14.2	19.9		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0006.



Reflectance Spectra of Tarbush.

Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tarbush Date Collected: 31 Aug 1987
Specific Name: Flourensia cernua DC.
Spectrum No.: 87LCS.49.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The portion of the in situ plant canopy that was measured was densely leaved. The deep green-colored leaves were about 20 mm long and 10 mm wide. Typically the plant canopy was an assemblage of sunlit and shaded green leaves and dark gray-colored branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

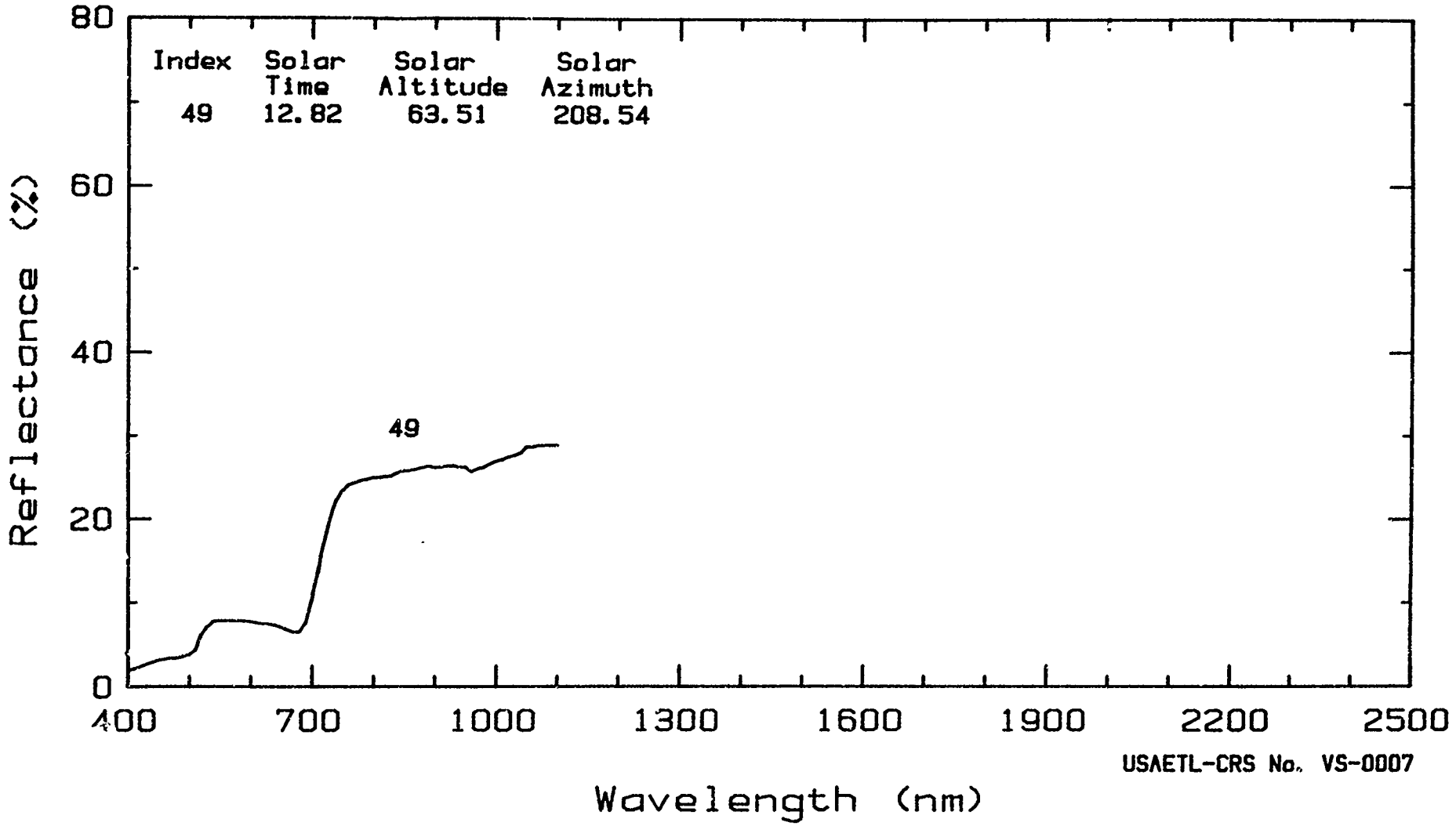
Physical & Chemical Properties:

Phenological stage: vegetative, green leaves.
Canopy cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.45 m Crown Diameter: 0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
49	3.9	7.6	7.0	25.3		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0007.
USAETL-RI-RSD



Reflectance Spectra of Tarbush.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tarbush Date Collected: 31 Aug 1987
Specific Name: Flourensia cernua DC.
Spectrum No.: LJOR.69

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The portion of the in situ plant canopy that was measured was densely leaved. The dark-green leaves were about 20 mm long and 10 mm wide. The canopy was dense and appeared representative of other individuals of this species at the sample site. The branches were stiff and came from a short trunk. Typically the plant canopy was an assemblage of sunlit and shaded "green" leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve are due to instrument noise related to low signal in these major atmospheric water absorption bands.

Physical & Chemical Properties:

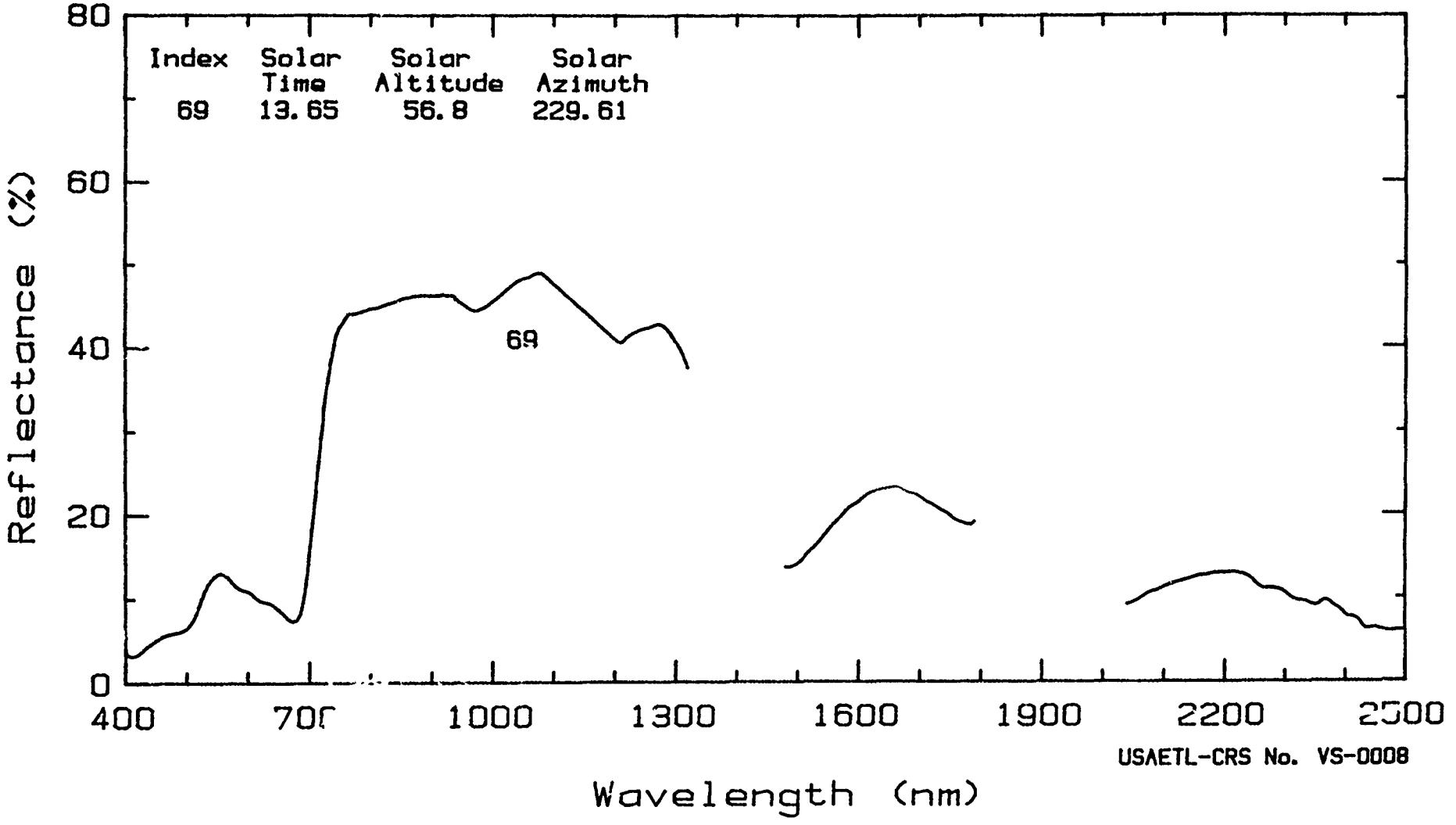
Phenological stage: vegetative.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.45 m Crown Diameter: 0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
69	6.4	11.6	8.4	44.2	21.5	11.5

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0008.



Reflectance Spectra of Tarbush.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Mesquite Date Collected: 7 Apr 1987
Specific Name: Prosopis glandulosa Torr.
Spectrum No.: 87LCA.26, .28, .32, .52.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The leafless in situ plant canopies consisted of dark gray-colored, stiff branches. The branches came from a central trunks that have been buried by aeolian sand. The sand collected within the canopies to form small coppice dunes. When viewed vertically the canopies were an assemblage of sunlit and shaded branches with sunlit and shaded sand and leaf litter beneath the branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

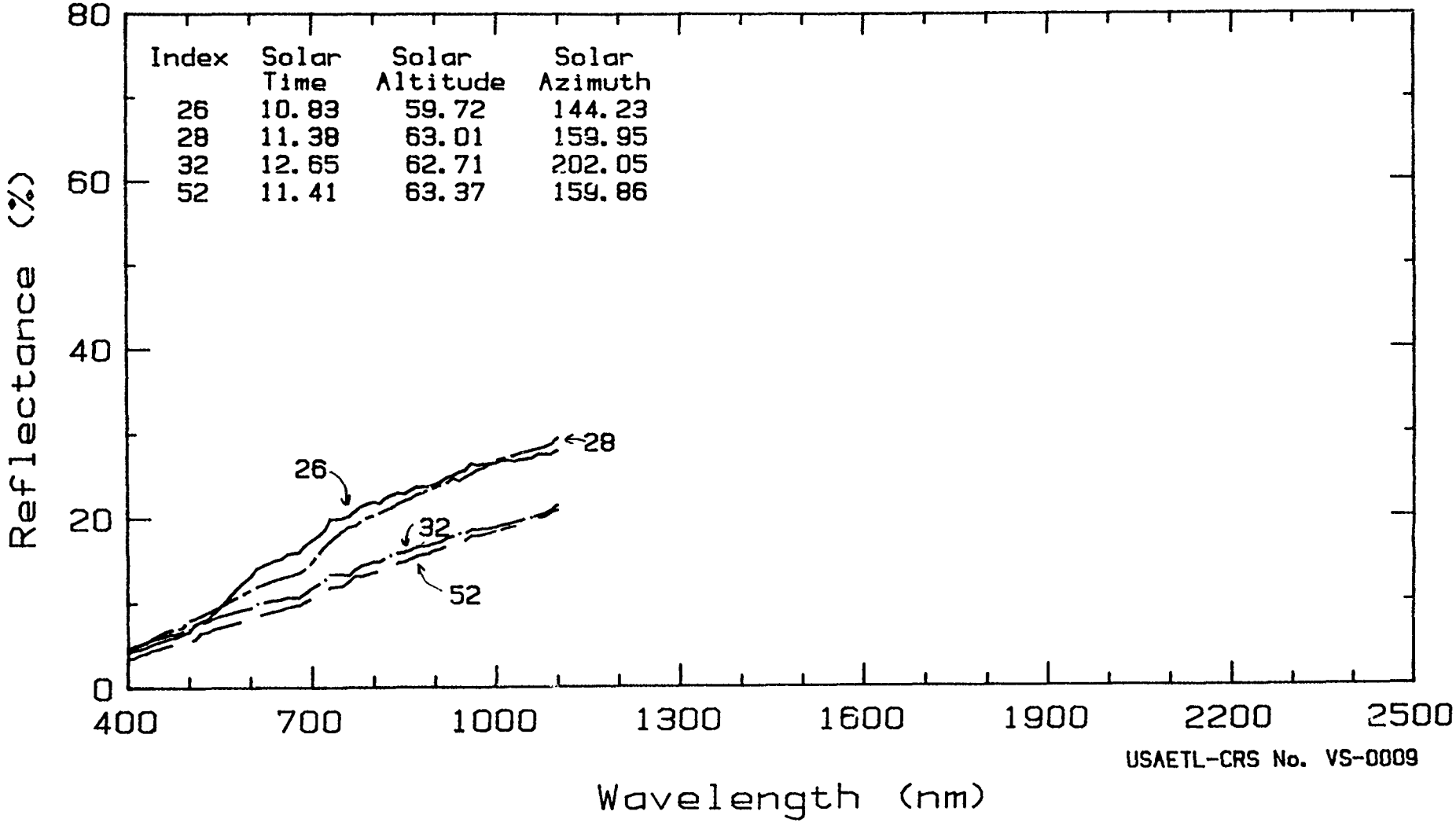
Physical & Chemical Properties:

Phenological stage: vegetative, dark gray colored branches.
Canopy cover in the FOV: 30% Crown closure (cover): 30%
Crown Height: 0.3 to 0.8 m Crown Diameter: >1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
26	6.4	10.4	15.7	22.5		
28	7.3	10.0	13.2	21.4		
32	6.7	8.[illegible]	10.6	15.5		
52	5.4	7.3	9.5	14.4		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0009.
USAETL-RI-RSD



Reflectance Spectra of Mesquite.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Mesquite Date Collected: 31 Aug 1987
Specific Name: Prosopis glandulosa Torr.
Spectrum No.: 87LCS.02, .10, .18, .19.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ canopies of fully-leaved shrubs were measured. The stiff, dark gray-colored banches came from a central trunk. Only the upper portion of the canopies were exposed. The lower branches and the trunk were buried by aeolian sand and formed coppice dunes. The leaves were pinnately compound and 7 to 15 cm long. Leaflets were dark green and about 30-45 mm long. Typically the plant canopy was an assemblage of sunlit and shaded green leaves and dark gray-colored branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

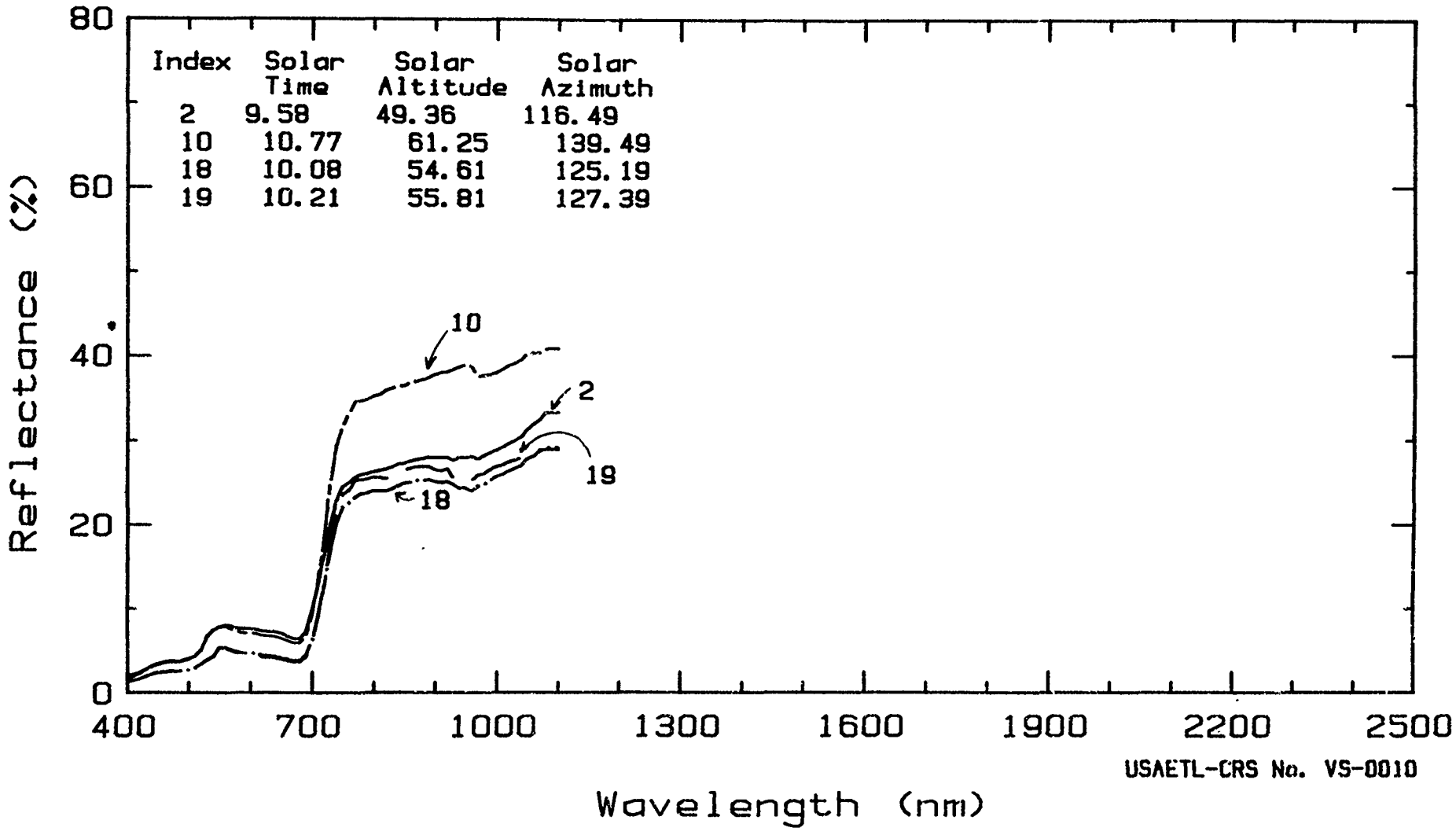
Physical & Chemical Properties:

Phenological stage: vegetative, green leaves.
Canopy cover in FOV: 100% Crown closure (cover): 100%
Plant Height: 0.3 to 0.8 m Crown Diameter: >1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
2	3.9	7.4	6.9	26.8		
10	4.0	7.2	6.4	36.0		
18	2.7	4.6	4.1	24.4		
19	2.8	4.5	3.9	26.0		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0010.
USAETL-RI-RSD



Reflectance Spectra of Mesquite.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Mesquite Date Collected: 29 Aug 1987
Specific Name: Prosopis glandulosa Torr.
Spectrum No.: LJOR.19, .22, .50

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level.

Sample: The in situ canopies of fully-leaved shrubs were measured. The stiff, dark gray-colored banches came from a central trunk. Only the upper portion of the canopies were exposed. The lower branches and the trunk were buried by aeolian sand and form small coppice dunes. The leaves were pinnately compound and 7 to 15 cm long. Leaflets were dark green and about 30-45 mm long. Typically the plant canopy was an assemblage of sunlit and shaded green leaves and dark gray-colored branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves were due to low signal to noise ratio in these major atmospheric water absorption bands.

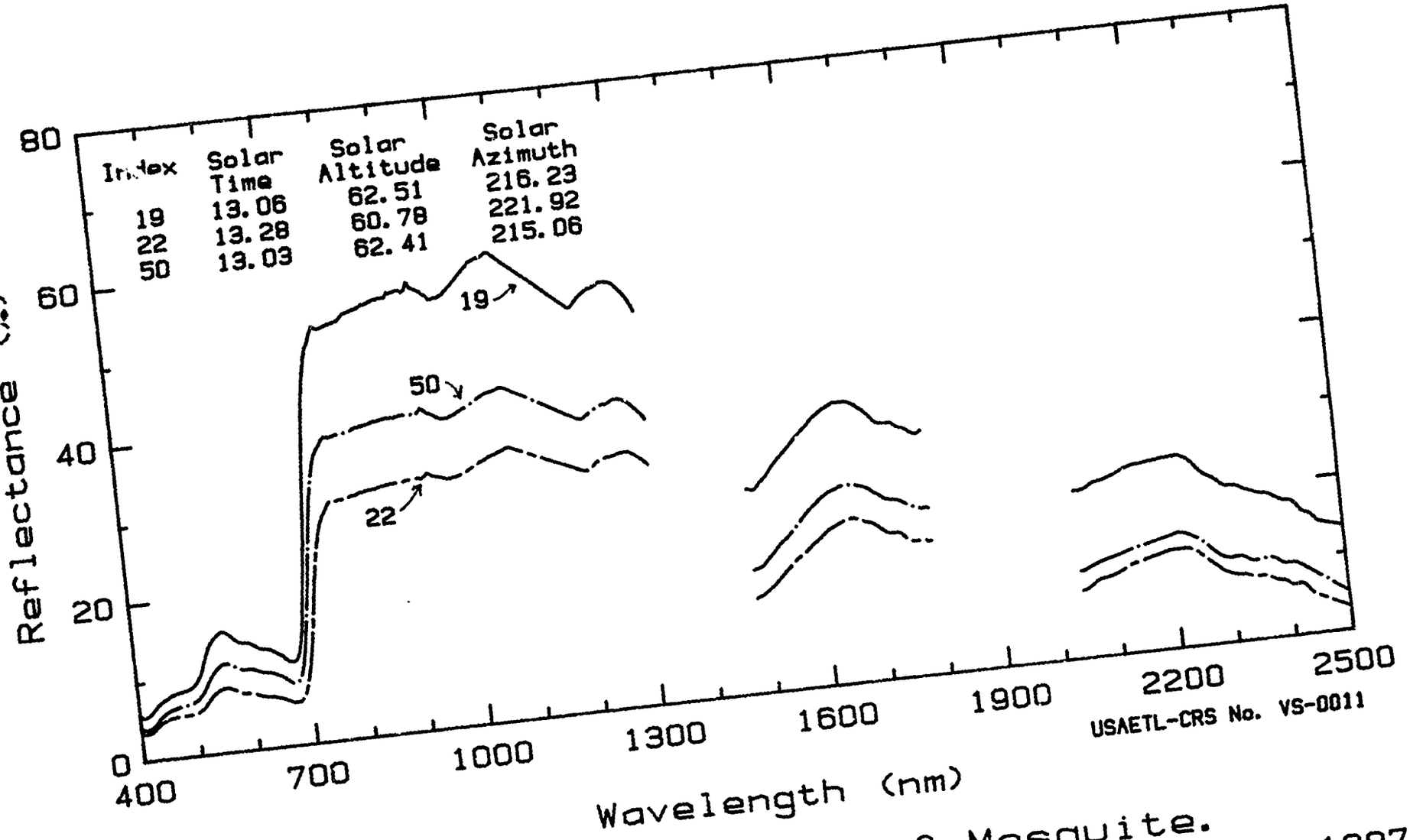
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Canopy cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <1.0 m Crown Diameter: >1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
19	8.9	14.2	11.7	54.0	34.0	22.6
22	5.5	7.6	6.0	31.3	19.3	10.8
50	6.8	10.5	8.9	39.6	23.7	12.8

Compiled by: Melvin B. Satterwhite Sheet No.: VS-0011.
USAETL-RI-RSD



Reflectance Spectra of Mesquite.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Bursage; Burro-weed Date Collected: 28 Aug 1987
Specific Name: Ambrosia dumosa Gray.
Spectrum No.: 87YAA.02, .03, .14, .26, .27.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The senescing in situ canopies were measured for these short, hemispherically shaped shrubs. The canopies were dense, composed primarily of slender, rigid, brittle branches that were white tipped. The dry, whitened leaves remaining on the stems were 6-8 mm long. Leaves senesce each year at the onset of the summer drought. The canopies were an assemblage of sunlit and shaded dry leaves and branches. Any soil seen directly through the holes in the canopies would have been shaded. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

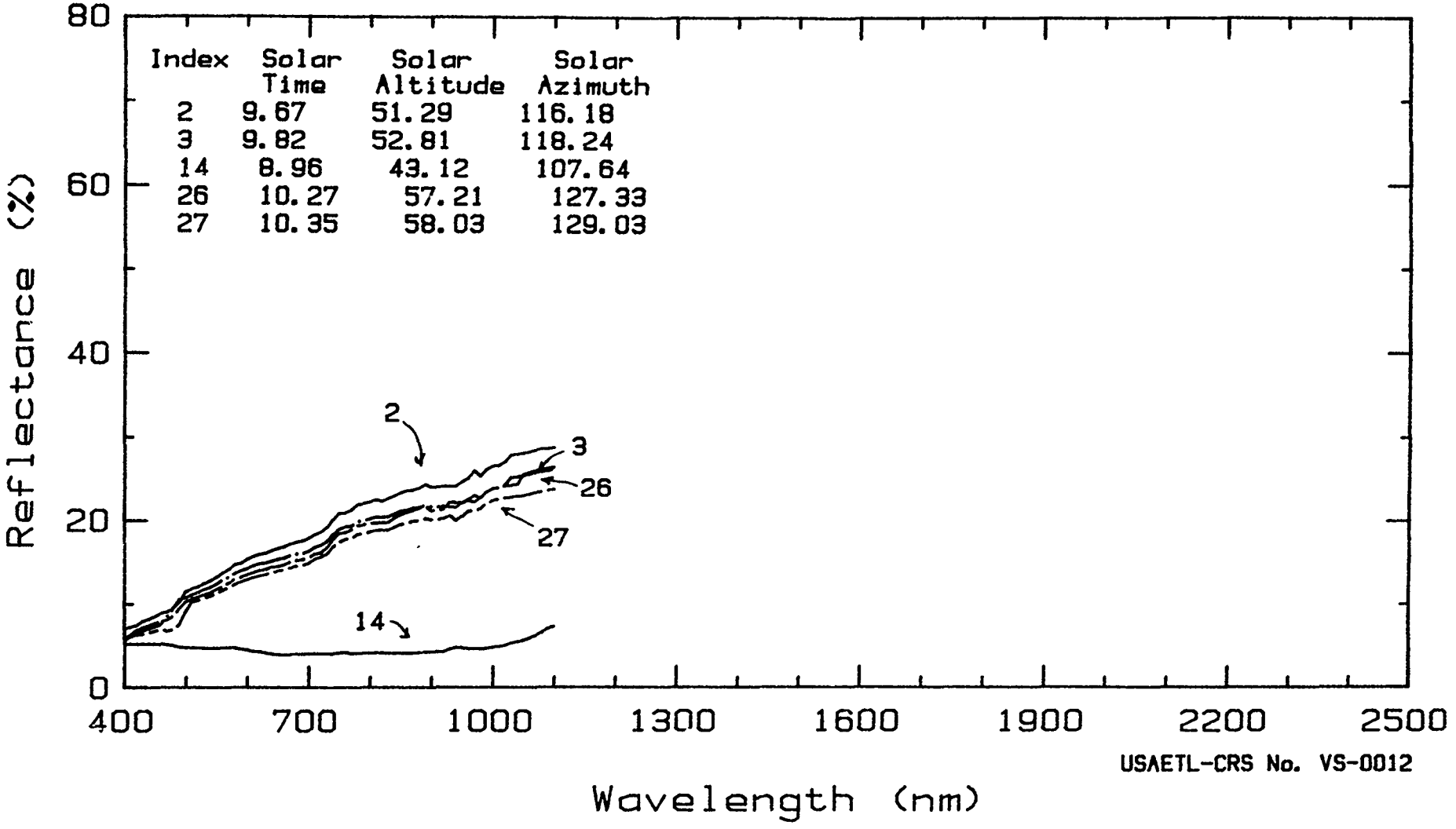
Phenological stage: vegetative; senesced, dry leaves.
Cover in the FOV: >90% Crown closure (cover): 100%
Plant Height: 0.4 to 0.6 m Crown Diameter: 0.6-0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
2	10.2	13.7	16.8	22.8		
3	9.1	12.1	14.8	20.2		
14	4.9	4.7	4.0	4.1		
26	9.6	12.8	15.6	20.7		
27	8.1	11.6	14.1	19.1		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0012.



Reflectance Spectra of Bursage.

Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Bursage; Burro-weed. Date Collected: 25 Aug 1987
Specific Name: Ambrosia dumosa Gray.
Spectrum No.: LYUM.26, .27, .28, .41.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level.

Sample: The senescing in situ canopies were measured for these short, hemispherically shaped shrubs. The canopies were dense, composed primarily of slender, rigid, brittle branches that were white tipped (26,41). The gray-colored plant material from previous year's growth was also measured (27,28). The dry, whitened leaves remaining on the stems were 6-8 mm long. Leaves senesce each year at the onset of the summer drought. The canopies were an assemblage of sunlit and shaded dry leaves and branches. Any soil seen directly through the holes in the canopies would have been shaded. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves were due to instrument noise related to low signal in these major atmospheric water absorption bands.

Physical & Chemical Properties:

Phenological stage: vegetative, senesced, dry whitish leaves.
Canopy Cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.4 to 0.6 m Crown Diameter: 0.6 to 0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
26	17.1	21.2	25.7	31.1	34.9	35.1
27	12.1	13.5	15.2	17.4	23.5	25.5
28	11.9	14.1	16.9	20.3	35.4	28.1
41	18.6	23.1	27.2	32.1	35.4	31.4

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD
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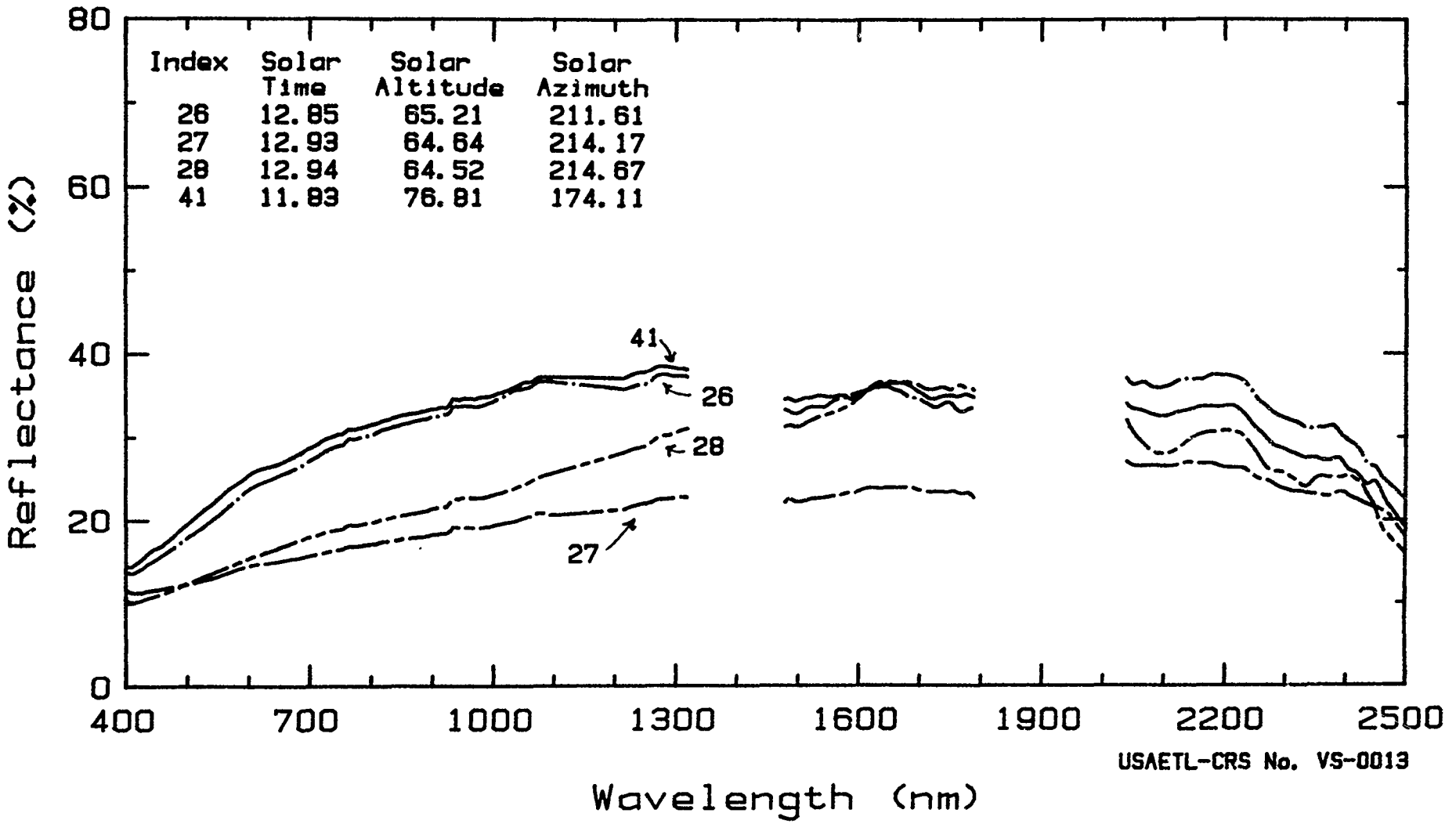

Reflectance Spectra of Bursage.

Marine Air Station, Yuma Co., AZ; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Broom snakeweed Date Collected: 7 Apr 1987
Specific Name: Xanthocephalum sarothrae (Pursh) Shinners.
Spectrum No.: 87LCA.24, .25, .41, .42.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ canopies were comprised of numerous branches coming from a single base, which tended to form a short hemispherical- or corymbiform-shaped canopy. Upper portions of stems were green in color and the lower portions brown to gray. The leaves were linear, 5-70 mm long and 1-3 mm wide, and yellow-green to green in color. These canopies had been affected by a light frost. The upper 1/ of each canopy was dry, brown colored stems and leaves. New growth was just beginning. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

Phenological stage: vegetative; brown leaves above (frost effect) and green leaves below.
Canopy Cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.4 m Crown Diameter: 0.3 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
24	5.0	7.4	9.8	17.9		
25	4.5	7.1	8.8	20.0		
41	5.2	7.5	9.5	15.6		
42	5.1	7.2	9.5	14.4		

Compiled by: Melvin B. Satterwhite
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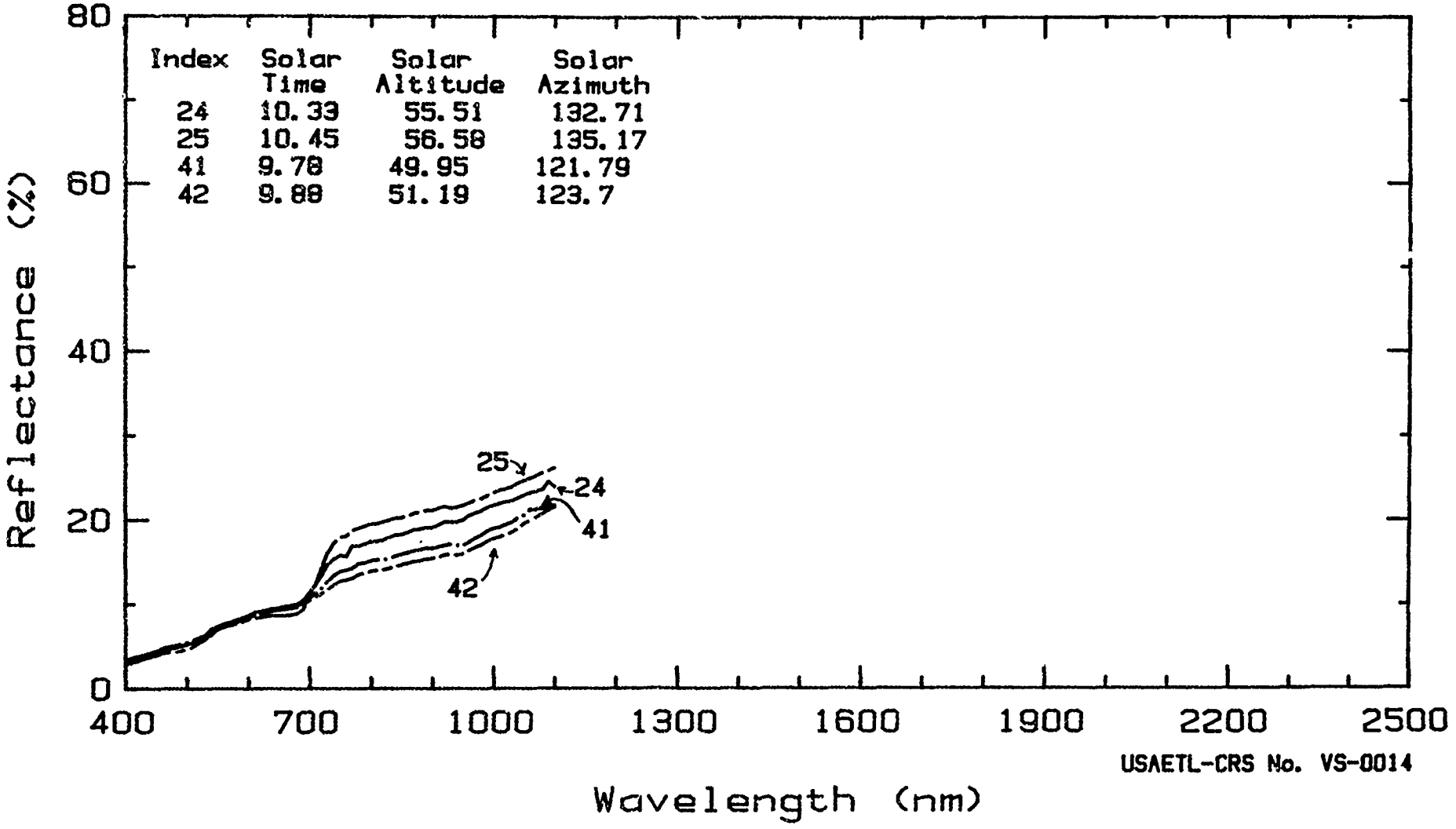


Reflectance Spectra of Broom Snakeweed.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Broom snakeweed Date Collected: 30 Aug 1987
Specific Name: Xanthocephalum sarothrae (Pursh.) Shinners.
Spectrum No.: 87LCS.07, .08, .15, .16, .36, .38, .55.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ canopies were comprised of numerous branches coming from a single base, which tended to form a short hemispherical- or corymbiform-shaped canopy. Upper portions of stems were green in color and the lower portions brown to gray. The leaves were linear, 5-70 mm long and 1-3 mm wide, and yellow-green to green in color. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

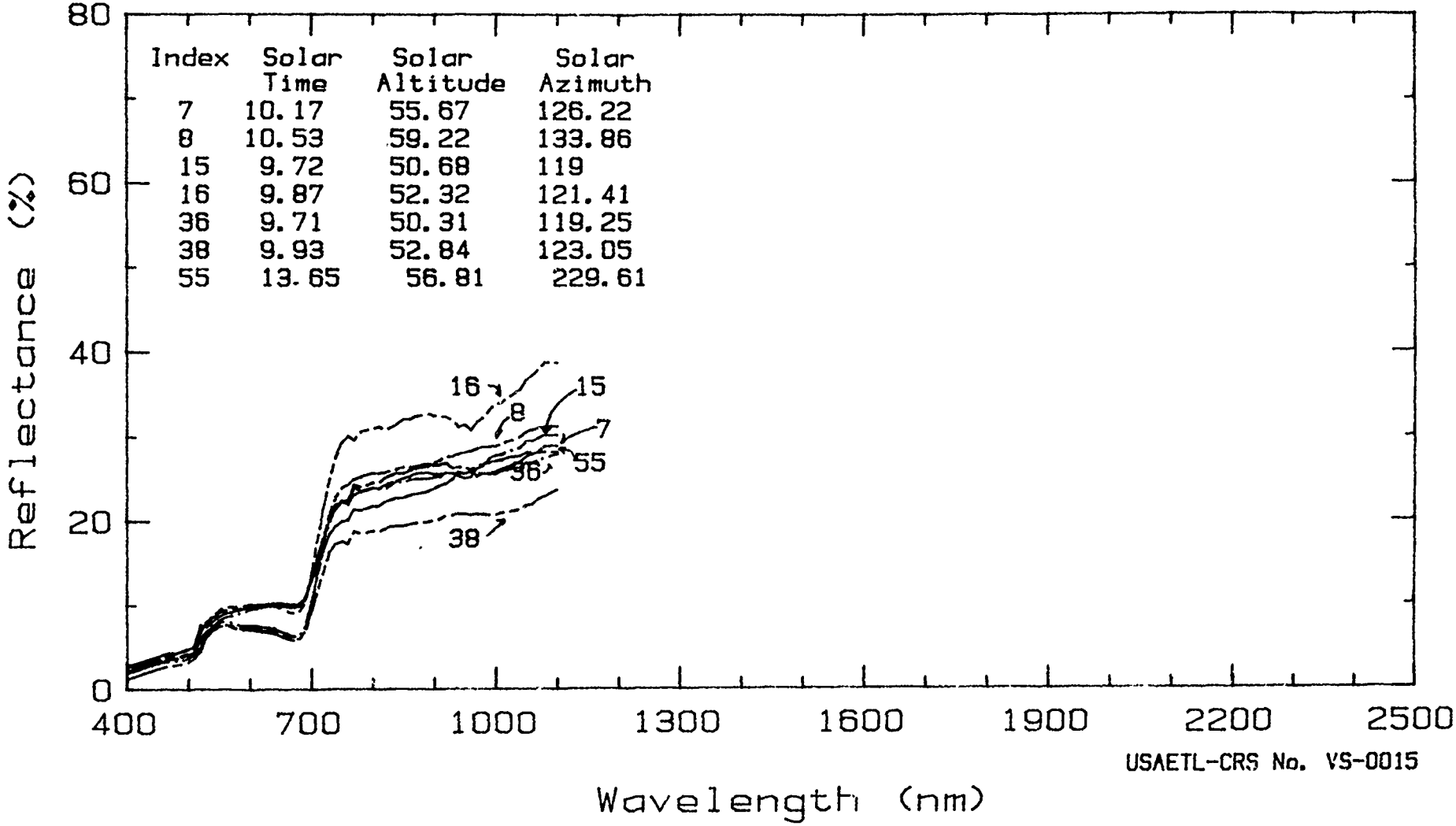
Phenological stage: vegetative; green leaves/stems.
Canopy cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: < 0.4 m Crown Diameter: <0.7 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
7	4.8	8.8	10.3	22.4		
8	4.8	9.0	10.1	25.3		
15	4.1	8.2	10.1	24.5		
16	4.4	9.2	9.7	31.5		
36	3.7	7.3	6.8	24.4		
38	4.1	7.2	6.5	19.2		
55	3.2	6.9	6.4	26.0		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0015.



Reflectance Spectra of Broom Snakeweed.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Broom snakeweed Date Collected: 28 Aug 1987
Specific Name: Xanthocephalum sarcthrae (Pursh.) Shinners.
Spectrum No.: LJOR.20, .59, .72, .74.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level.

Sample: The in situ canopies were comprised of numerous branches coming from a single base, which tended to form a short hemispherical- or corymbiform-shaped canopy. Upper portions of stems were green in color and the lower portions brown to gray. The leaves were linear, 5-70 mm long and 1-3 mm wide, and yellow-green to green in color. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. Initial flowering was beginning. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves were due to instrument noise related to low signal in these major atmospheric water absorption bands.

Physical & Chemical Properties:

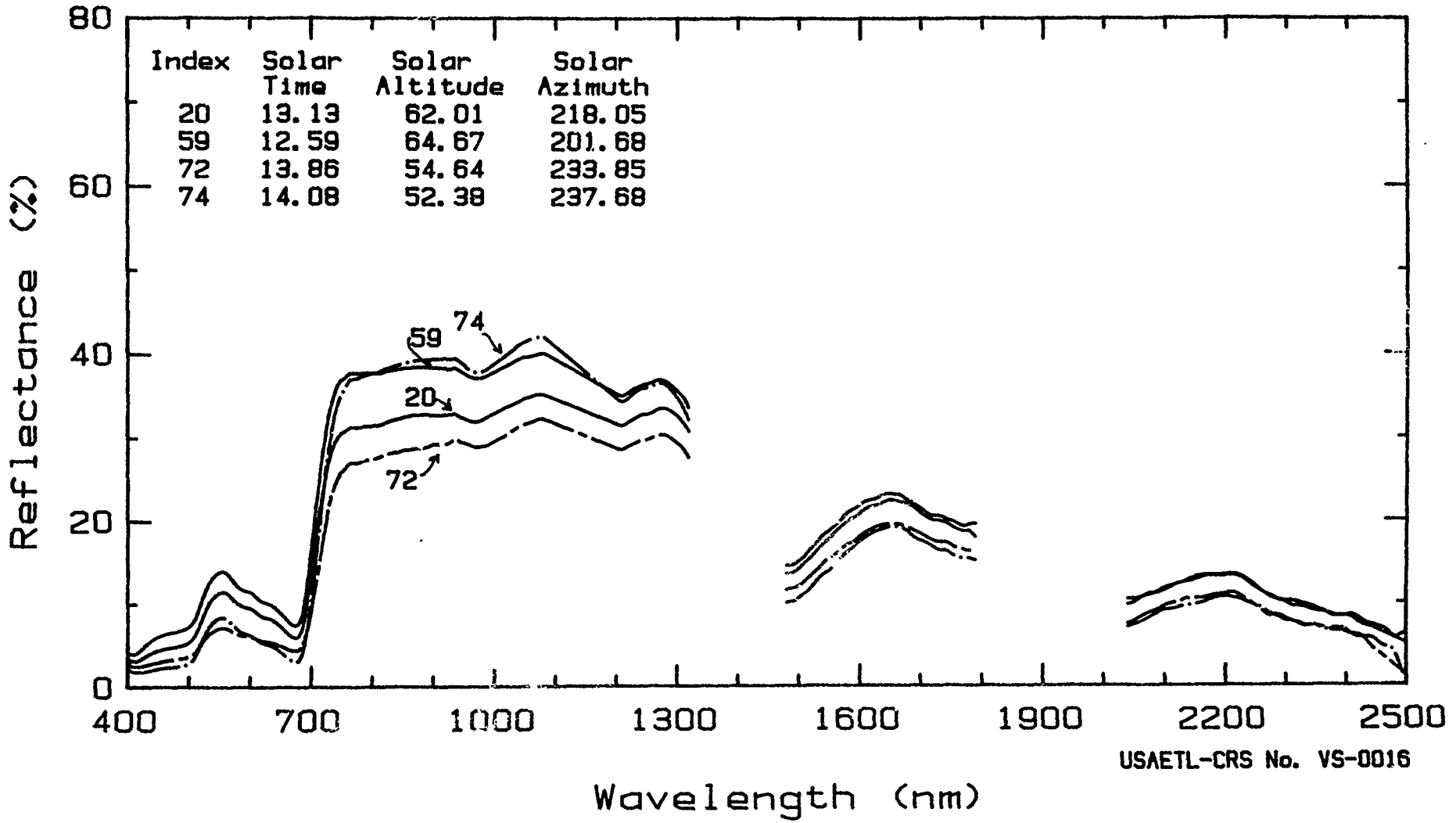
Phenological stage: vegetative, green leaves, early flowering.
Crown Cover in the FOV 100% Crown closure (cover): 100%
Plant Height: <0.5 m Crown Diameter: <0.6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
20	5.3	10.2	7.1	32.1	20.8	11.8
59	7.1	12.4	8.7	38.0	21.5	11.6
72	3.6	6.4	4.8	28.0	18.1	9.4
74	2.9	7.2	4.0	38.3	17.3	9.2

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0016.



Reflectance Spectra of Broom Snakeweed.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Four-wing saltbush Date Collected: 30 Aug 1987
Specific Name: Atriplex canescens (Pursh.) Nutt.
Spectrum No.: 87LCS.20, .21, .22.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopies were well branched from a short trunk. The stout, erect branches were dense below and loose in the upper 1/2 of the canopy. Leaves were 1 to 5 cm long, linear to narrowly oblong. Leaves and bracts of the fruits were light gray-green or bluish-green in color. The canopy consisted of numerous branches and densely packed small leaves. Spectrum #9 was of a canopy that included the densely arranged leaves and fruits on the upper branches. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

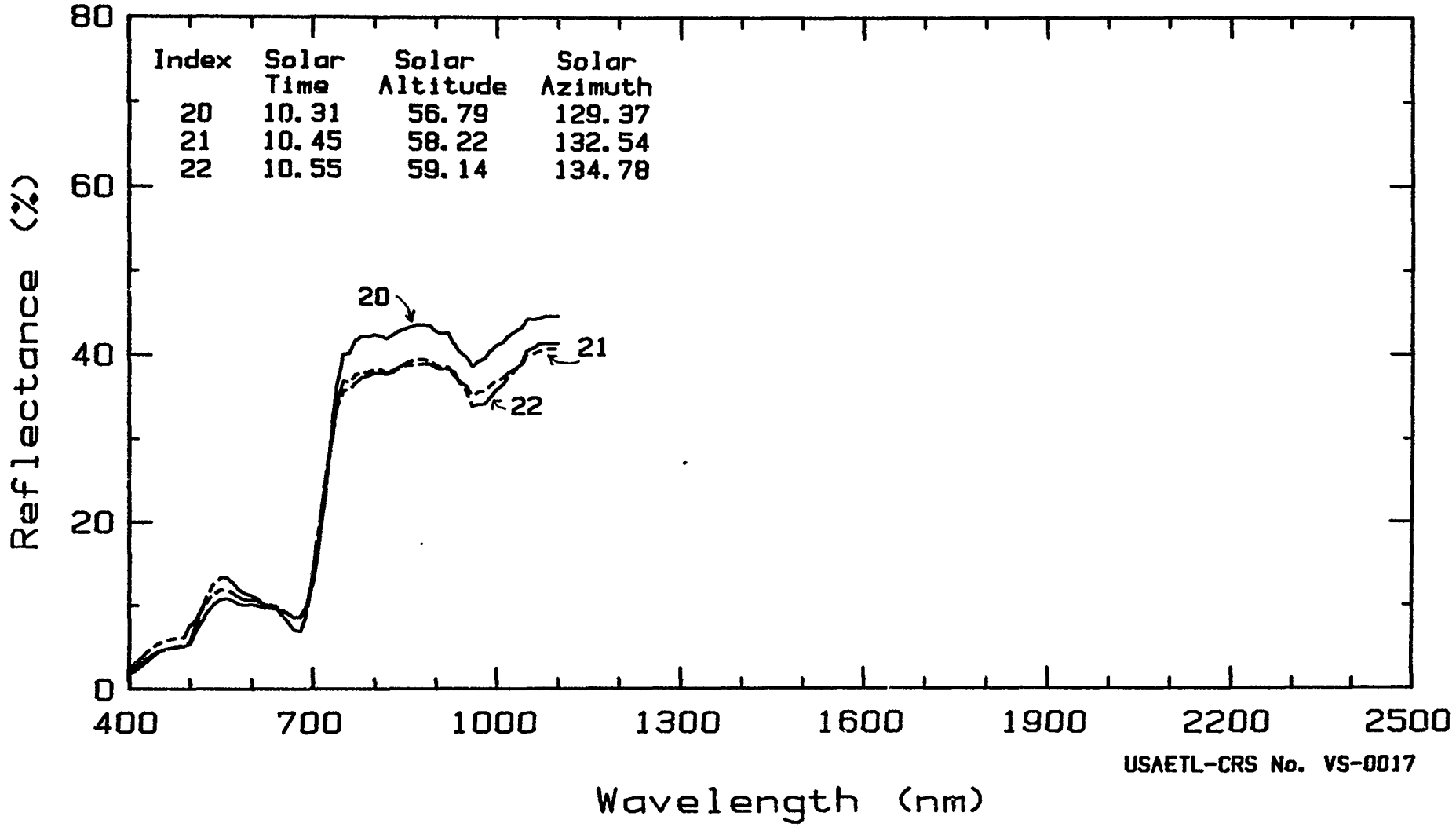
Phenological stage: vegetative; green leaves; flower/fruiting.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 1 to 2 m Crown Diameter: 1 to 1.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
20	5.6	10.0	9.2	42.5		
21	6.9	11.0	9.3	38.4		
22	6.0	12.0	8.4	38.0		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0017.



Reflectance Spectra of Four-winged Saltbush.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Four-wing saltbush Date Collected: 30 Aug 1987
Specific Name: Atriplex canescens (Pursh.) Nutt.
Spectrum No.: LJOR.23, .47

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopies were well branched from a short trunk. The stout, erect branches were dense below and loose in the upper 1/2 of the canopy. Leaves were 1 to 5 cm long, linear to narrowly oblong. Leaves and bracts of the fruits were light gray-green or bluish-green in color. The canopy consisted of numerous branches and densely-packed small leaves. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to low signal to noise ratios in these major atmospheric water absorption bands.

Physical & Chemical Properties:

Phenological stage: vegetative, green leaves, early flowering
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: >1.0 m Crown Diameter: >1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
23	10.6	16.6	13.3	43.8	22.7	16.5
47	11.7	21.7	16.2	57.7	26.4	14.9

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

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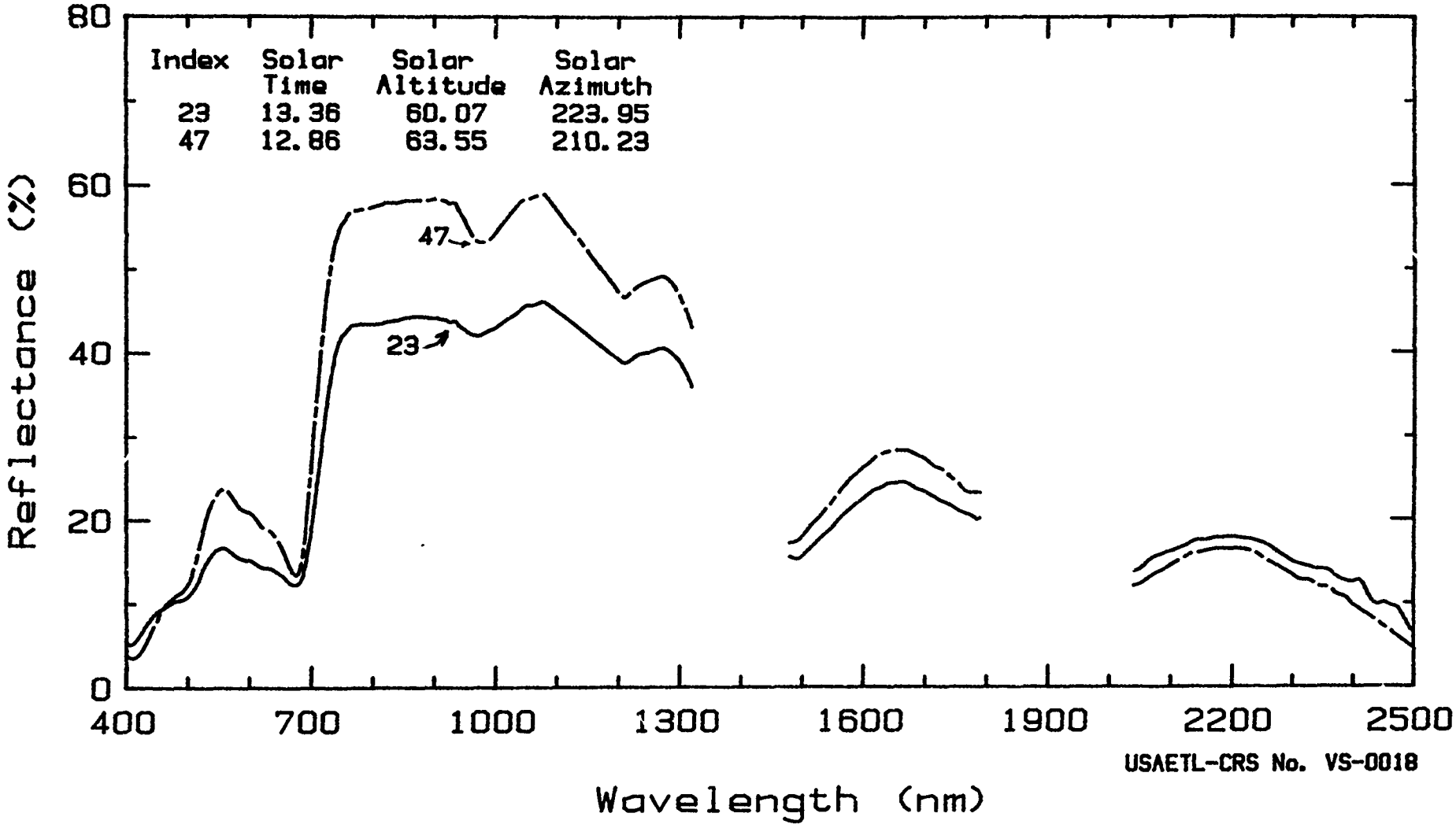


Reflectance Spectra of Four-wing Saltbush.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Yucca; Soaptree Date Collected: 7 Apr. 1987
Specific Name: Yucca elata Engelm.
Spectrum No.: 87LCA.27, .29, .38, .39, .53, .54.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was centered on crown.

Sample: The in situ plant canopies consisted of a single stem or trunk. Numerous leaves, 30 to 90 cm long and 2.5 cm wide, were clustered at the top of the stem. Leaves were bluish-green, stout and spine-tipped, with whitish margins, which were the previous year's growth that had persisted over the winter. The canopy was a rather loose arrangement of the linear spirally-arranged leaves. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

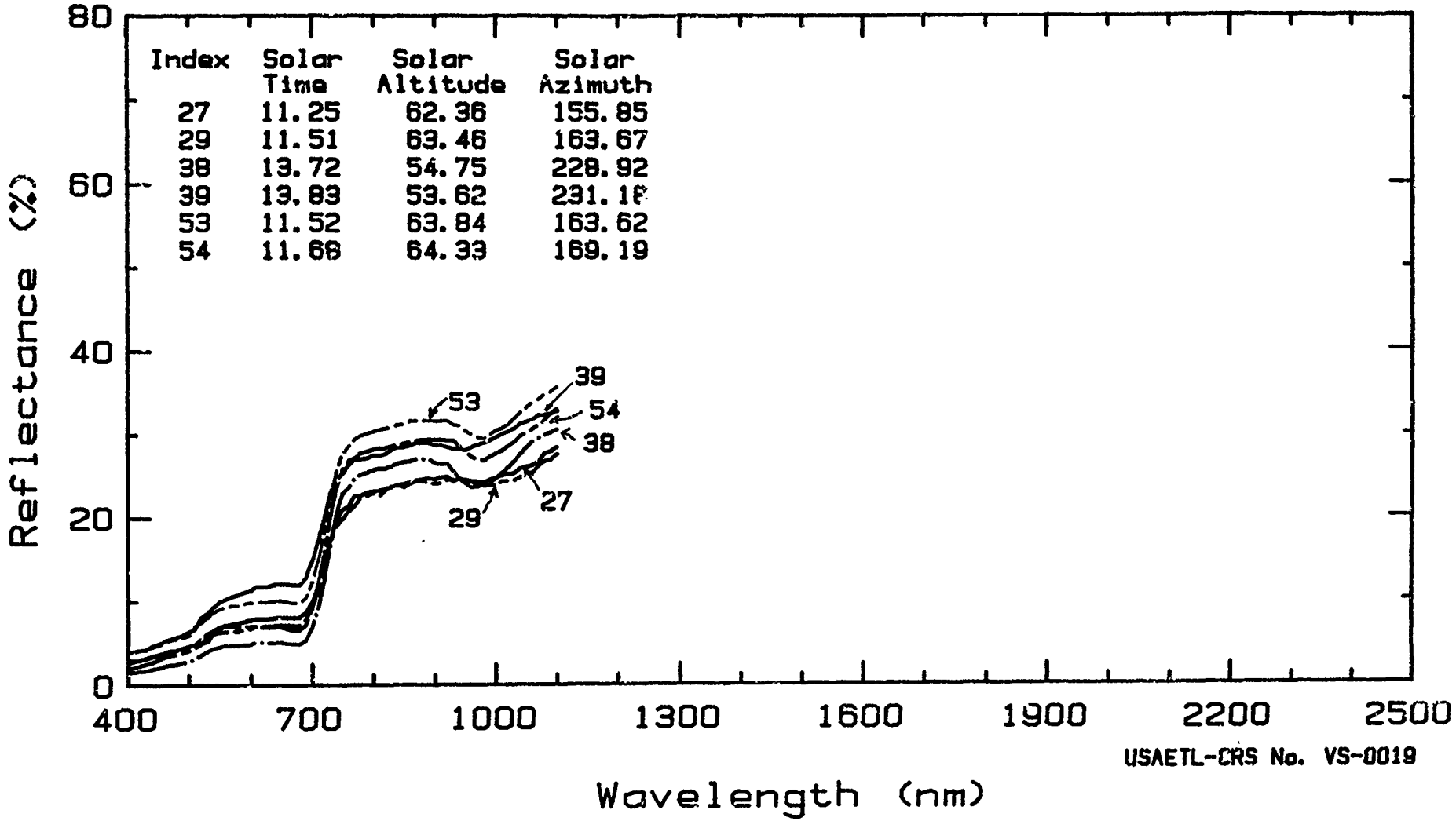
Phenological stage: vegetative; bluish-green leaves.
Crown cover in the FOV: >90% Crown closure (cover): 100%
Plant Height: 0.6 m Crown Diameter: 0.6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
27	4.4	6.9	8.1	23.6		
29	4.2	6.2	7.2	23.3		
38	2.7	4.5	5.1	26.1		
39	6.1	10.0	12.1	28.0		
53	5.9	9.1	10.1	30.8		
54	3.9	6.6	6.9	28.6		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0019.



Reflectance Spectra of Yucca.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Yucca; Soaptree Date Collected: 30 Aug 1987
Specific Name: Yucca elata Engelm.
Spectrum No.: 87LCS.06, .25, .26, .39, .40.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was centered on crown.

Sample: The in situ plant canopies consisted of a single stem or trunk. Numerous leaves, 30 to 90 cm long and 2.5 cm wide, were clustered at the top of the stem. Leaves were bluish-green, stout and spine-tipped, with whitish margins. The leaves were the present year's and the previous year's growth. The canopy was a rather loose arrangement of the linear, spirally-arranged leaves. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

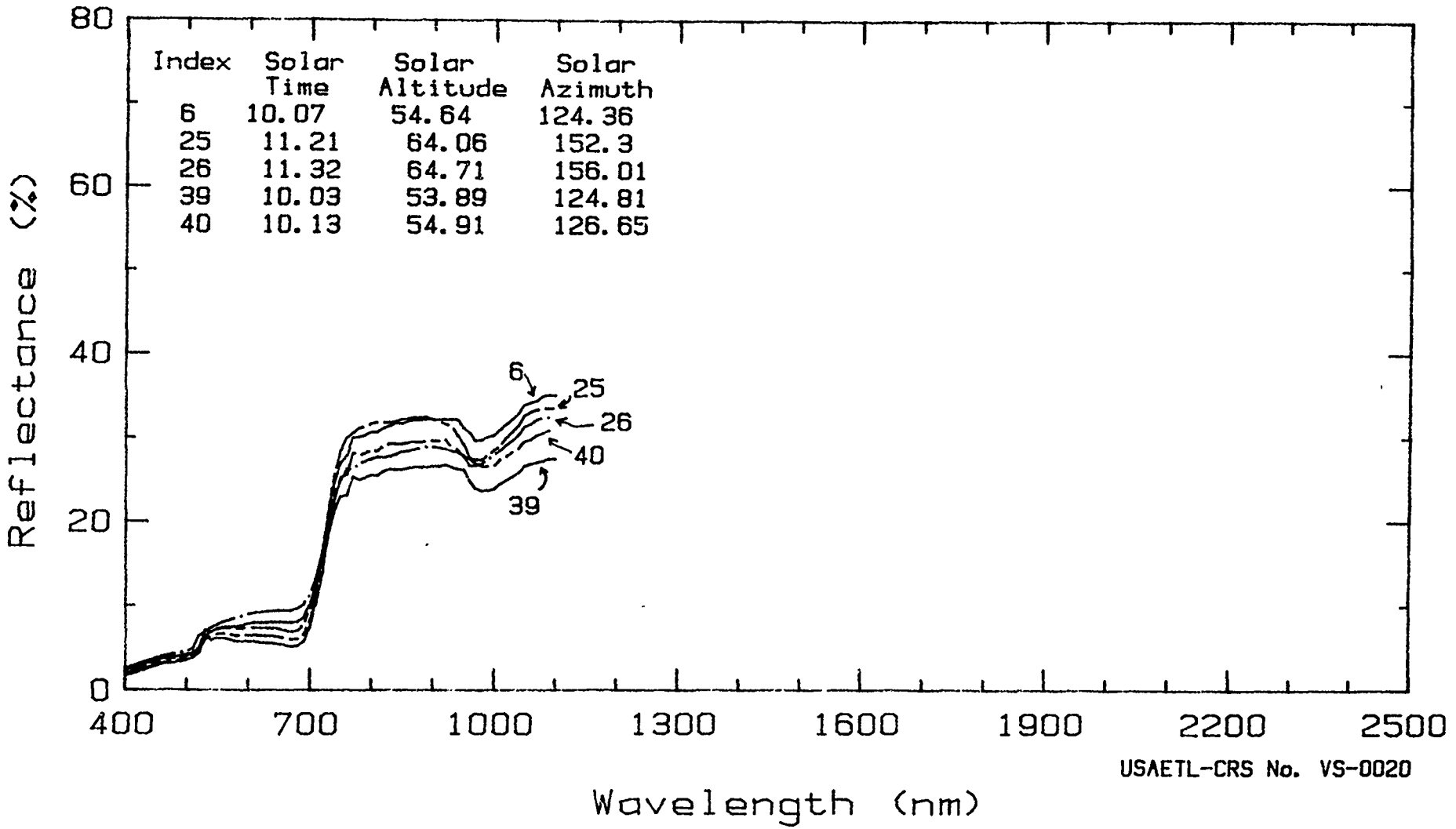
Physical & Chemical Properties:

Phenological stage: vegetative; bluish-green leaves.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.7 m Crown Diameter: <0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
6	4.1	7.1	8.1	31.1		
25	3.6	6.9	7.2	31.8		
26	4.6	7.9	9.6	27.8		
39	3.4	5.8	5.4	25.8		
40	3.9	6.2	6.2	28.8		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0020.
USAETL-RI-RSD



Reflectance Spectra of Yucca.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Yucca; Soaptree Date Collected: 29 Aug 1987
Specific Name: Yucca elata Engelm.
Spectrum No.: LJOR.53.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The in situ plant canopy consisted of a single stem or trunk. Numerous leaves, 30 to 90 cm long and 2.5 cm wide, were clustered at the top of the stem. Leaves were bluish-green, stout and spine-tipped, with whitish margins. The leaves were the present year's and the previous year's growth. The canopy was a rather loose arrangement of the linear, spirally-arranged leaves. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

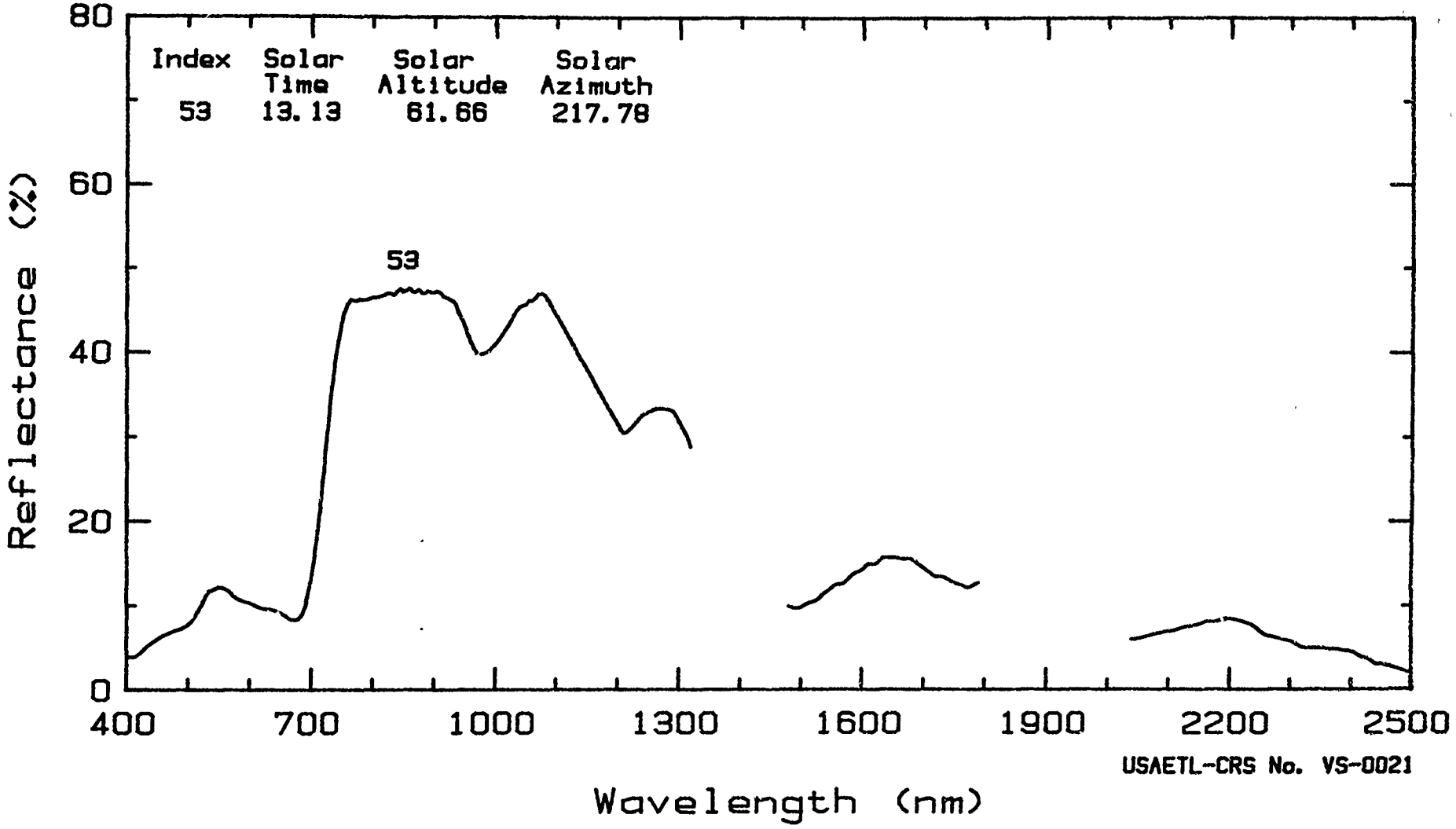
Phenological stage: vegetative, bluish-green leaves.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.7 m Crown Diameter: 0.75 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
53	7.4	11.2	9.0	46.8	14.2	6.9

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0021.



Reflectance Spectra of Yucca.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Longleaf ephedra Date Collected: 5 Apr 1987
Specific Name: Ephedra trifurca Torr.
Spectrum No.: 87LCA.02.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: An in situ canopy of an erect shrub was measured. Its rigid, hard branches, 3.5 mm thick, were solitary or whorled at the nodes. Leaves were 5 to 10 mm long. The photosynthetic leaves and branches were olive-green to gray-green in color. The lower, older branches were ashy gray. The canopy was open, but when viewed from the vertical, the canopy had an almost complete cover. Typically the plant canopy was an assemblage of sunlit and shaded leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

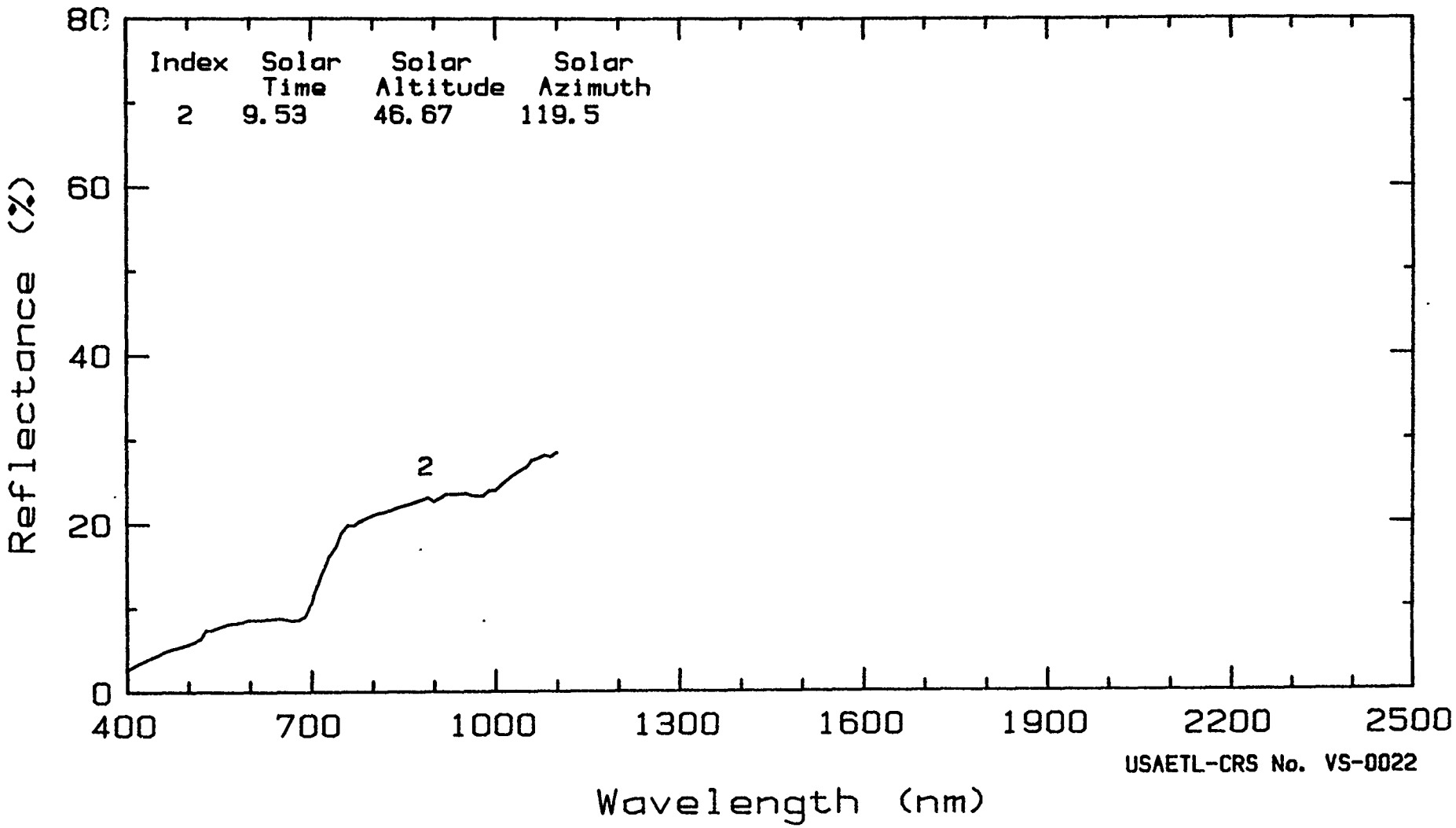
Phenological stage: vegetative; olive-green leaves and twigs.
Cover in the FOV: 80-90% Crown closure (cover): 80%
Plant Height: <0.8 m Crown Diameter: <1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
2	5.4	7.8	8.7	21.6		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0022.



Reflectance Spectra of Longleaf Ephedra.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Longleaf ephedra Date Collected: 31 Aug 1987
Specific Name: Ephedra trifurca Torr.
Spectrum No.: 87LCS.43.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: An in situ canopy of this erect shrub was measured. The canopy was composed primarily of rigid, hard branches, 3.5 mm thick, that were solitary or whorled at the nodes. Leaves were 5 to 10 mm long. The photosynthetic leaves and branches were olive-green to gray-green in color. The lower, older branches were ashy gray. The canopy was open, but when viewed from the vertical, the canopy had an almost complete cover. Typically the plant canopy was an assemblage of sunlit and shaded leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

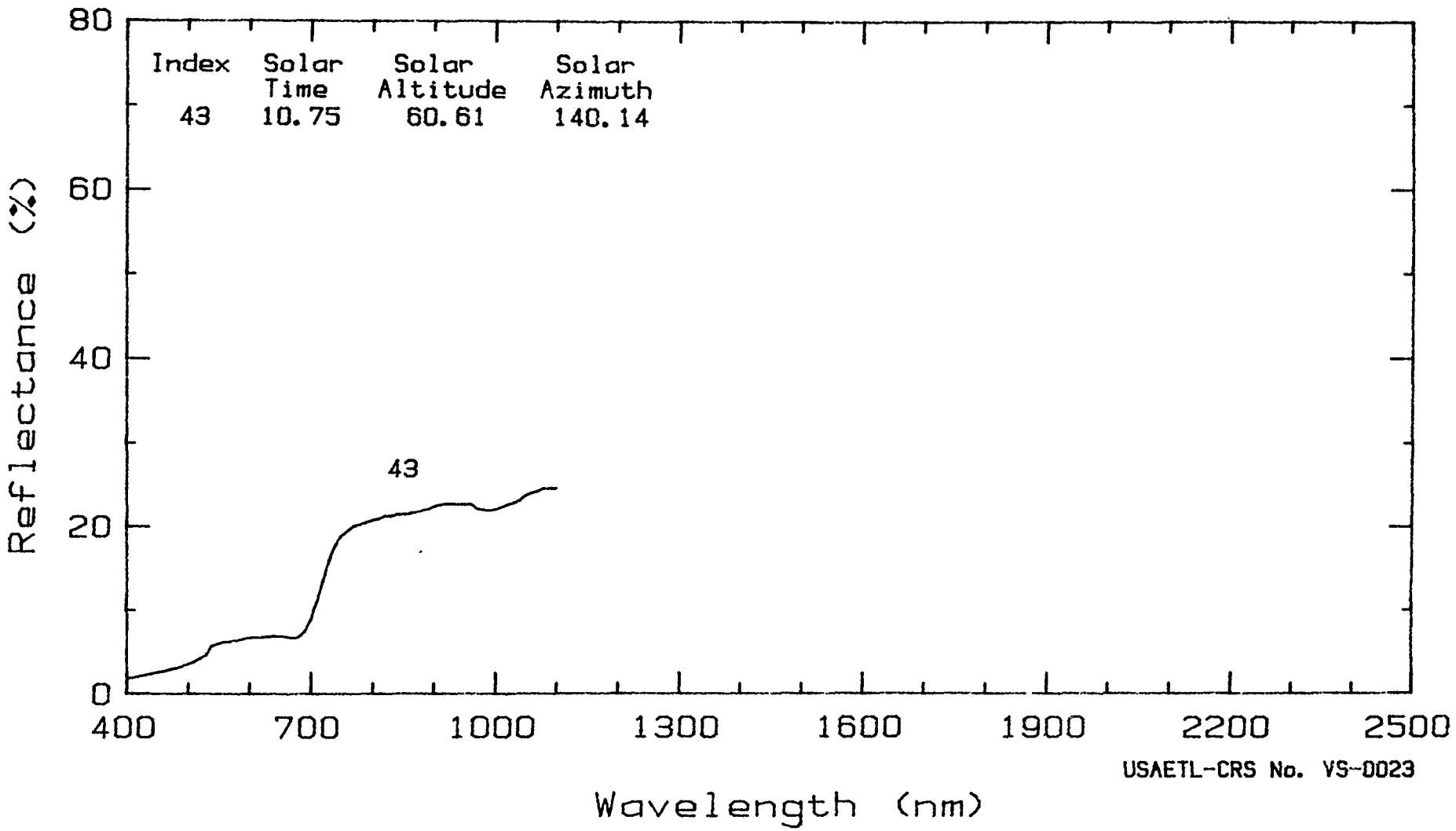
Phenological stage: vegetative; olive-green leaves and twigs.
Cover in the FOV: 80-90% Crown closure (cover): 80%
Plant Height: <1.0 m Crown Diameter: <0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
43	3.2	5.8	6.9	21.2		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0023.



Reflectance Spectra of Longleaf Ephedra.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Longleaf ephedra Date Collected: 2 Sep 1987
Specific Name: Ephedra trifurca Torr.
Spectrum No.: LJOR.104.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: An in situ canopy of this erect shrub was measured. The canopy was composed primarily of rigid hard branches, 3.5 mm thick, that were solitary or whorled at the nodes. Leaves were 5 to 10 mm long. The photosynthetic leaves and branches were olive-green to gray-green in color. The lower, older branches were ashy gray. The canopy was open, but when viewed from the vertical, the canopy had an almost complete cover. Typically the plant canopy was an assemblage of sunlit and shaded leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve are due to low signal to noise ratio related to these major atmospheric water absorption bands.

Physical & Chemical Properties:

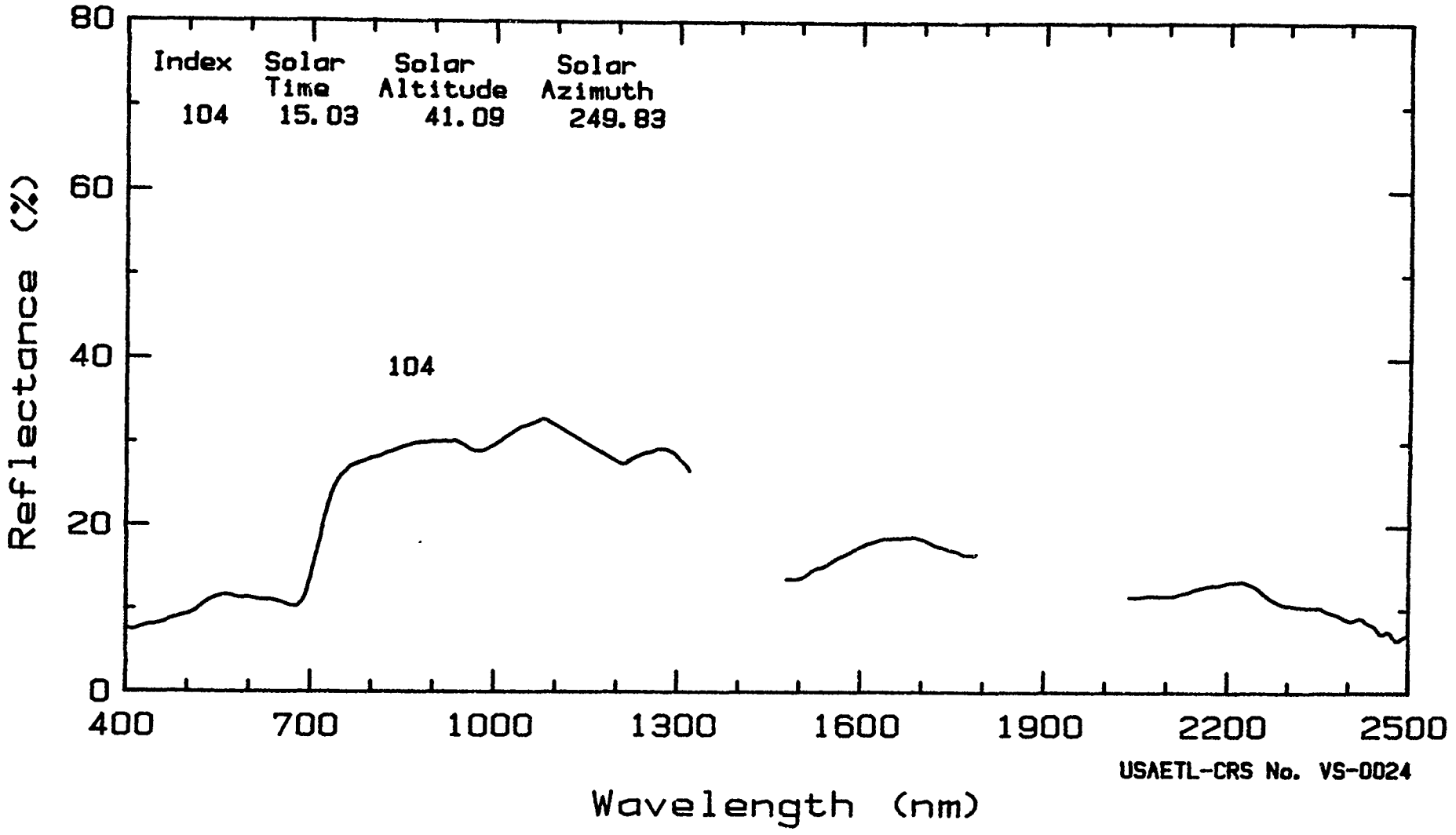
Phenological stage: vegetative, olive-green leaves and twigs.
Crown cover in the FOV: 90% Crown closure (cover): 80%
Plant Height: <0.4 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
104	9.0	11.2	10.7	28.8	17.7	11.9

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0024.



Reflectance Spectra of Longleaf Ephedra.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Torrey ephedra Date Collected: 1 Sep 1987
Specific Name: Ephedra torreyana Wats.
Spectrum No.: 87LCS.59

Site Location: Valley of Fire, Lincoln Co., NM, USA.
33.7 deg. N Latitude; 105.9 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: An in situ canopy of an erect shrub was measured. Its rigid, hard branches, 3.5 mm thick, were solitary or whorled at the nodes. Leaves were 2 to 5 mm long. The photosynthetic leaves and branches were blue-green in color. The lower, older branches were ashy gray. The canopy was open, but when viewed from the vertical, the canopy had an almost complete cover. Typically the plant canopy was an assemblage of sunlit and shaded leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

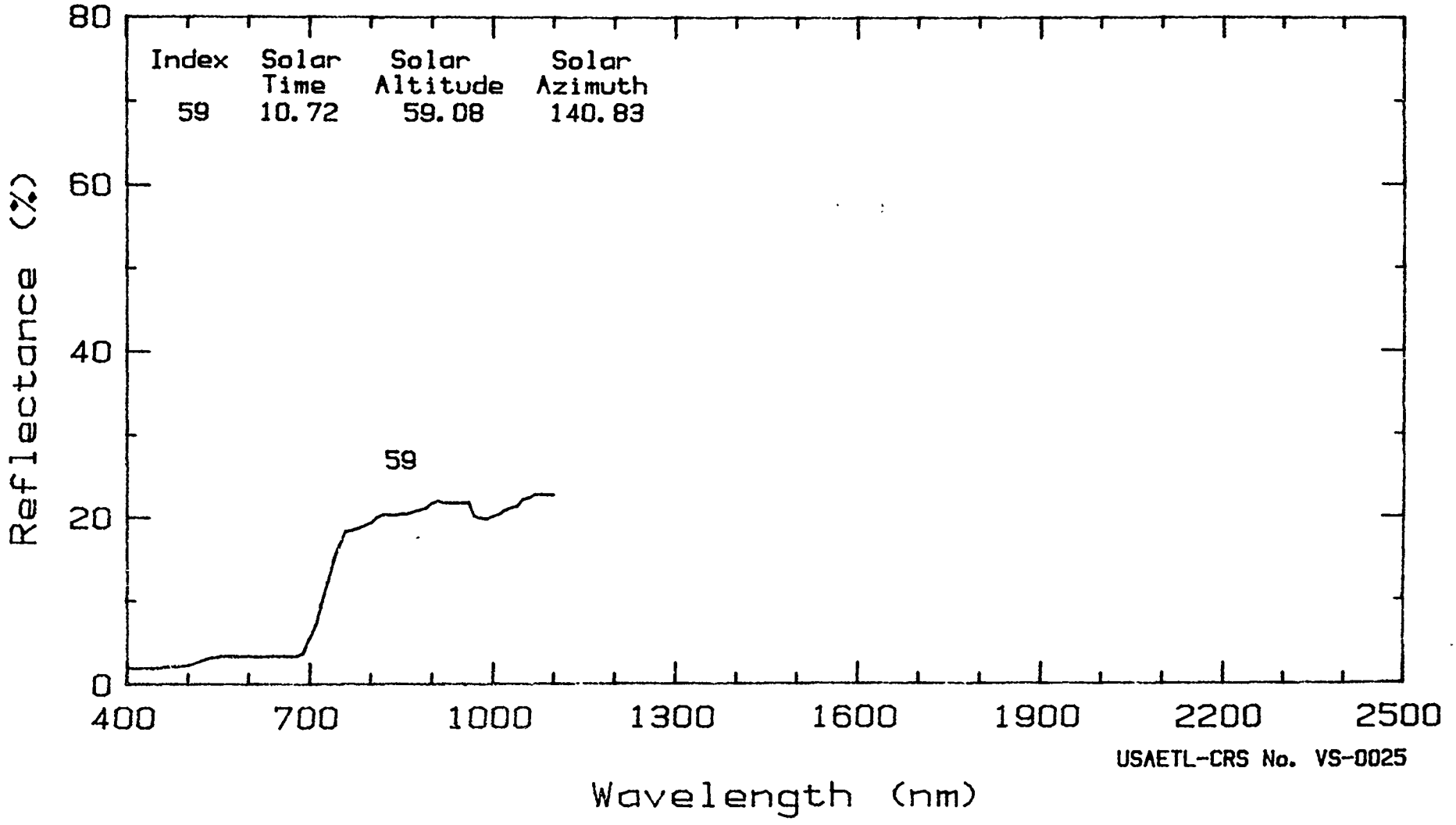
Phenological stage: vegetative; blue-green leaves and twigs.
Cover in the FOV: 80-90% Crown closure (cover): 80%
Plant Height: 1-1.5 m Crown Diameter: 1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
59	2.2	3.2	3.4	20.0		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VS-0025.



Reflectance Spectra of Torrey Ephedra.
Valley of Fire, Lincoln Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Wax currant Date Collected: 1 Sep 1987
Specific Name: Ribes cereum Dougl.
Spectrum No.: 87LCS.58.

Site Location: Valley of Fire, Lincoln Co., NM, USA.
33.7 deg. N Latitude; 105.9 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The in situ plant canopy was measured. The plant was in late-flowering to early-fruiting stage. This was a much branched shrub. Branches were reddish brown to dark brown. Leaves are 1.5-2.5 cm long and green colored. When viewed from the vertical the canopy appears dense. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

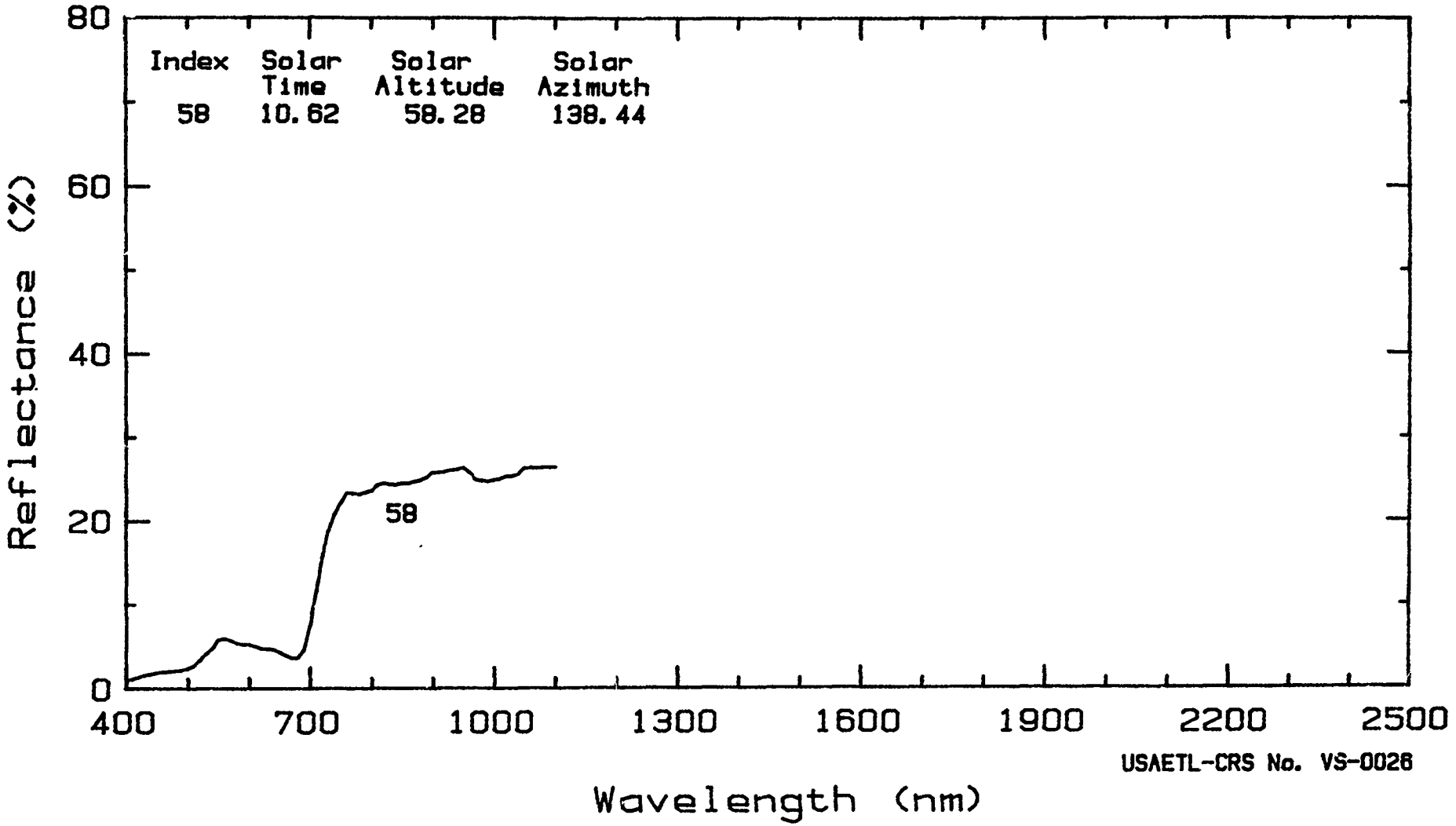
Physical & Chemical Properties:

Phenological stage: vegetative, late flowering to early fruiting.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <1.5 m Crown Diameter: <2.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
58	2.4	5.1	4.2	24.3		

Compiled by: Melvin B. Satterwhite Sheet No. VS-0026.
USAETL-RI-RSD



Reflectance Spectra of Wax Currant.
Valley of Fire, Lincoln Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Wax currant Date Collected: 1 Sep 1987
Specific Name: Ribes cereum Dougl.
Spectrum No.: LJOR.80.

Site Location: Valley of Fire, Lincoln Co., NM, USA.
33.7 deg. N Latitude; 105.9 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above and centered on the canopy.

Sample: The in situ plant canopy was measured. The plant was in late-flowering to early-fruiting stage. This was a much-branched shrub. Branches were reddish brown to dark brown. Leaves are 1.5-2.5 cm long and green colored. When viewed from the vertical the canopy appears dense. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and branches. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve are due to low signal to noise ratio in these major atmosphere water absorption bands.

Physical & Chemical Properties:

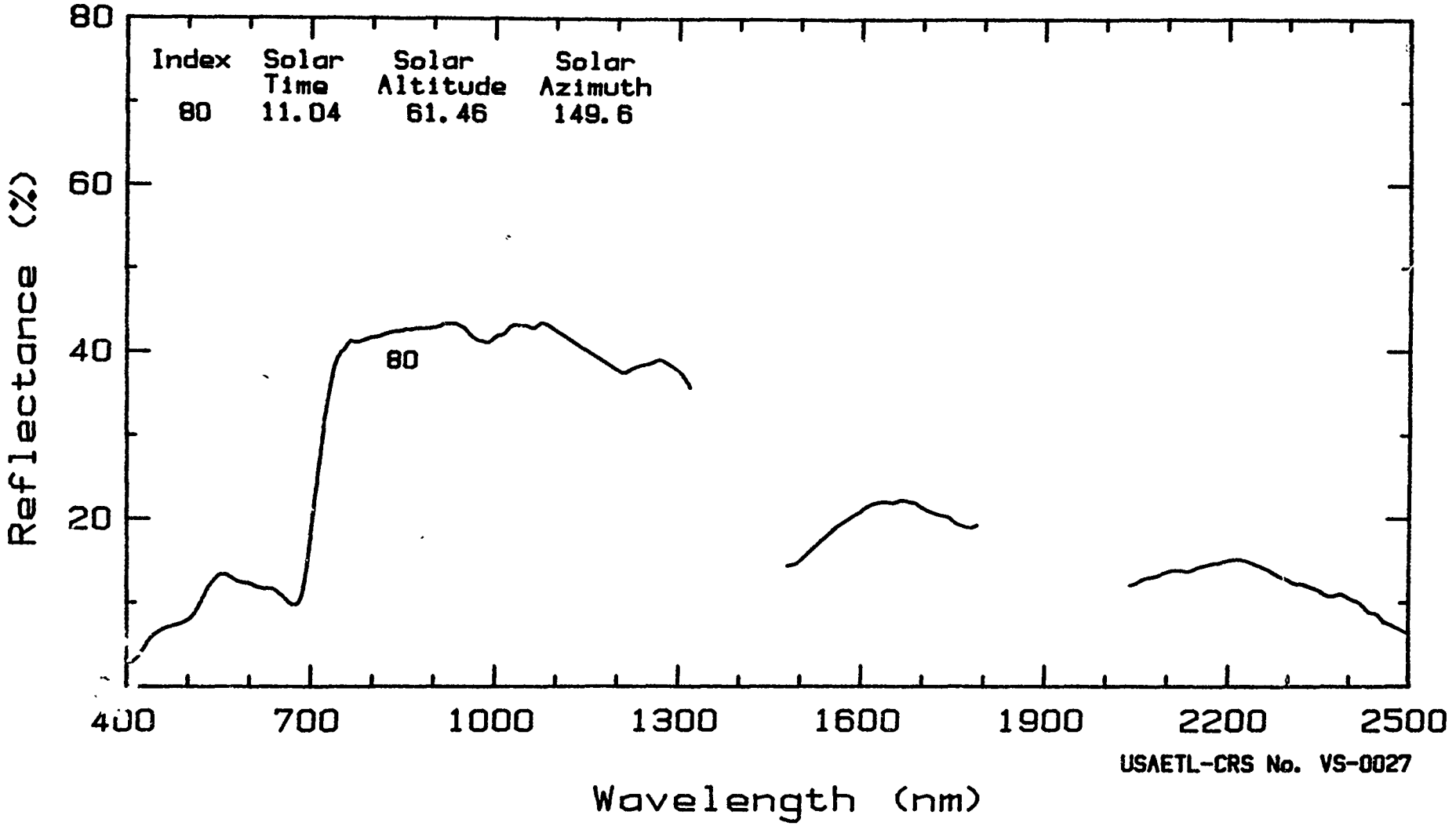
Phenological stage: vegetative, late flowering - early fruiting.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 1.5 m Crown Diameter: 2.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
80	7.7	12.3	10.8	42.1	20.9	13.7

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VS-0027.



Reflectance Spectra of Wax Currant.
Valley of Fire State Park, Lincoln Co., NM; Sep, 1987.

Index of Reflectance Spectra for Vegetation Samples (Grasses)

SPECIES	SHEET NUMBER	SPECTRUM NUMBER
Bush Muhly Grass	VG.0001	87LCS.54
	VG.0002	LJOR.73
	VG.0003	LJOR.103
Burro Grass	VG.0004	LJOR.29, .30
	VG.0005	87LCA.59, .61
	VG.0006	87LCS.30, .31, .35
Tobosa Grass	VG.0007	87LCA.01, .05, .12
		87LCA.17, .58, .60
	VG.0008	87LCS.28, .29, .53
	VG.0009	LJOR.31, .32, .33, .70, .71
Big Galleta Grass	VG.0010	LYUM.29, .30, .38
	VG.0011	87YAA.04, .05, .28
Three Awn Grass	VG.0012	87LCA.21, .30
	VG.0013	87YAA.07, .08, .32, .33
	VG.0014	87LCS.01
	VG.0015	LYUM.22, .23
Black Grama Grass	VG.0016	87LCA.33, .40, .46
	VG.0017	LJOR.57, .58
	VG.0018	87LCS.37, .41, .42
Sand Dropseed Grass	VG.0019	87LCA.18, .51, .55
	VG.0020	87LCS.14, .17
	VG.0021	LJOR.21, .52

Field Reflectance Spectra of Vegetation

Plant Name: Bush muhly grass Date Collected: 31 Aug 1987
Specific Name: Muhlenbergia porteri Scribn.
Spectrum No.: 87LCS.54.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.4 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetation.

Sample: The in situ grass canopy was measured. The canopy consisted of the present year's green leaves and culm, and some dried leaves from the previous year. This is loosely tufted perennial grass with culms 30-50 cm tall and leaf blades 2-4 cm long. Typically the grass grows up within and beneath shrub canopies. The grass canopy was an assemblage of sunlit and shaded green- and tan-colored leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

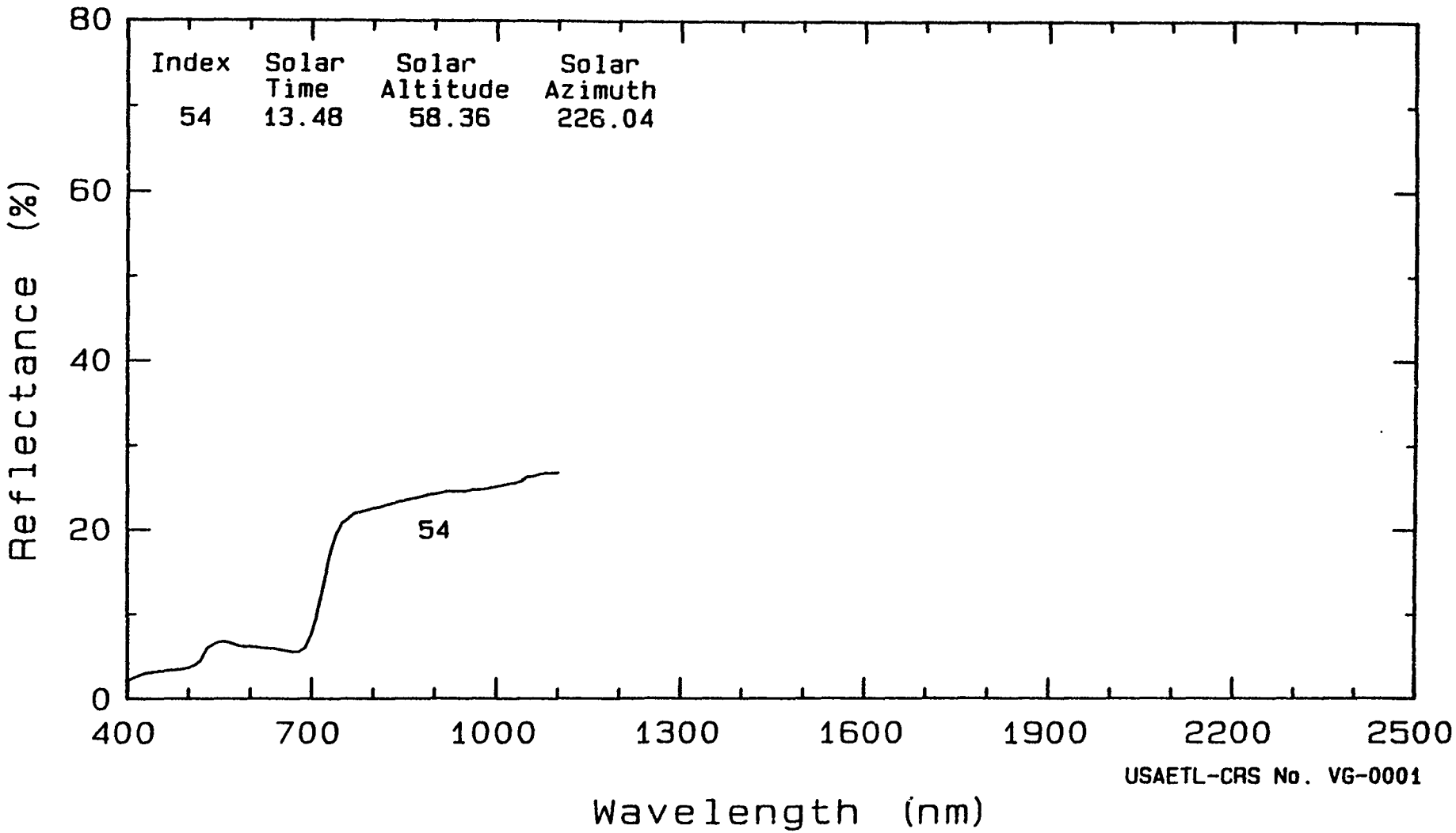
Phenological stage: vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.4 m Crown Diameter: <0.8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
54	3.6	6.2	5.8	23.1		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0001.



Reflectance Spectra of Bush Muhly Grass.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Bush muhly grass Date Collected: 31 Aug 1987
Specific Name: Muhlenbergia porteri Scribn.
Spectrum No.: LJOR.73.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy.

Sample: The in situ grass canopy was measured. The canopy consisted of the present year's green leaves and culm, and some dried leaves from the previous year. This is loosely tufted perennial grass with culms 30-50 cm tall and leaf blades 2-4 cm long. Typically the grass grows up within and beneath shrub canopies. The grass canopy was an assemblage of sunlit and shaded green- and tan-colored leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curve are due to instrument noise related to low signal in these major atmospheric water absorption bands.

Physical & Chemical Properties:

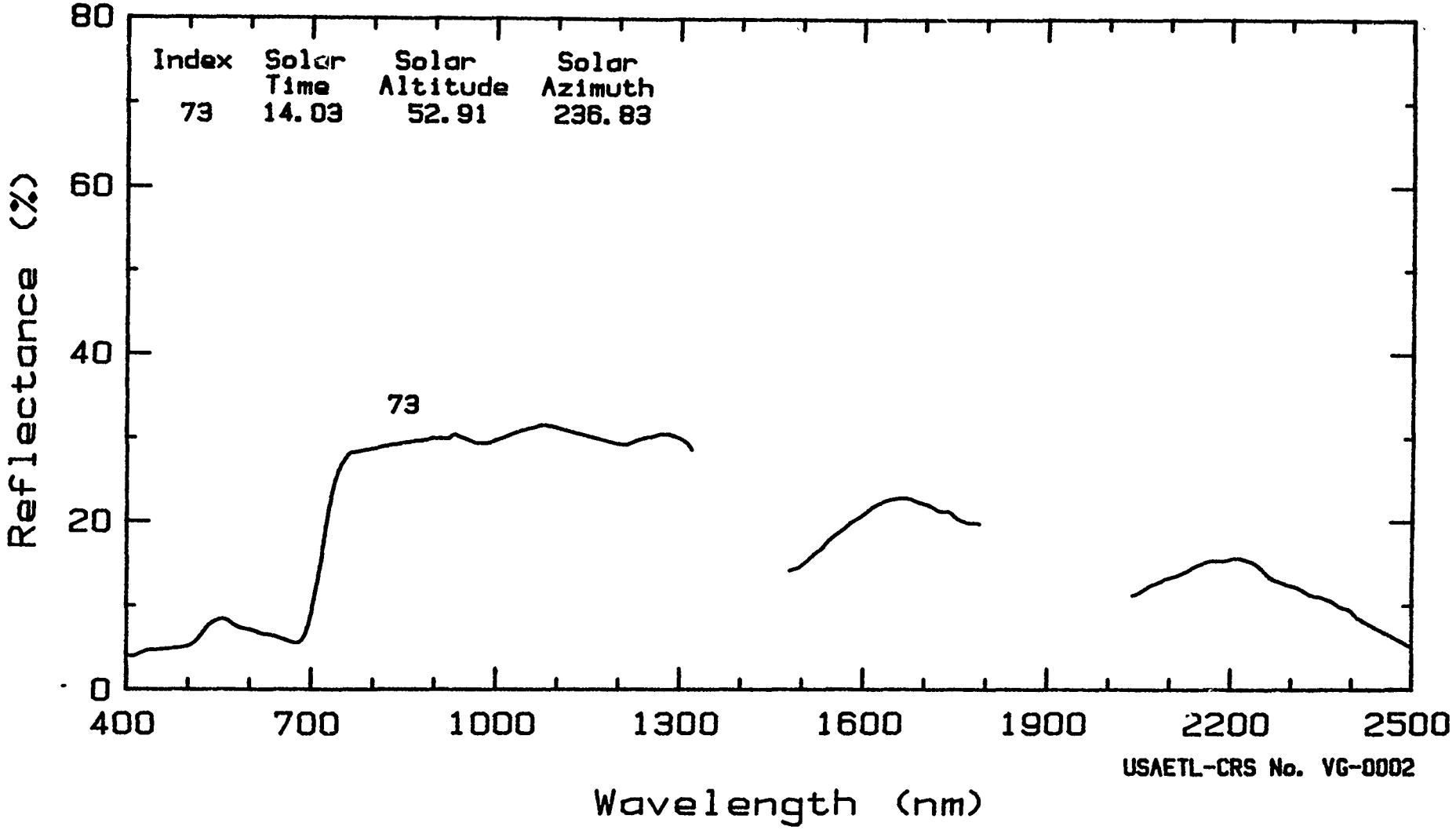
Phenological stage: vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.5 m Crown Diameter: 1.0 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
73	5.2	7.6	6.0	29.1	21.3	14.8

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0002.



Reflectance Spectra of Bush Muhly Grass.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Ring muhly grass Date Collected: 29 Aug 1987
Specific Name: Muhlenbergia torreyi (Kunth) Hitchc.
Spectrum No.: LJOR.103.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopy was measured. The canopy consisted of the present year's green leaves and culm, and some dried leaves from the previous year. The leaf blades are 2-4 cm long and 0.3-0.5 mm wide. Typically the plant canopy was an assemblage of sunlit and shaded green leaves and culms with some tan-colored dry leaves from the previous year. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

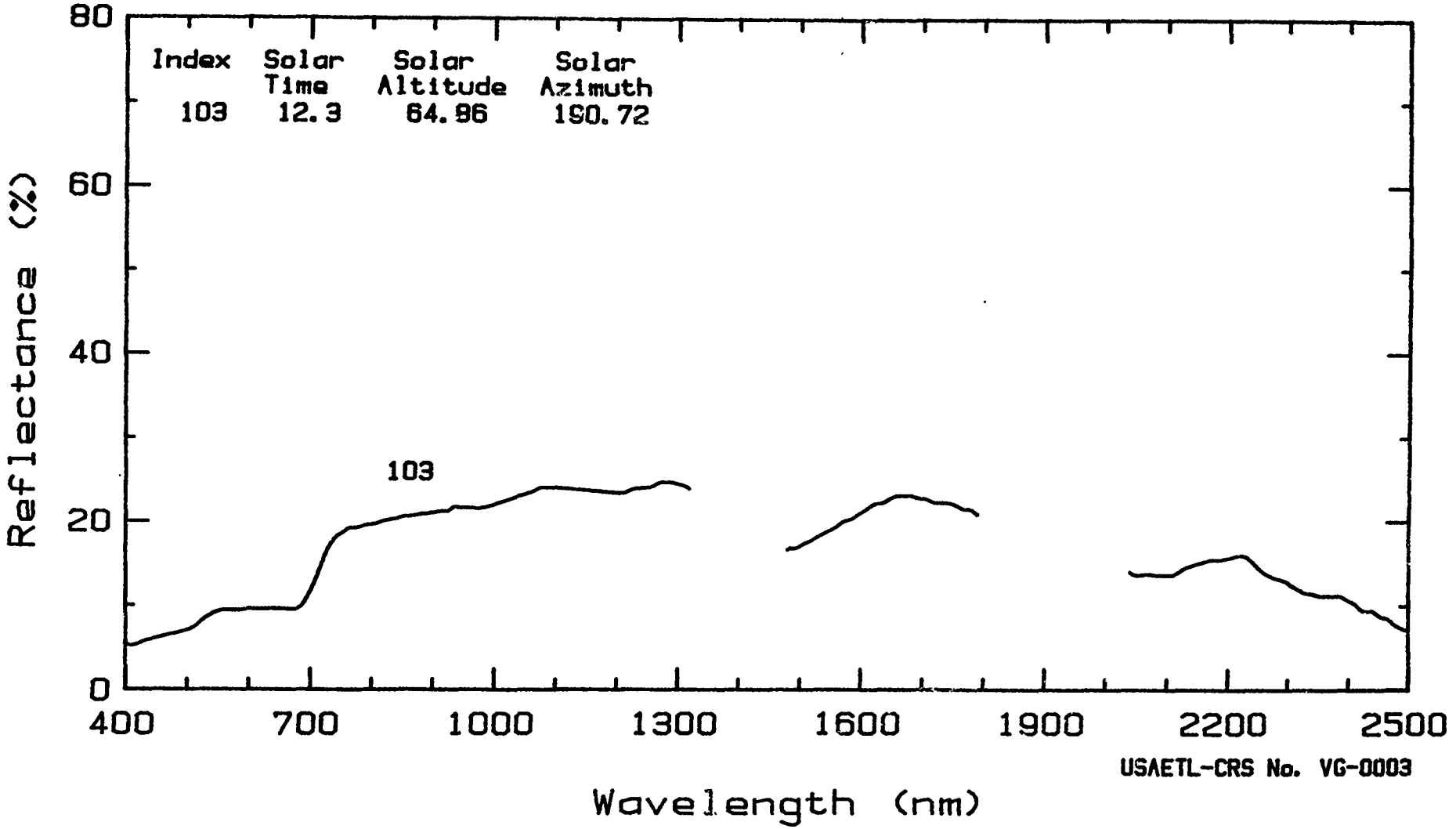
Phenological stage: vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.4 m Crown Diameter: >0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
103	6.8	9.1	9.6	20.1	21.8	14.0

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0003.



Reflectance Spectra of Ring Muhly Grass.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Burro grass Date Collected: 30 Aug 1987
Specific Name: Scleropogon brevifolius Phil.
Spectrum No.: LJOR.29, .30.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was an essentially 100% vegetative cover.

Sample: The in situ grass canopy was measured. The canopy consisted of equal portions of the present year's blue-green leaves and the previous year's dried, gray-colored leaves. The plant forms extensive cover of tightly-tufted plants on ephemeral lake beds. Leaf blades are 15-70 mm long, 1.5 to 2.5 mm wide. The culms are usually 10-20 cm tall but foliage is <15 cm. tall. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

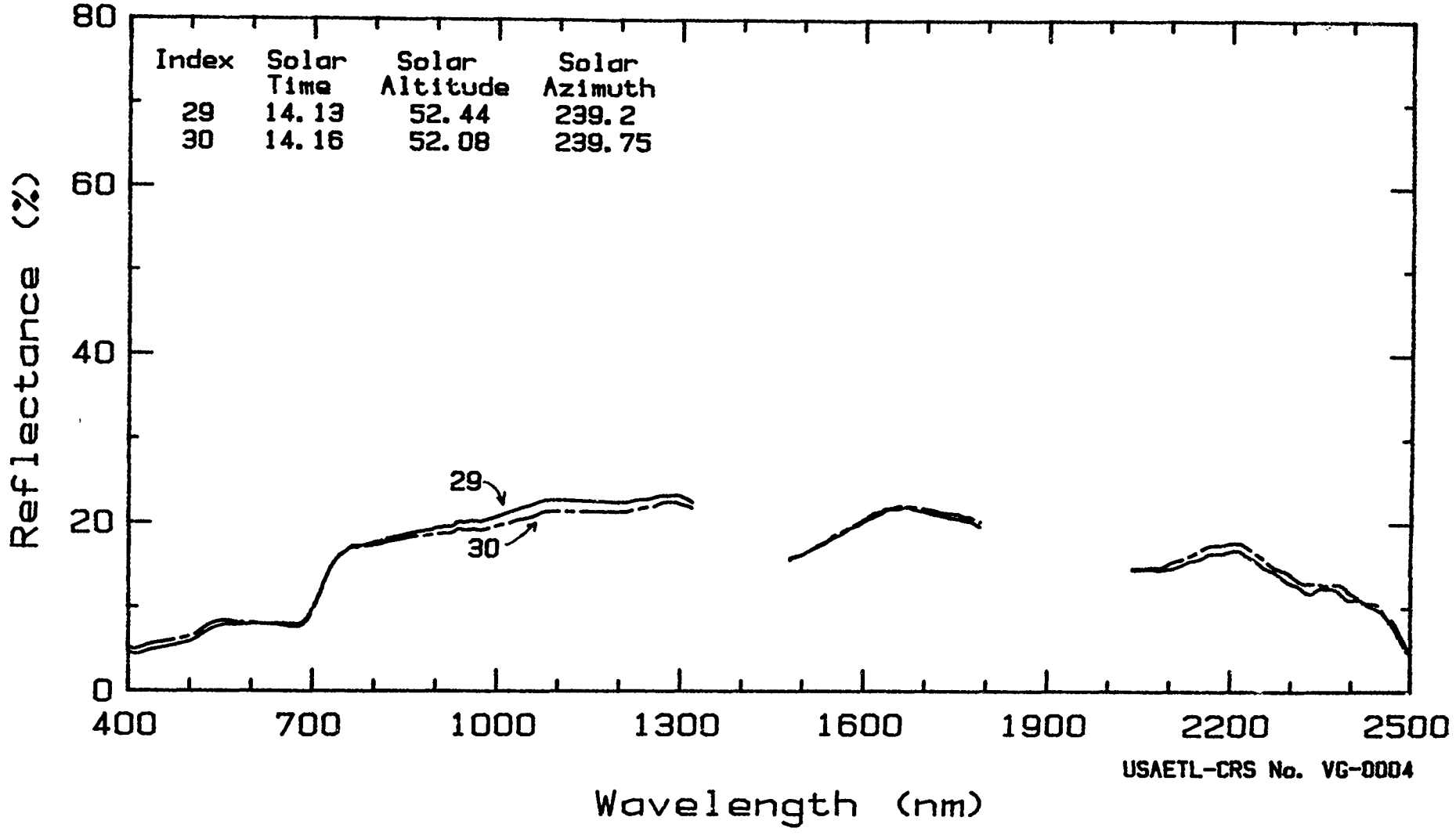
Phenological stage: vegetative, active growth; early flower initiation.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
29	5.7	7.6	8.0	18.2	20.7	14.8
30	6.2	8.0	7.8	17.8	21.0	15.6

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0004.



Reflectance Spectra of Burrograss.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Burro grass Date Collected: 5 Apr 1987
Specific Name: Scleropogon brevifolius Phil.
Spectrum No.: 87LCA.59, .61.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The *in situ* grass canopy was measured. It consisted of the previous year's dried, gray-colored leaves. The plant forms an extensive cover of tightly-tufted plants on epheremal lake beds. Leaf blades are 15-70 mm long, 1.5 to 2.5 mm wide. The culms are usually 10-20 cm tall but foliage is <10 cm tall. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

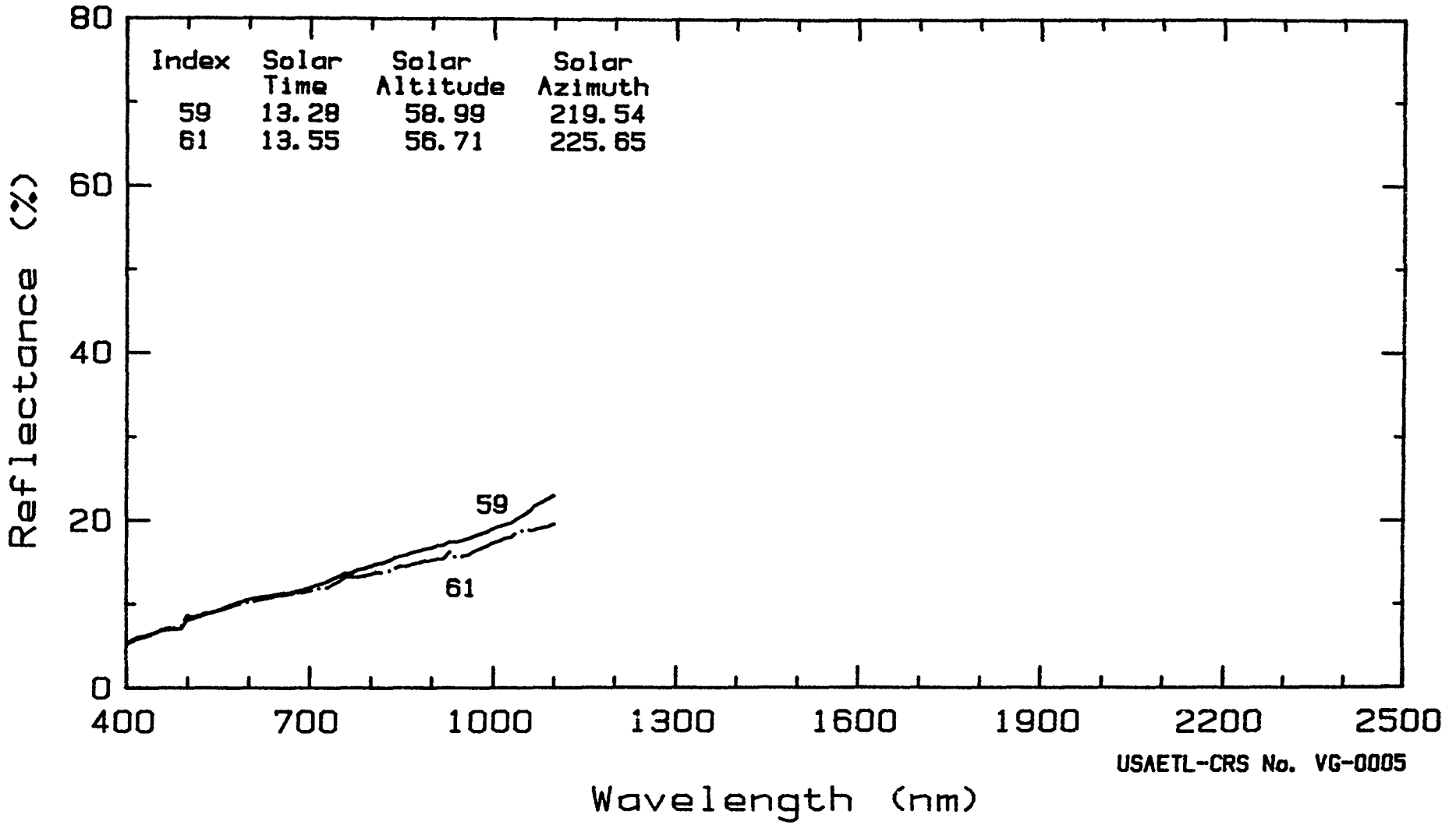
Physical & Chemical Properties:

Phenological stage: vegetative, active growth, early flower.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
59	7.4	9.5	11.3	15.2		
61	7.6	9.5	11.1	14.1		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0005.
USAETL-RI-RSD



Reflectance Spectra of Burrograss.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Burro grass Date Collected: 30 Aug 1987
Specific Name: Scleropogon brevifolius Phil.
Spectrum No.: 87LCS.30, .31, .35.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopy was measured. It consisted of equal portions of the present year's blue-green leaves and the previous year's dried, gray-colored leaves. The plant forms extensive cover of tightly-tufted plants on epheremal lake beds. Leaf blades are 15-70 mm long, 1.5 to 2.5 mm wide. The culms are usually 10-20 cm tall but foliage is <15 cm tall. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

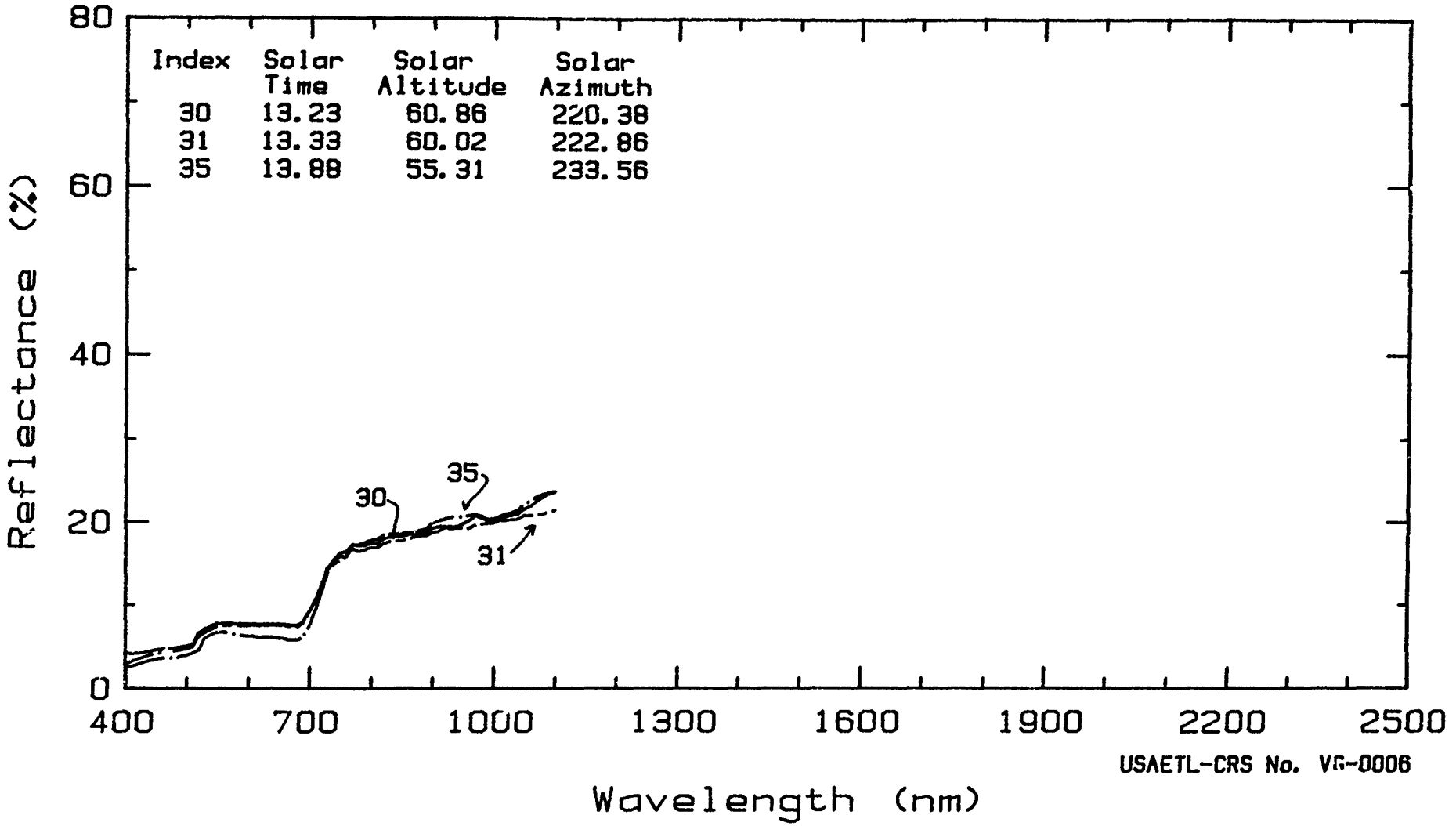
Phenological stage: vegetative, active growth, early flower.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.4.m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
30	5.1	7.5	7.7	17.9		
31	4.7	7.2	7.6	17.4		
35	3.8	6.2	6.0	18.3		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0006.



Reflectance Spectra of Burrograss.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tobosa grass Date Collected: 5 Apr 1987
Specific Name: Hilaria mutica (Buckl.) Benth.
Spectrum No.: 87LCA.01, .05, .12, .17, .58, .60.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopy was measured. The canopy consisted of the previous year's leaves that were dried and gray colored. The grass canopy was short and when viewed from the vertical or horizontal was a rather dense mat of tufted grasses. The leaves are 2-3 mm wide and culms are 30 to 60 cm tall. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

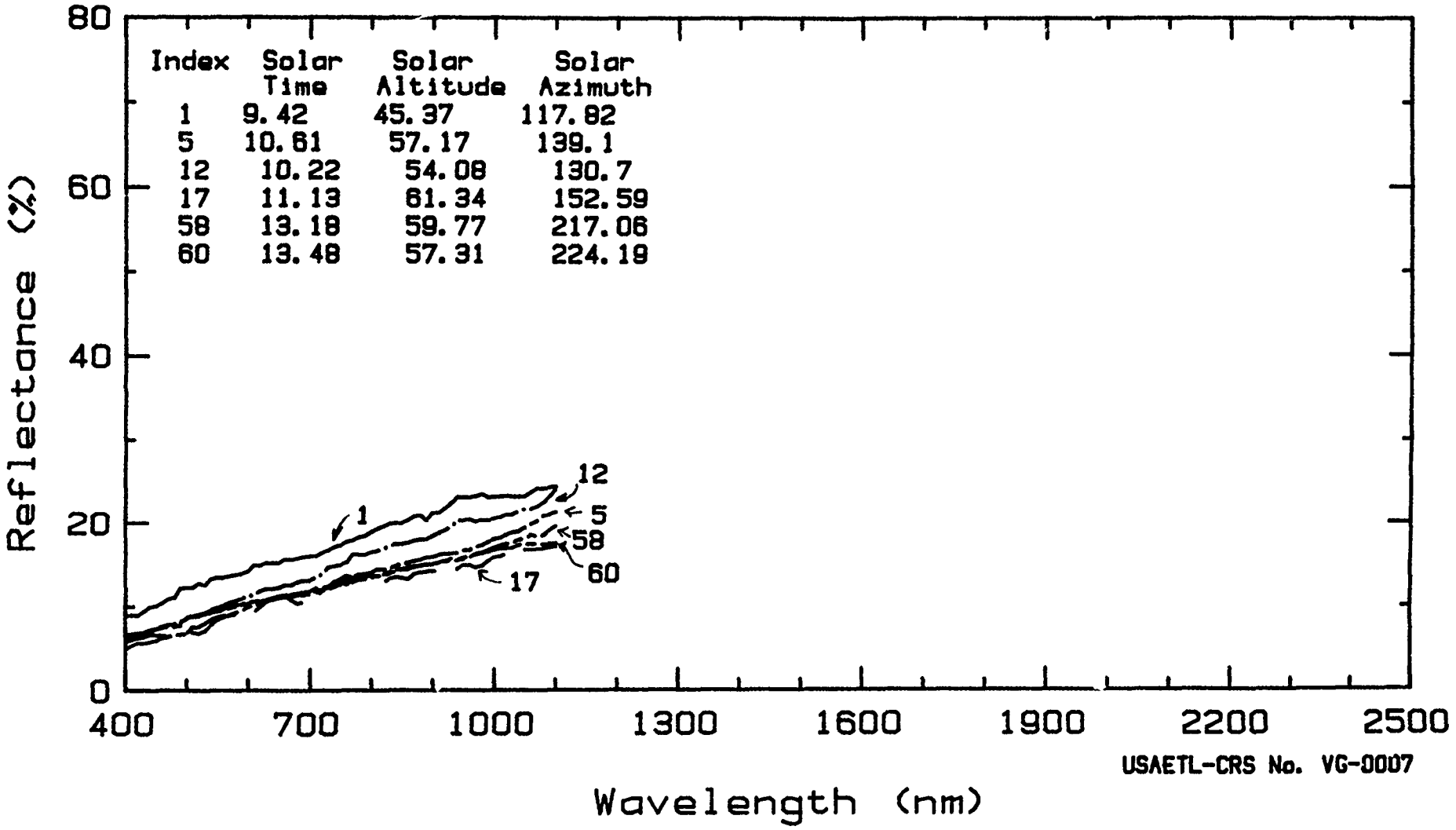
Physical & Chemical Properties:

Phenological stage: vegetative, dormant
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	11.5	13.5	15.6	19.6		
5	8.1	9.8	11.4	14.7		
12	8.2	10.2	12.6	17.2		
17	6.7	8.8	10.8	13.6		
58	8.0	9.7	11.2	14.0		
60	6.7	8.5	11.2	14.1		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0007.
USAETL-RI-RSD



Reflectance Spectra of Tobosa Grass.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tobosa grass Date Collected: 30 Aug 1987
Specific Name: Hilaria mutica (Buckl.) Benth.
Spectrum No.: 87LCS.28, .29, .53.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopy was measured. The canopy consisted of about equal portion of the present year's blue-green foliage and the previous year's gray colored foliage. The grass canopy was short and when viewed from the vertical or horizontal formed a rather dense mat of tufted grasses. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

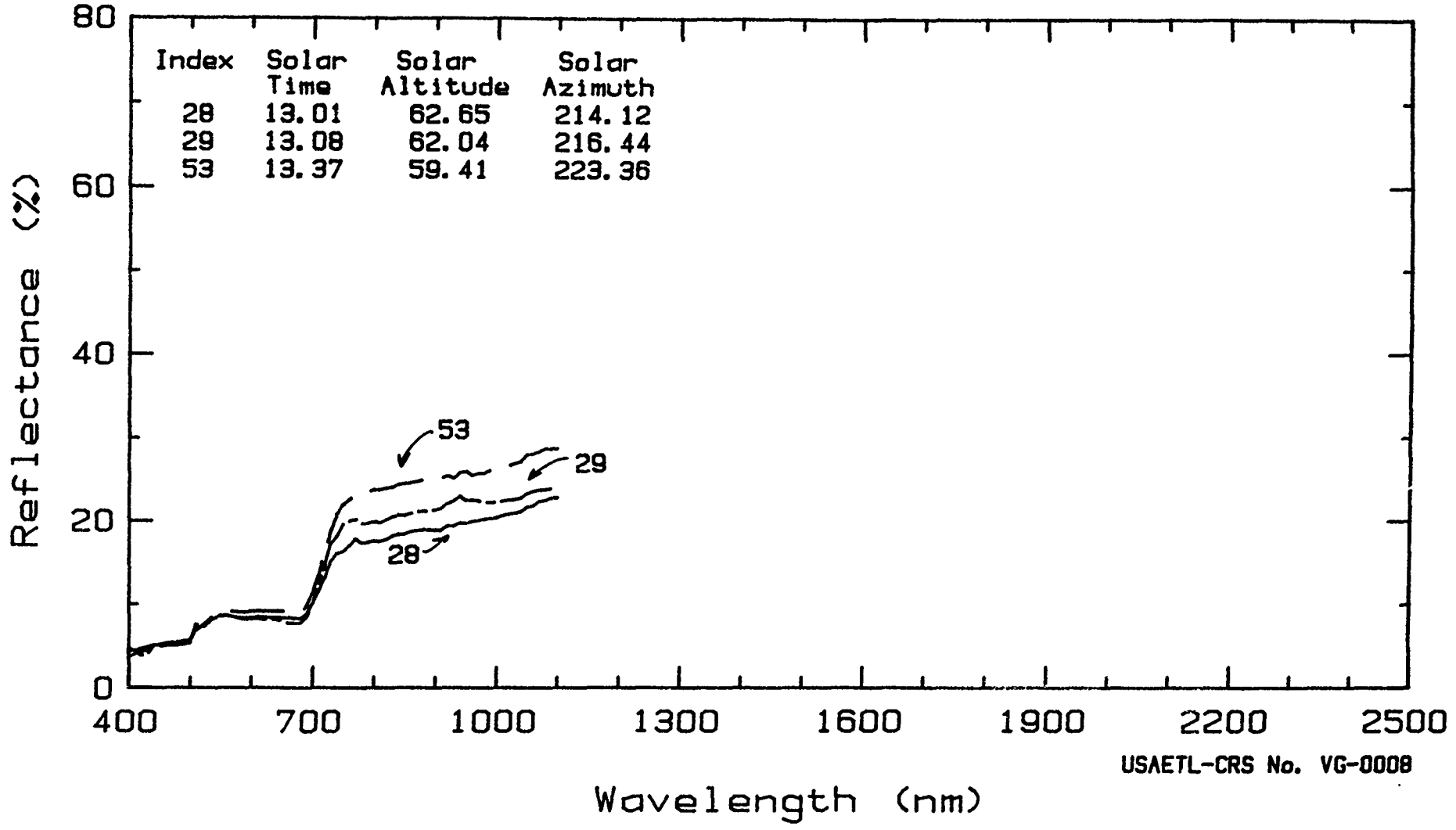
Phenological stage: vegetative, active growth.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
28	5.8	8.3	8.4	18.1		
29	5.7	8.2	7.9	20.5		
53	5.7	8.8	9.2	24.1		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0008.



Reflectance Spectra of Tobosa Grass.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Tobosa grass Date Collected: 30 Aug 1987
Specific Name: Hilaria mutica (Buckl.) Benth.
Spectrum No.: LJOR.31, .32, .33, .70, .71.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level.

Sample: The in situ grass canopy was measured. The canopy consisted of about equal portions of the present year's blue-green leaves and the previous year's dried, gray colored leaves. The radiometer was positioned above the canopy so the vegetation filled the FOV. Spectrum #33 was of a dry, gray-colored grass cover. Typically the plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to instrument noise related to low signal in these major atmospheric water absorption bands.

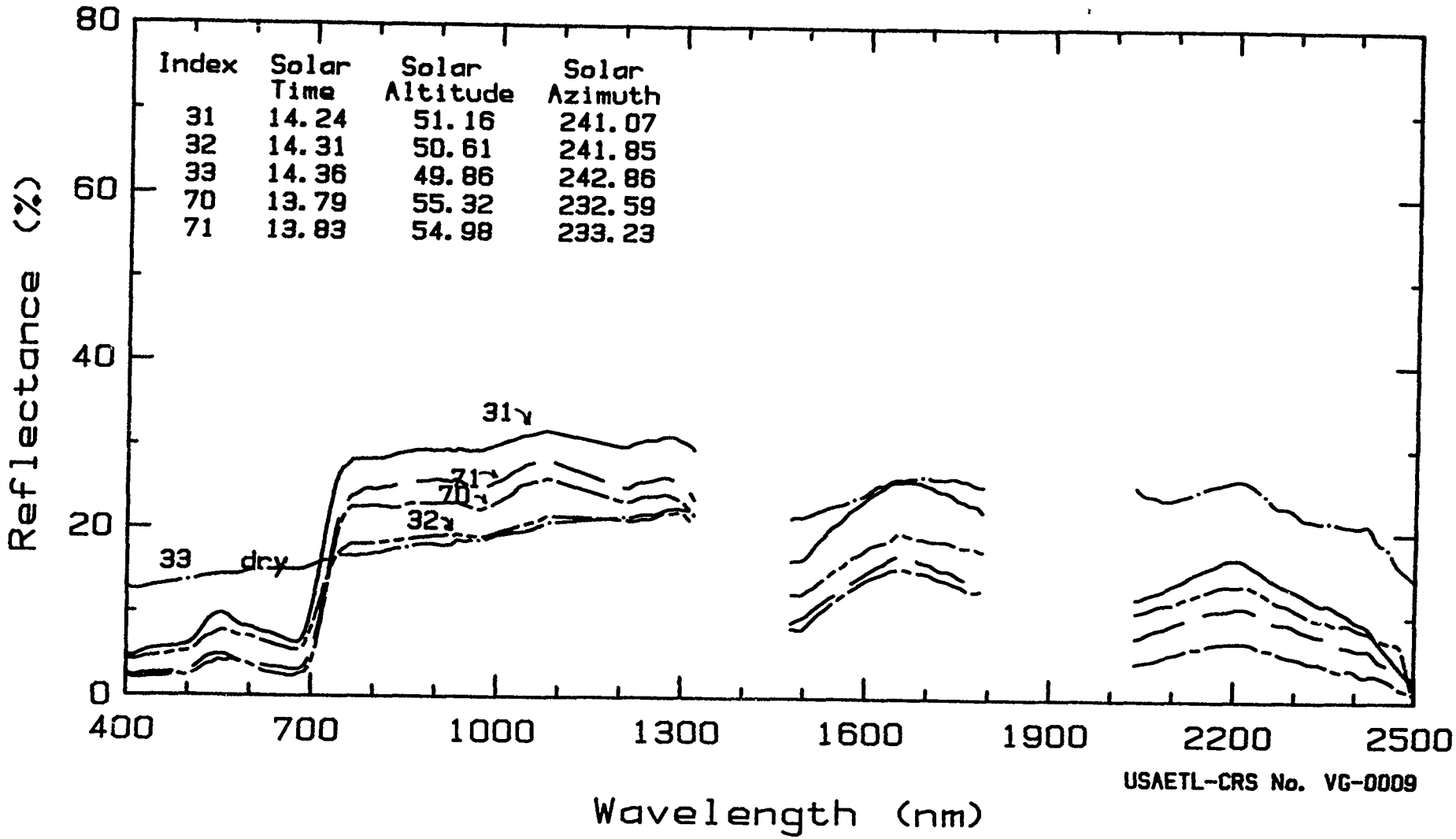
Physical & Chemical Properties:

Phenological stage: Vegetative, active growth.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.2 m Crown Diameter: >0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
31	6.0	8.9	6.9	28.8	24.4	14.6
32	5.2	7.2	5.8	18.5	18.2	12.1
33	13.5	14.4	15.1	17.4	25.4	24.2
70	2.4	3.9	2.6	22.7	14.2	6.0
71	3.0	4.4	3.3	25.0	15.4	9.6

Compiled by: Melvin B. Satterwhite Sheet No.: VG-0009.
USAETL-RI-RSD



Reflectance Spectra of Tobosa Grass.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Big galleta grass Date Collected: 25 Aug 1987
Specific Name: Hilaria rigida (Torr.) Benth.
Spectrum No.: LYUM.29, .30, .38.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopy was measured. The canopy consisted of the present year's senesced vegetation, which was dry, tan-colored leaves and culms. The canopies were stout, bunch grasses, with rigid leaf blades 2.5- 6 cm long and 2-4 mm wide, and rigid, woody culms. The plant canopy was an assemblage of sunlit and shaded leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

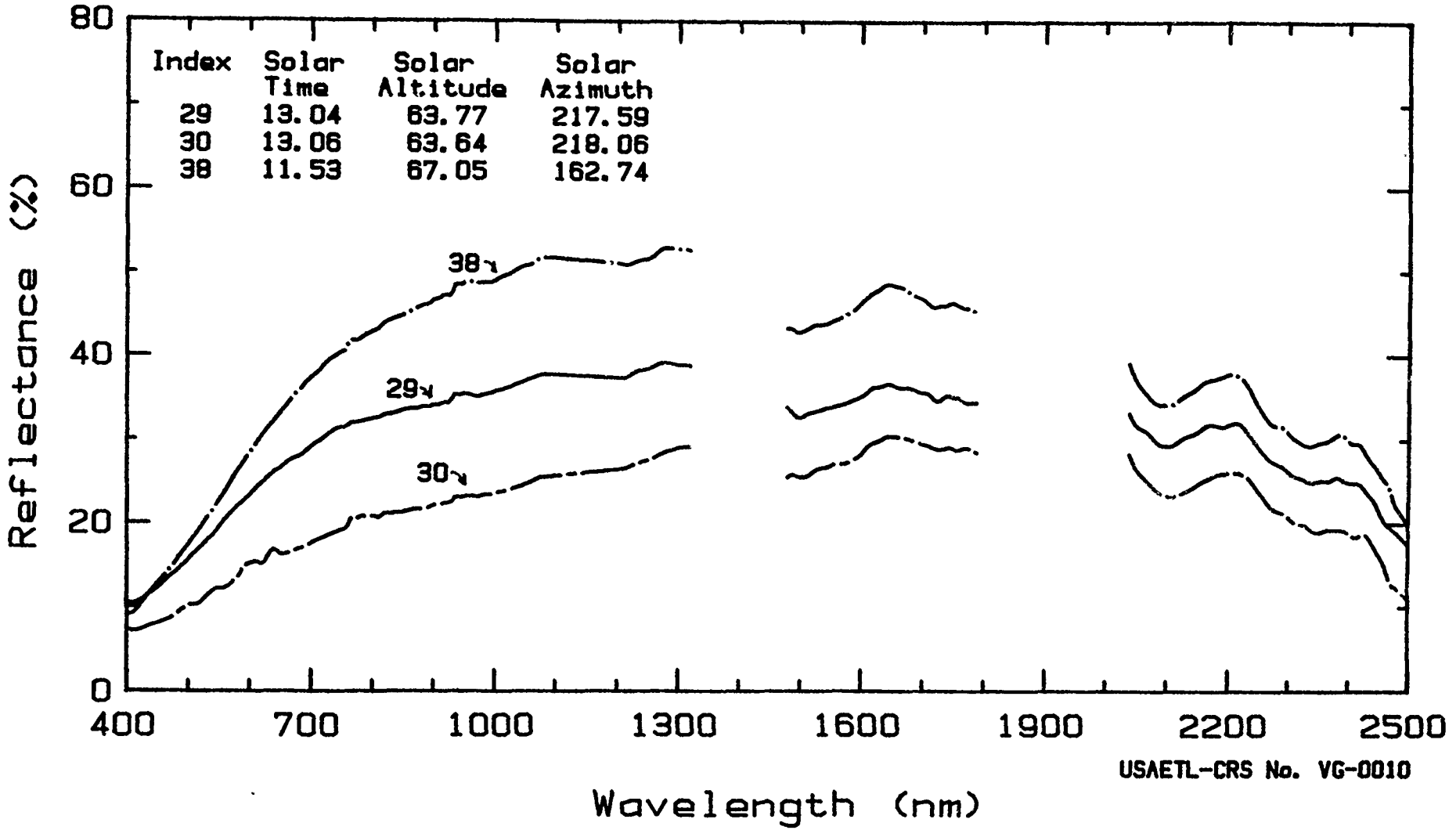
Phenological stage: vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 1.0 m Crown Diameter: 0.7 to 0.9 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
29	14.5	20.2	27.0	33.0	35.4	29.1
30	9.3	12.6	16.5	21.1	29.0	23.2
38	15.9	23.7	33.9	44.0	46.6	34.1

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0010.



Reflectance Spectra of Big Galleta Grass.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Big galleta grass Date Collected: 25 Aug 1987
Specific Name: Hilaria rigida (Torr.) Benth.
Spectrum No.: 87YAA.04, .05, .28.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover

Sample: The in situ grass canopy was measured. The canopy consisted of the present year's senesced vegetation, which was dry, tan-colored leaves and culms. The canopies were stout, bunch grasses, with rigid leaf blades 2.5- 6 cm long and 2-4 mm wide, and rigid, woody culms. The plant canopy was an assemblage of sunlit and shaded leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

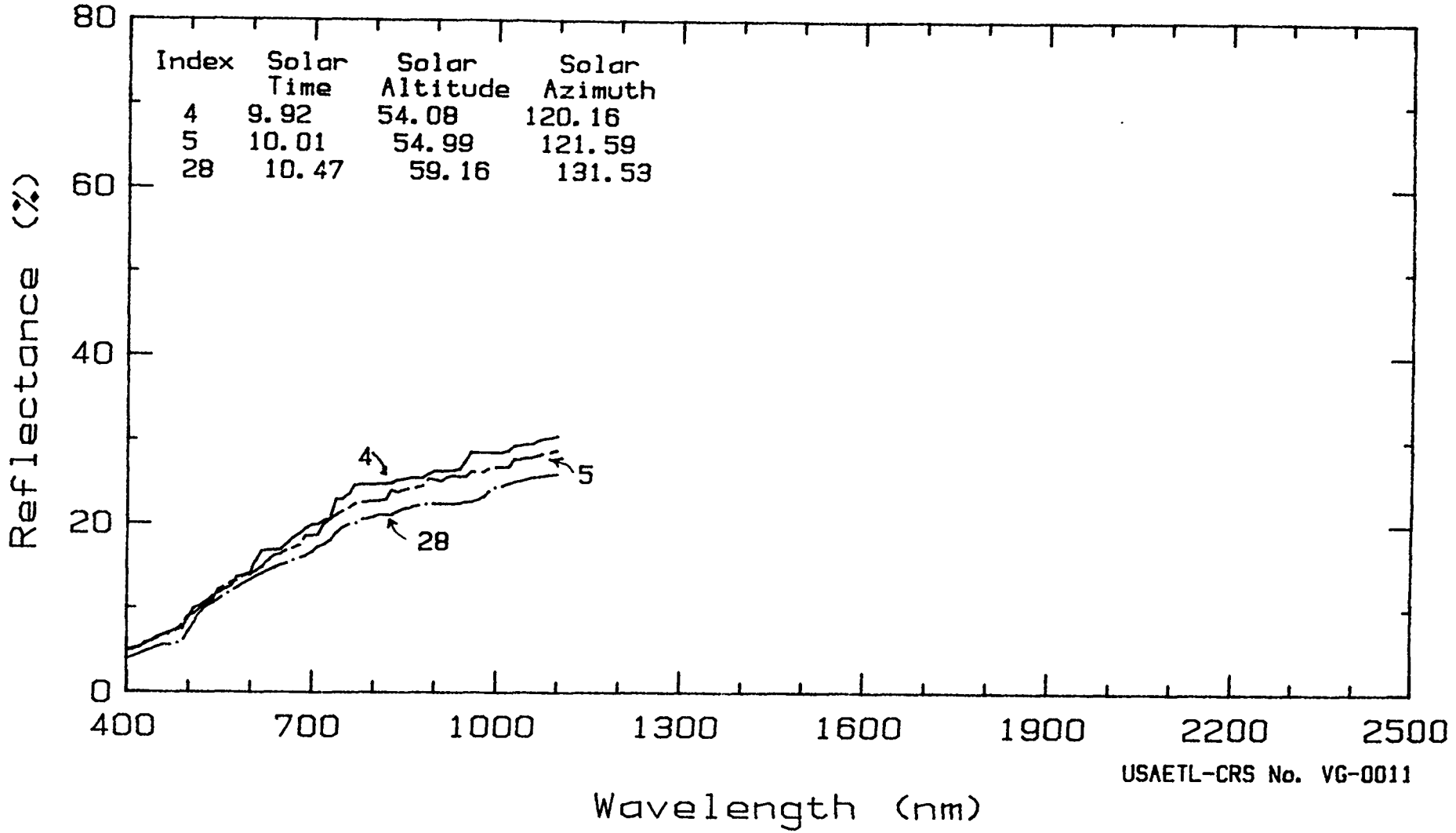
Physical & Chemical Properties:

Phenological stage: vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 1.0 m Crown Diameter: 0.7 to 0.9 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
4	8.0	12.3	17.8	24.9		
5	8.1	12.3	16.9	23.6		
28	6.7	11.5	15.4	21.3		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0011.
USAETL-RI-RSD



Reflectance Spectra of Big Galleta Grass.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Three awn grass Date Collected: 7 Apr 1987
Specific Name: Aristida sp.
Spectrum No.: 87LCA.21, .30.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: In situ plant canopies were measured for this perennial, short bunch grass species. The canopy consisted of this year's vegetation, which was senesced, dry, tan-colored or gray-colored leaves and culms. Leaves were flexible 4-10 cm long. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

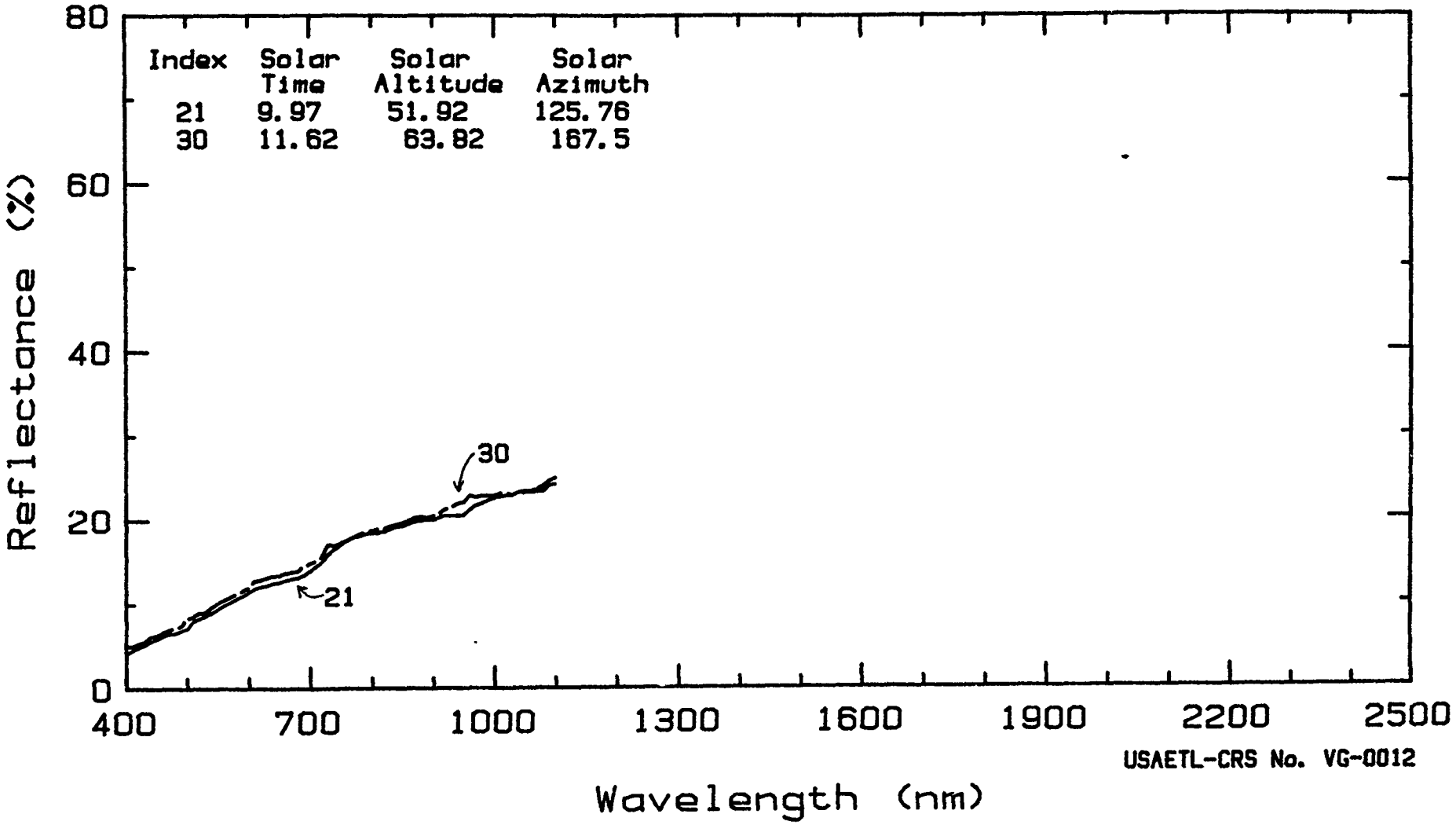
Phenological stage: vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.4 m Crown Diameter: 0.3 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
21	7.0	9.9	12.9	19.0		
30	7.6	10.5	13.8	19.3		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0012.



Reflectance Spectra of Three Awn Grass.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Three awn grass Date Collected: 25 Aug 1987
Specific Name: Aristida sp. L.
Spectrum No.: 87YAA.07, .08, .32, .33.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopy was measured. The canopy consisted of this year's vegetation, which was senesced, dry, tan-colored (curves 7,32) or gray-colored (curves 8,33) leaves and culms. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

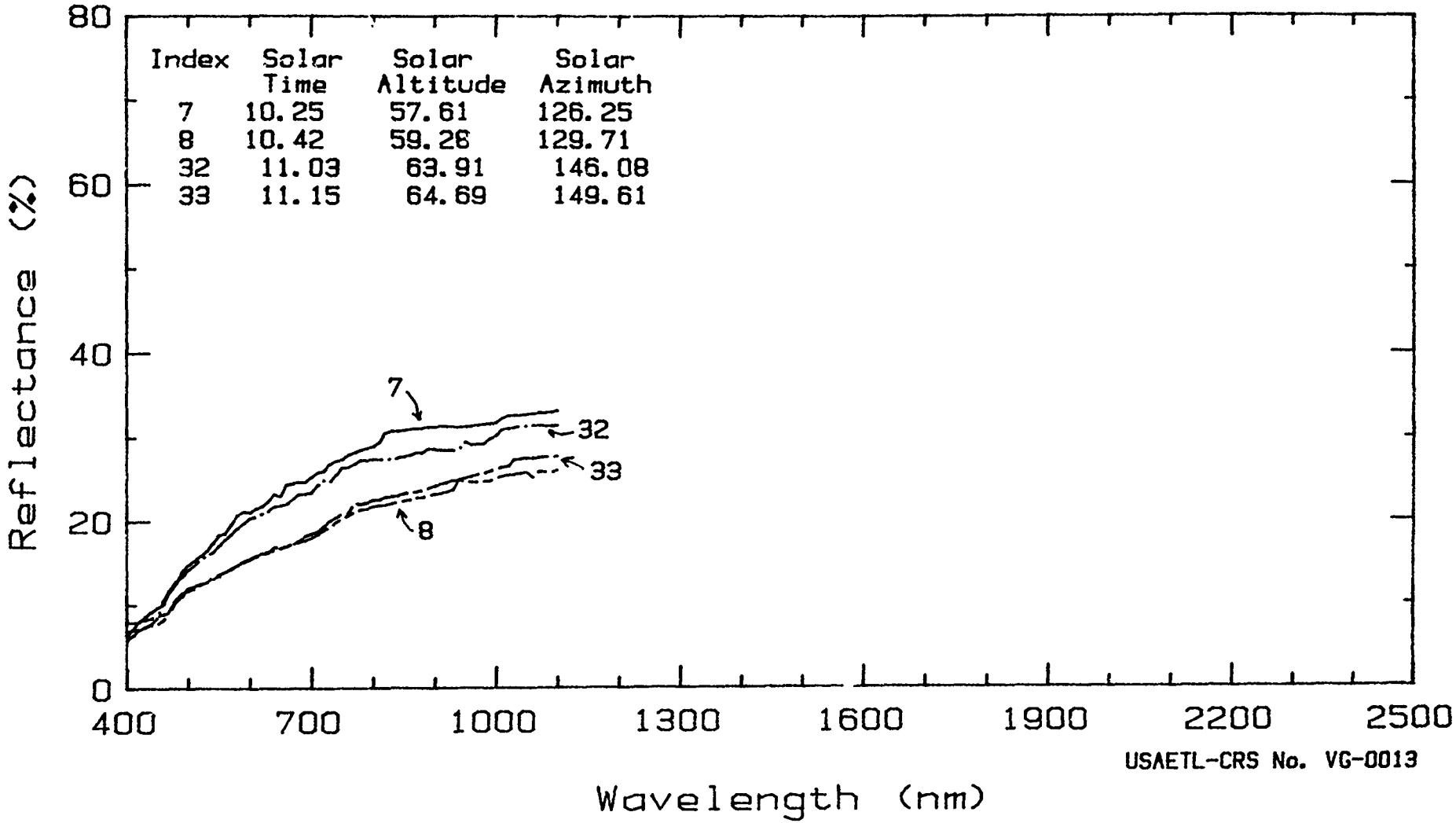
Physical & Chemical Properties:

Phenological stage: vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.5 m Crown Diameter: 0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
7	13.0	18.8	23.8	30.1		
8	10.6	14.0	17.2	23.0		
32	12.6	17.8	22.3	27.7		
33	10.4	14.0	17.1	22.2		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0013.
USAETL-RI-RSD



Reflectance Spectra of Three Awn Grass.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Three awn grass Date Collected: 29 Aug 1987
Specific Name: Aristida sp. L.
Spectrum No.: 87LCS.01.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopy was measured. The canopy consisted of this year's green vegetation, with some tan-colored leaves from the previous year. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

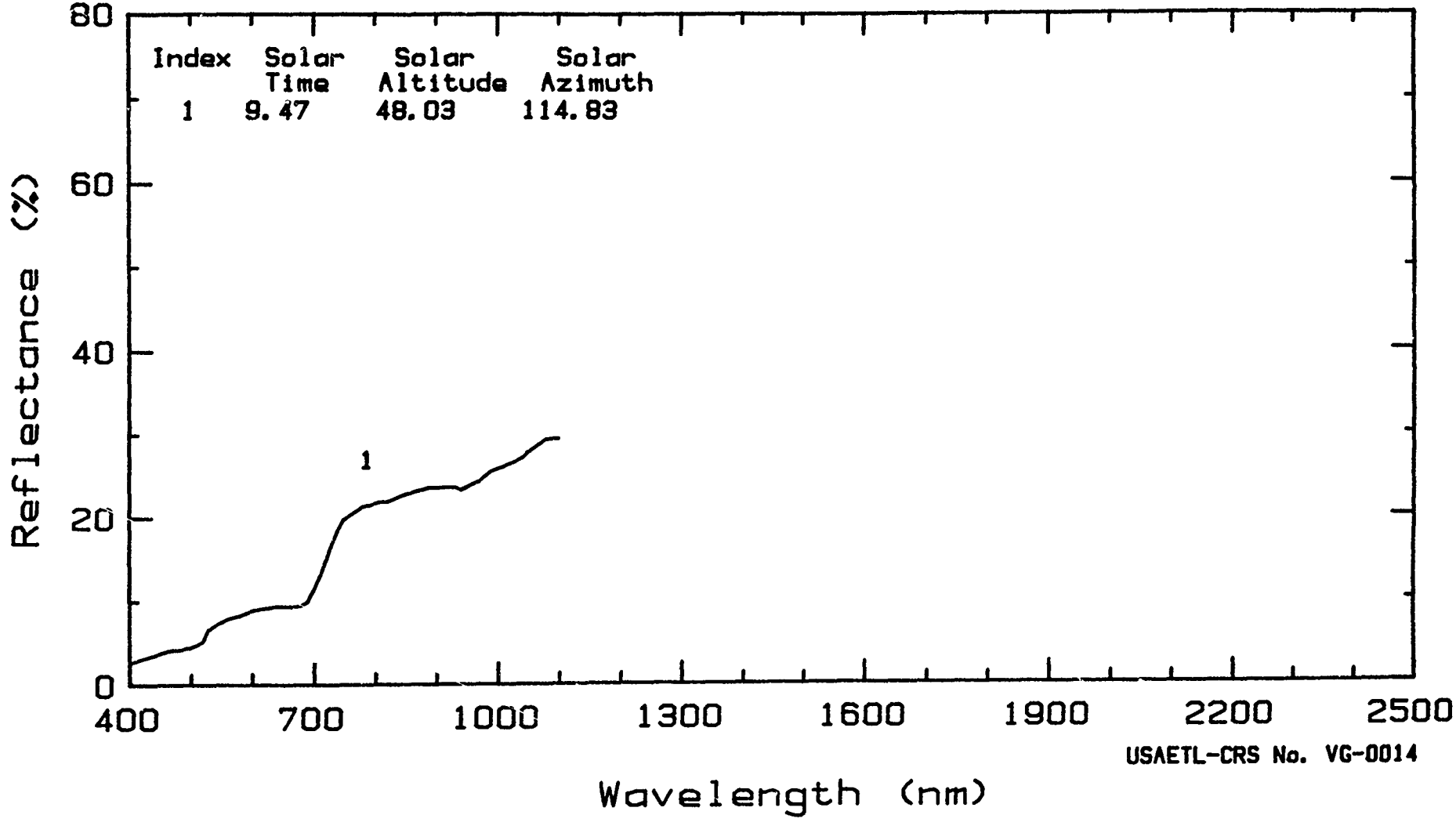
Phenological stage: vegetative, green, flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.2 to 0.4 m Crown Diameter: <0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	4.4	7.6	9.5	22.3		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0014.



Reflectance Spectra of Three Awn Grass.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Three awn grass Date Collected: 25 Aug 1987
Specific Name: Aristida sp. L.
Spectrum No.: LYUM.22, .23.

Site Location: Marine Air Station, Yuma, AZ, USA.
32° 5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:Rb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopy was measured. The present year's senesced vegetation consisted of dry, tan colored leaves and culms (curves 22 & 23). In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to instrument noise related to low signal in these major atmospheric water absorption bands.

Physical & Chemical Properties:

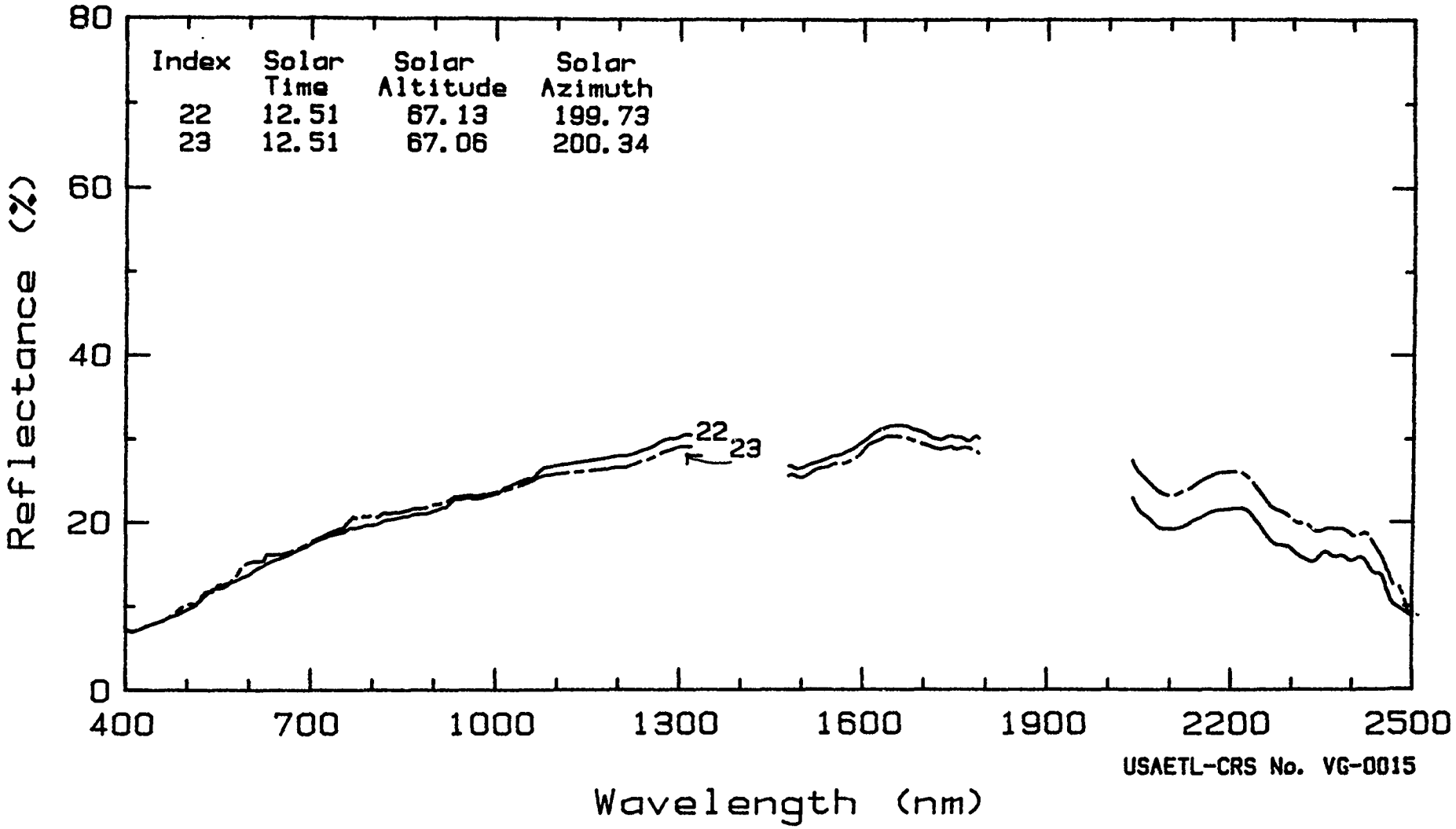
Phenological stage: Vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.5 m Crown Diameter: 0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
22	9.8	13.2	17.4	21.0	31.0	19.4
23	10.0	13.4	18.0	21.9	29.8	23.6

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0015.



Reflectance Spectra of Three Awn Grass.
Marine Air Station, Yuma Co., AZ; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Black grama grass Date Collected: 7 Apr 1987
Specific Name: Bouteloua eriopoda (Torr.) Torr.
Spectrum No.: 87LCA.33, .40, .46.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G Spectroradiometer, Model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopies of this tufted perennial grass species were measured. The canopies consisted of the previous year's senesced, dry, tan- and gray-colored leaves and culms. The leaves were 2-10 cm long and 1-2 mm wide, and culms were sprawling, strongly genuflexed and unbranched above the base. The canopy was porous, but when viewed from the vertical or oblique, the canopy had a dense cover, often times over large areas. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

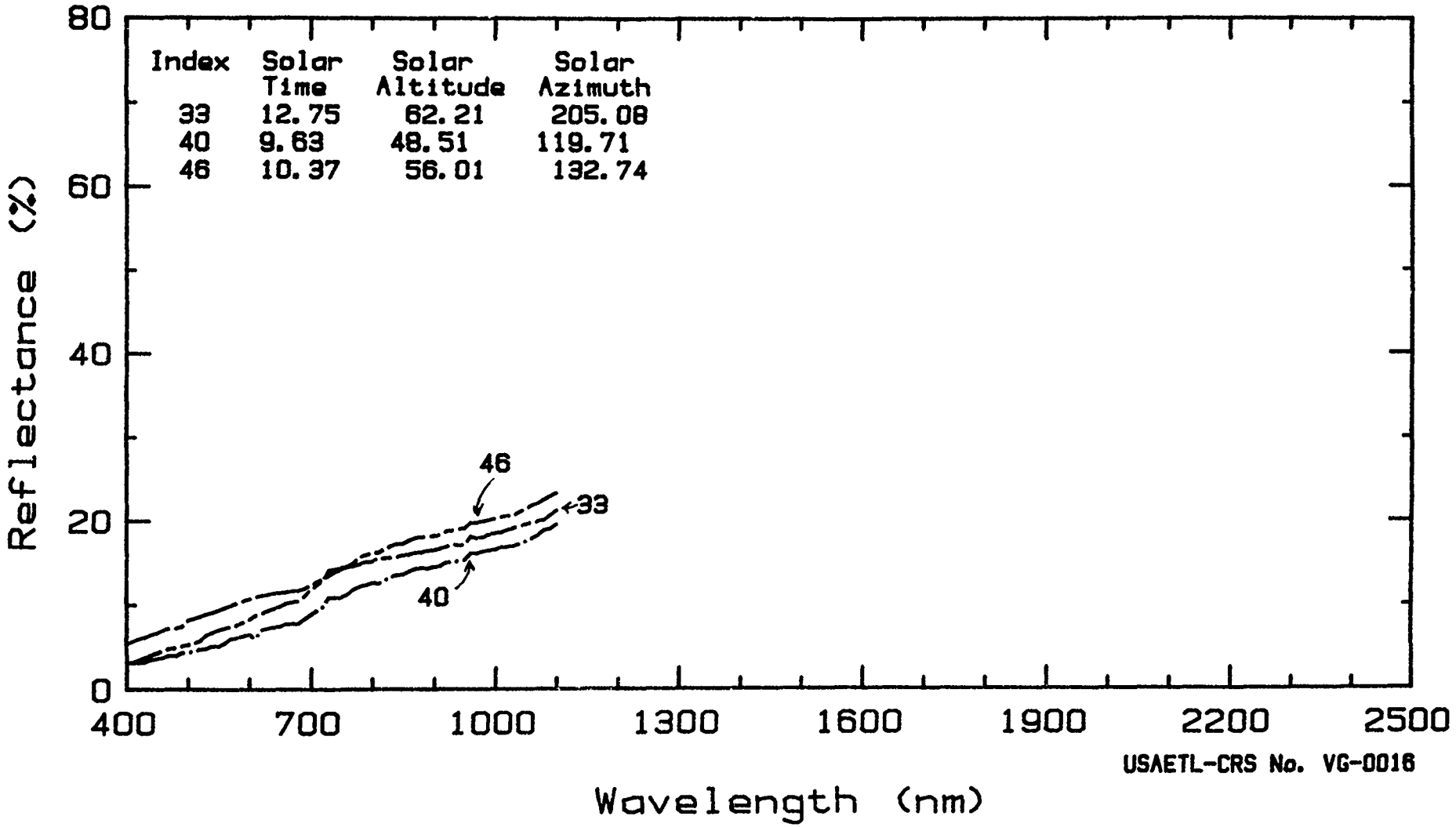
Physical & Chemical Properties:

Phenological stage: vegetative, dormant.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.3 m Crown Diameter: 0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
33	7.6	9.7	11.6	15.6		
40	4.2	5.6	7.7	13.2		
46	5.1	7.2	10.2	16.9		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0016.
USAETL-RI-RSD



Reflectance Spectra of Black Grama Grass.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Black grama grass Date Collected: 31 Aug 1987
Specific Name: Bouteloua eriopoda (Torr.) Torr.
Spectrum No.: LJOR.57, .58.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopies were measured for this perennial, tufted grass species. The canopies consisted of the present year's green vegetation, although some vegetation was the previous year's leaves and culm that had now turned gray in color. The leaves were 2-10 cm long and 1-2 mm wide. The culms were sprawling, strongly genuflexed and unbranched above the base. These dense canopies were an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

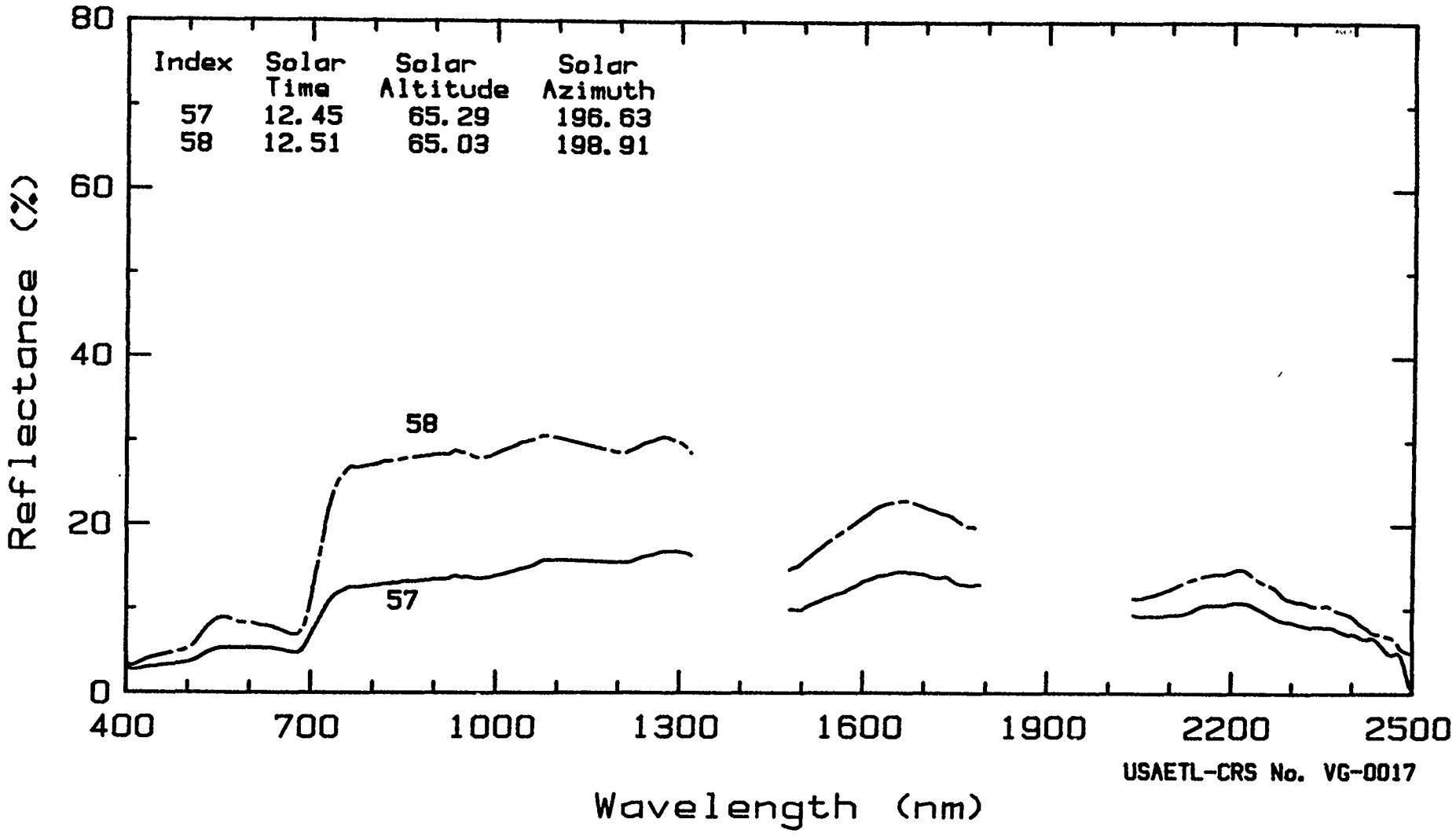
Phenological stage: vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.5 m Crown Diameter: 0.6 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
57	3.5	5.1	5.0	13.0	13.5	9.5
58	5.0	8.3	7.3	27.5	21.4	12.8

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0017.



Reflectance Spectra of Black Grama Grass.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Black grama grass Date Collected: 31 Aug 1987
Specific Name: Bouteloua eriopoda (Torr.) Torr.
Spectrum No.: 87LCS.37, .41, .42.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: In situ canopies of this perennial, tufted grass species were measured. The canopy consisted of green vegetation and some of the senesced, dry, gray-colored leaves and culms from the previous year. The leaves were 2-10 cm long and 1-2 mm wide. Culms were sprawling, strongly genuflexed and unbranched from the base. The canopy appears rather dense when viewed from the vertical or oblique, even though it is rather porous. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

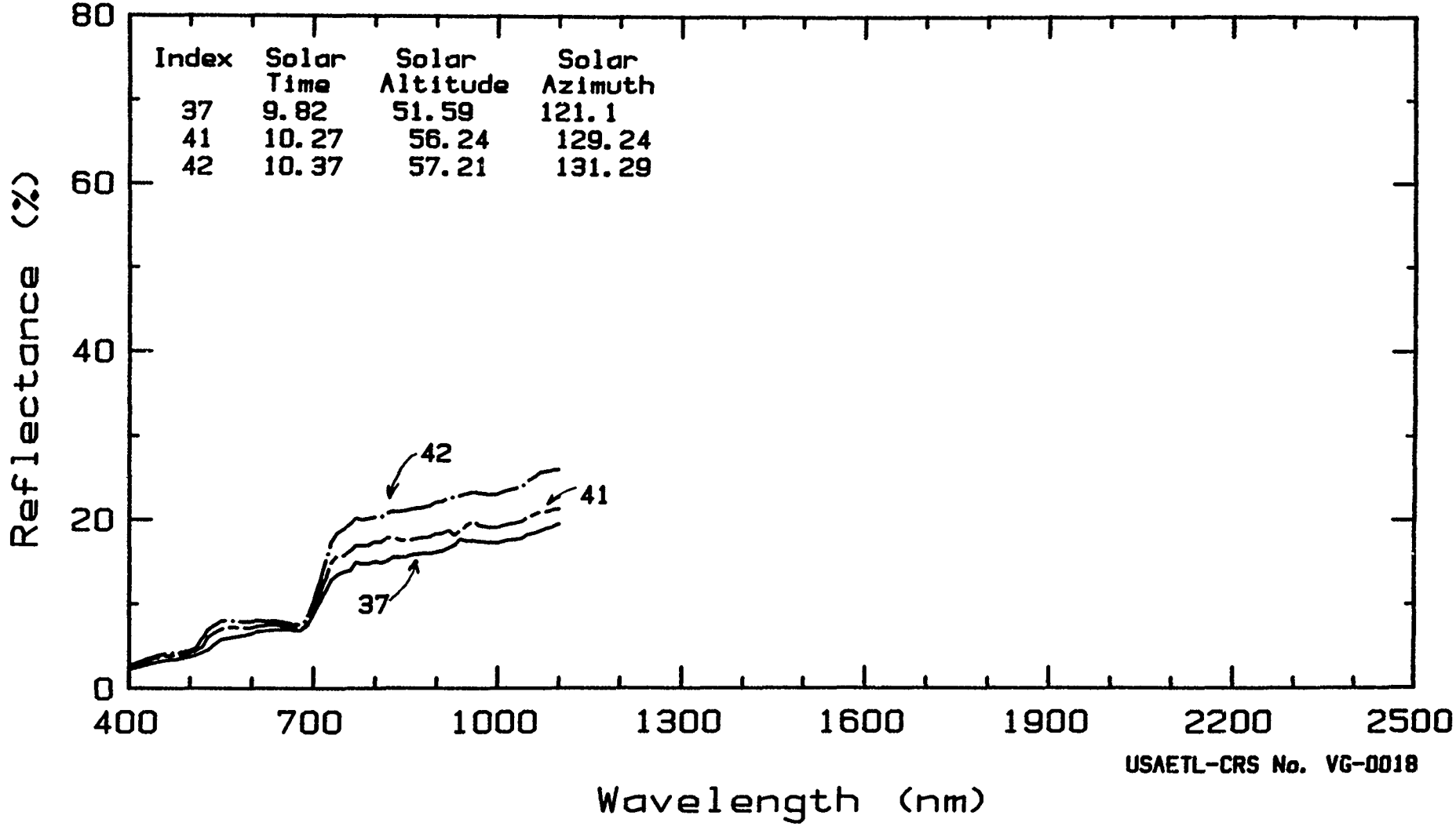
Physical & Chemical Properties:

Phenological stage: vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.5 m Crown Diameter: 0.3 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
37	3.6	5.6	7.0	15.4		
41	4.1	6.7	7.3	17.5		
42	4.5	7.6	7.8	20.8		

Compiled by: Melvin B. Satterwhite Sheet No. VG-0018.
USAETL-RI-RSD



Reflectance Spectra of Black Grama Grass.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Sand dropseed grass Date Collected: 7 Apr 1987
Specific Name: Sporobolus cryptandrus (Torr.) Gray
Spectrum No.: 87LCA.18, .51, .55.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: Three in situ canopies of this tufted perennial grass species were measured. The canopies consist of dry, tan-colored leaves, 3-35 cm long and 2-6 mm wide, and unbranched erect culms, 3-11 cm long, from the previous growth season. Typically the plant canopy was an assemblage of sunlit and shaded dry leaves and culms. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

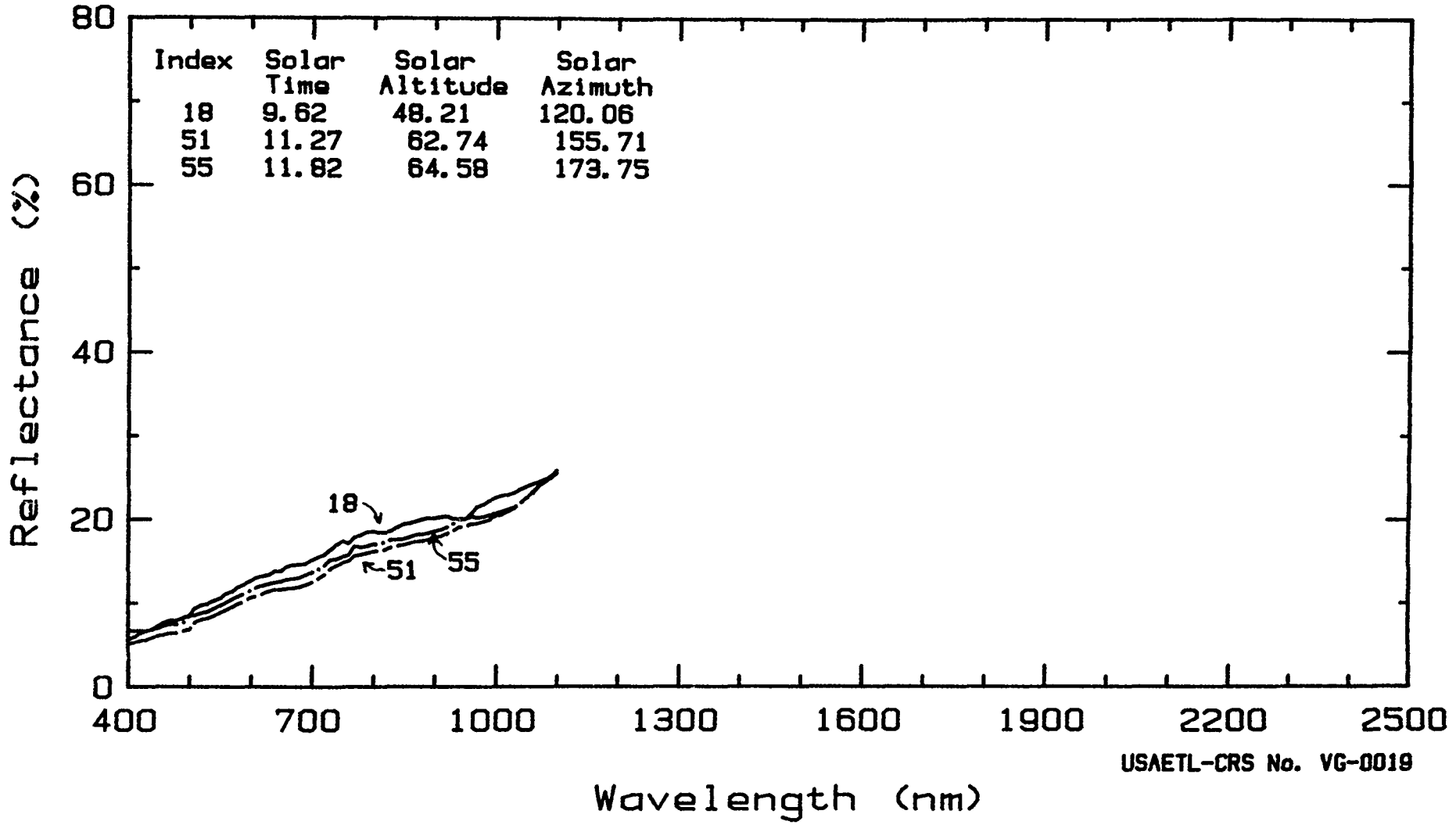
Phenological stage: vegetative, dormant.
Crown cover in the the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.8 m Crown Diameter: 0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
18	8.3	11.1	14.2	19.0		
51	6.8	9.2	11.8	16.6		
55	7.8	10.1	12.8	17.4		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0019.



Reflectance Spectra of Sand Dropseed Grass.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Sand dropseed grass Date Collected: 30 Aug 1987
Specific Name: Sporobolus cryptandrus (Torr.) Gray.
Spectrum No.: 87LCS.14, .17.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ plant canopies of this perennial, tufted grass species were measured. The canopy consisted green-colored leaves, 3-35 cm long and 2-6 mm wide, and unbranched, erect culms, 3-11 cm long, from this growth season. Also present were some of the tan-colored dry leaves and culms from the previous season. Typically the plant canopy was an assemblage of sunlit and shaded green and senesced, dry foliage. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time.

Physical & Chemical Properties:

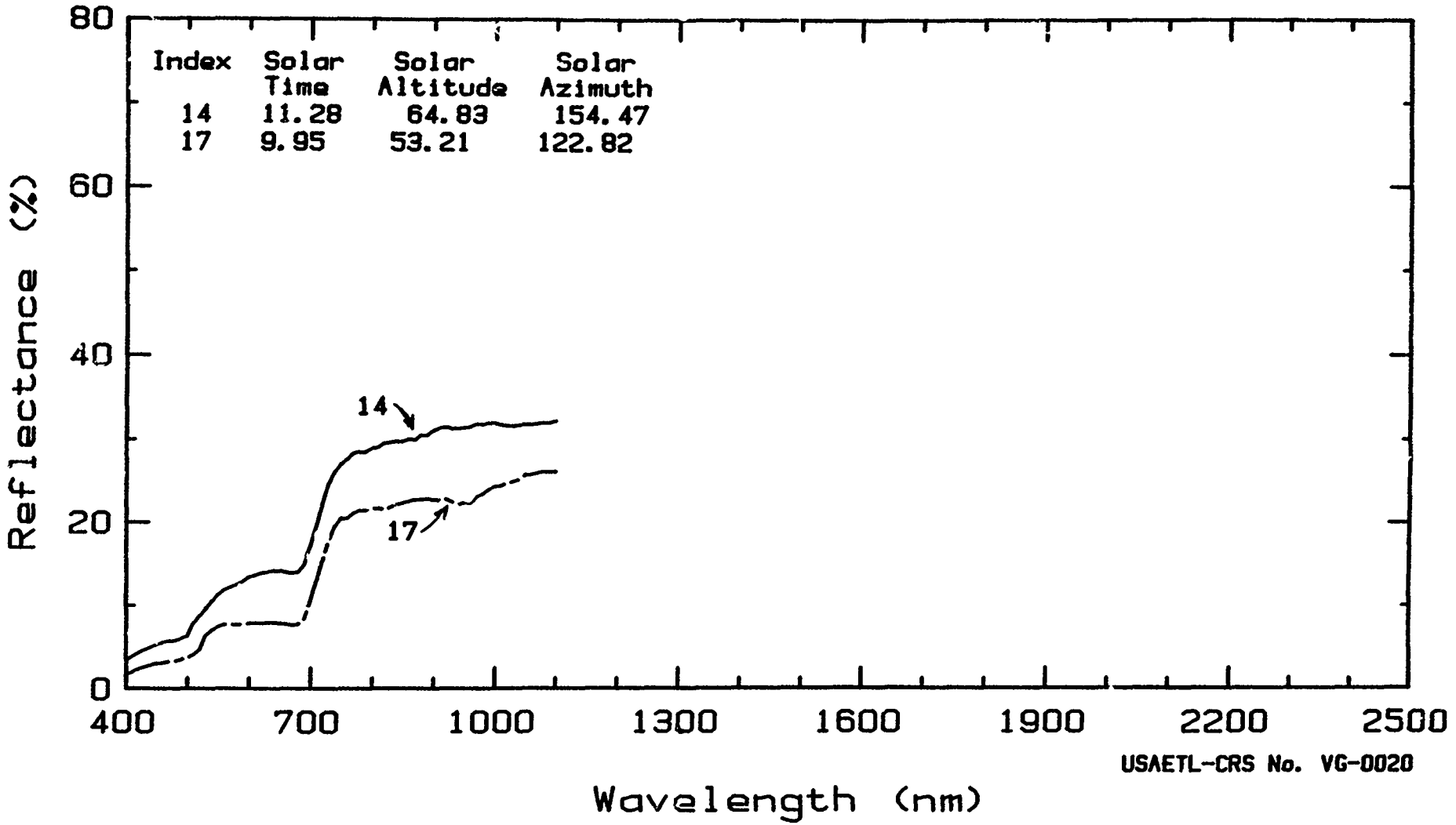
Phenological stage: vegetative, active growth.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.5 m Crown Diameter: 0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
14	6.4	11.4	14.2	29.4		
17	3.6	7.1	7.9	22.0		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VG-0020.



Reflectance Spectra of Sand Dropseed Grass.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Sand dropseed grass Date Collected: 29 Aug 1987
Specific Name: Sporobolus cryptandrus (Torr.) Gray.
Spectrum No.: LJOR.21, .52.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude.; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024: 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: The in situ grass canopies were measured for this perennial, tufted grass species. The canopies consisted of the present year's green vegetation although some vegetation was the previous year's leaves and culm that had now turned gray in color. The leaves were 2-35 cm long and 2-6 mm wide. The culms were unbranched and erect. These dense canopies were an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

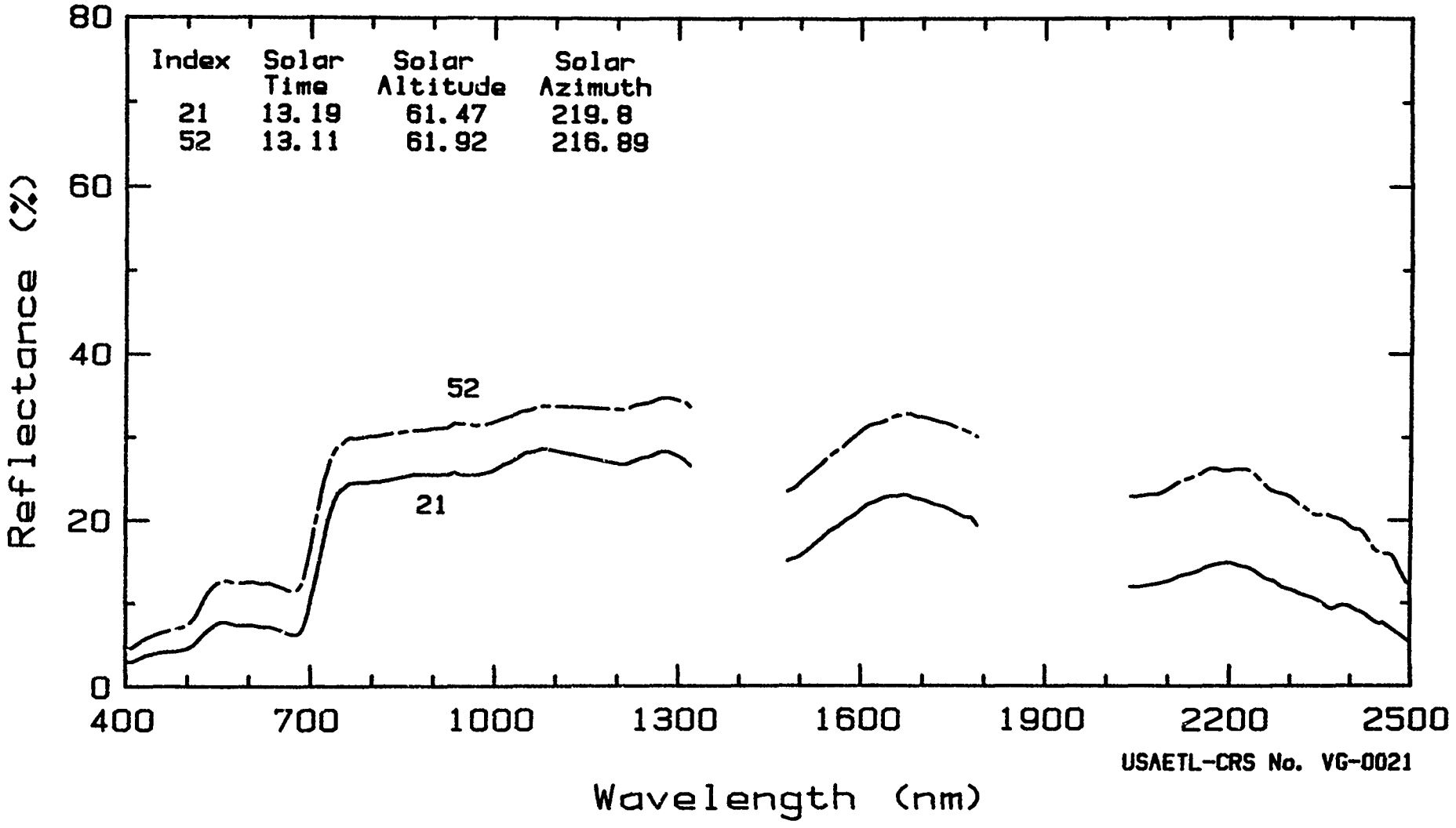
Phenological stage: Vegetative, early flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.5 m Crown Diameter: 0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
21	4.5	7.2	6.7	25.0	21.7	13.0
52	7.2	11.9	12.0	30.4	31.3	24.2

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VG-0021.



Reflectance Spectra of Sand Dropseed Grass.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Index of Reflectance Spectra for Vegetation Samples (Herbaceous)

SPECIES	SHEET NUMBER	SPECTRUM NUMBER
Paper Flower	VH.0001	LJOR.10, .11
Buffalo-Gourd	VH.0002	LJOR.41, .42, .43
Desert Mallow	VH.0003	LJOR.75
Russian Thistle	VH.0004	LJOR.68
Leaf Litter	VH.0005	LJOR.18
	VH.0006	87LCA.23, .47
	VH.0007	87LCS.09
	VH.0008	87YAA.11
	VH.0009	LYUM.37
Algal Mat	VH.0010	87LCS.34
Moss	VH.0011	87LCA.62, .63
Desert Unicorn Plant	VH.0012	LJOR.35, .36, .37, .38
Bush Bean	VH.0013	GR-BEAN.MEN
	VH.0014	GR-BEAN.MEN, BEAN-YG.MEN Y-BEAN.MEN, B-BEAN.MEN BE868.22
	VH.0015	SULEV.16, .17
	VH.0016	SULEV.59, .60, ..61
Chrysanthemum	VH.0017	CHRYSAN.MEN
Spinach	VH.0018	SPINACH.MEN

Field Reflectance Spectra of Vegetation

Plant Name: Paper flower Date Collected: 29 Aug 1987
Specific Name: Psilostrophe tagetina (Nutt.) Greene.
Spectrum No.: LJOR.10, .11.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the leaf samples so its FOV was filled with vegetation.

Sample: Leaves taken from this perennial herb were placed on a light trap and the spectra were taken of a single leaf (10) and of a stack of two leaves (11). These spectra were indicative of those that could be anticipated from a canopy of multi-layered leaves. However, differences would be expected with the plant canopy spectra since the canopy would typically be an assemblage of shaded and sunlit leaves, stems, branches, etc. Breaks in the spectral curves are due to instrument noise related to low signal in these major atmospheric water absorption bands.

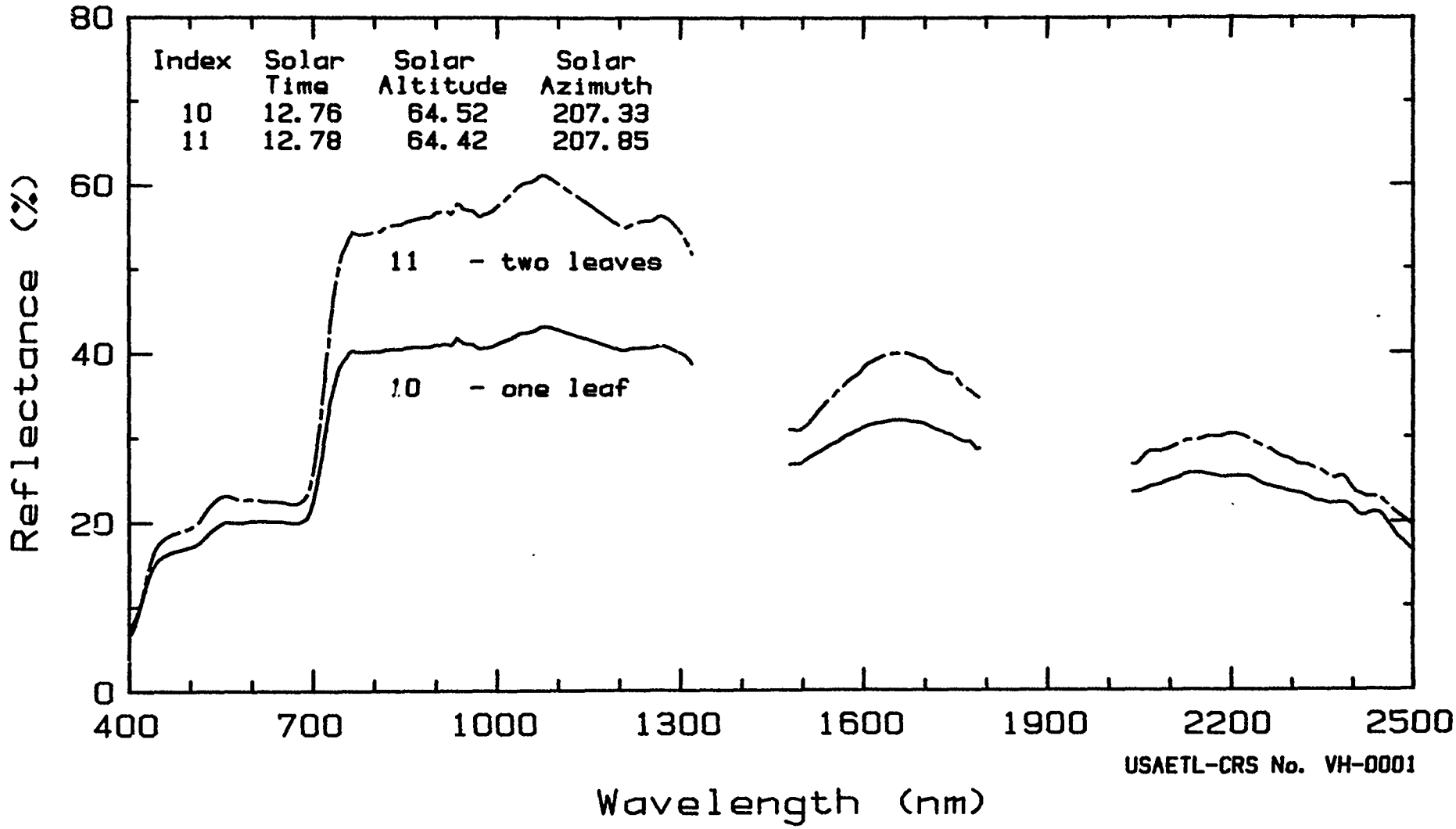
Physical & Chemical Properties:

Phenological stage: vegetative, flowering.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: <0.5 m Crown Diameter: 0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
10	16.8	19.6	20.1	40.5	31.1	24.6
11	19.0	22.5	22.4	55.1	38.3	28.8

Compiled by: Melvin B. Satterwhite Sheet No.: VH-0001.
USAETL-RI-RSD



Reflectance Spectra of Paper Flower.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Buffalo-gourd Date Collected: 29 Aug 1987
Specific Name: Cucurbita foetidissima H.B.K.
Spectrum No.: LJOR.41, .42, .43.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.6 deg. N Latitude.; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the leaves so they filled the radiometer's FOV.

Sample: This plant is a trailing vine that can densely cover areas 5 m x 5 m in size in favorable habitats. The coarse and thick triangular-ovate, grayish-green leaf blades were >10 cm long and 10 cm wide. Multiple leaf layers usually occur in the spreading canopy. Excised leaves were layered over a light trap in the field. Spectra were taken of leaves arranged in one leaf layer (41), two leaf layers (42), and three leaf layers (43). Successive leaf layers were added to the bottom of the stack so the first leaf of the stack was the same for all three spectra. Shadows were not a factor because the leaves were held flat. All spectra were taken over a 4-minute period. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

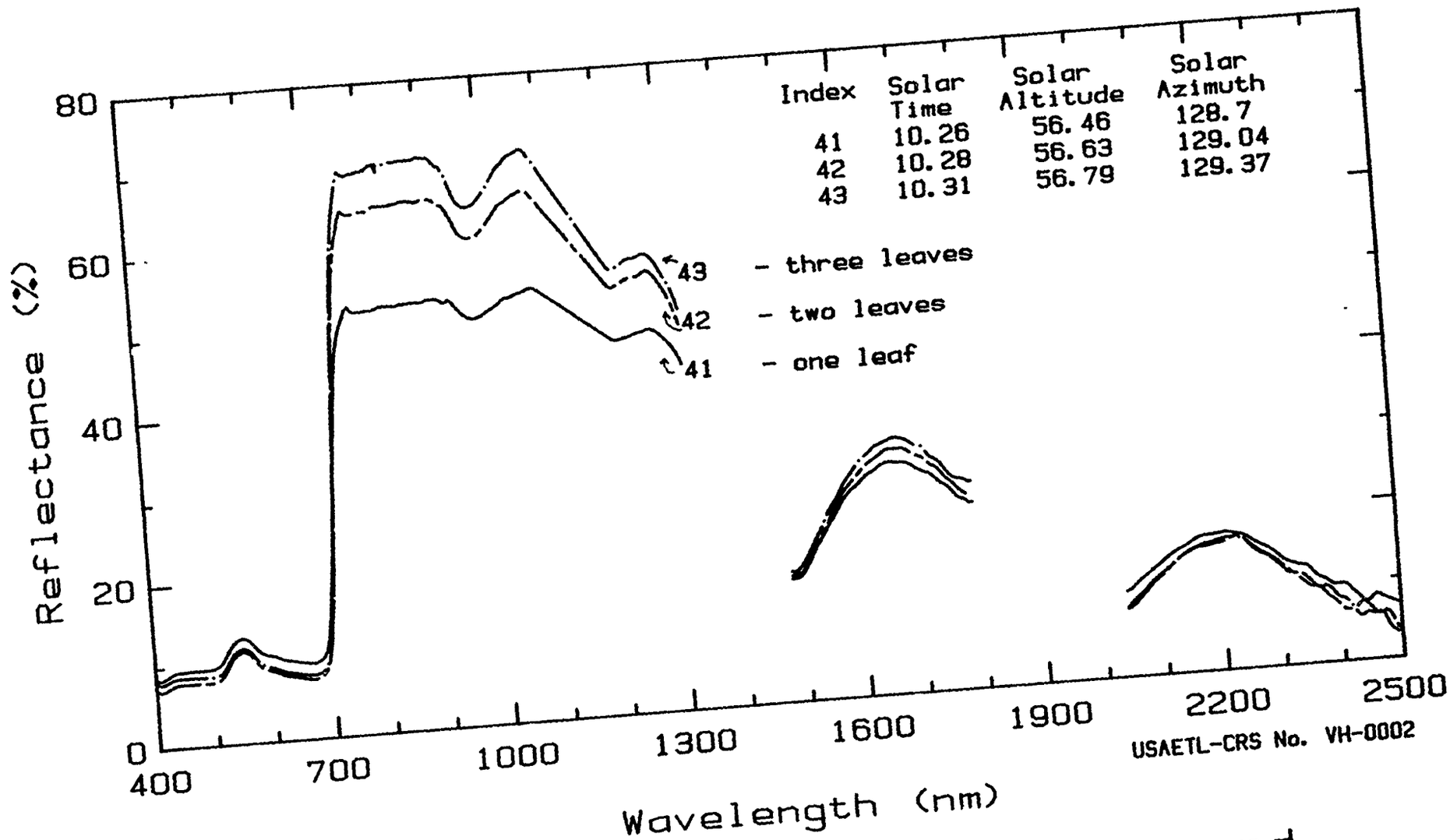
Phenological stage: grayish-green leaves from a flowering plant. The triangular leaves were >10 cm wide and >10 cm long.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
41	9.6	11.8	9.7	52.5	27.8	15.1
42	8.0	10.1	7.7	64.6	28.1	14.0
43	8.6	10.5	8.2	69.7	29.2	14.0

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VH-0002.



Reflectance Spectra of Buffalo-gourd.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Desert mallow Date Collected: 31 Aug 1987
Specific Name: Sphaeralcea fendleri Gray.
Spectrum No.: LJOR.75.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-u24; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was filled by vegetation.

Sample: The in situ plant canopy was measured. The canopy consisted of the present year's bluish-green, pubescent leaves. The plant is a perennial herb of erect or ascending stems from a woody crown. The plant canopy was an assemblage of sunlit and shaded leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are due to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

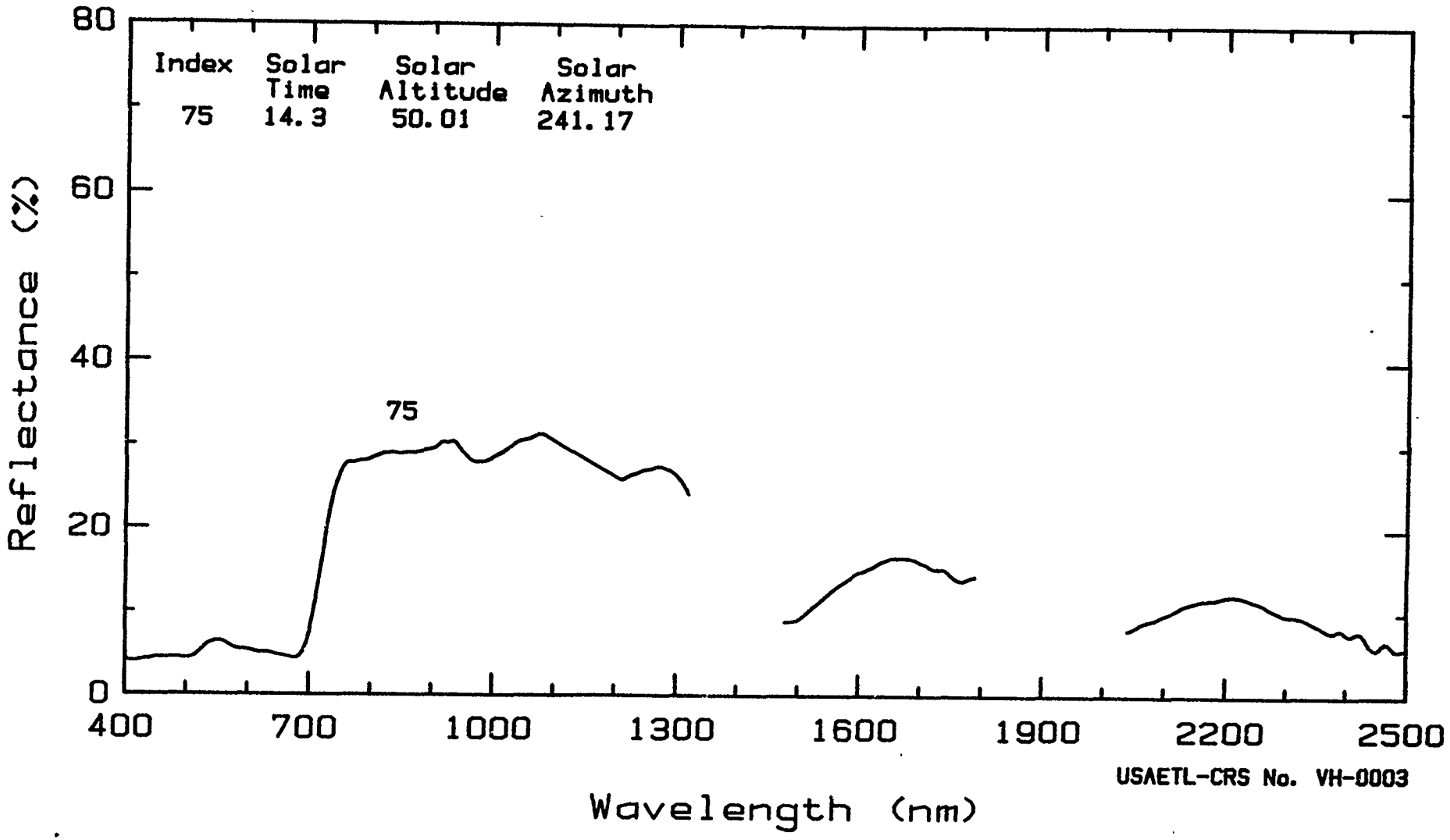
Phenological stage: vegetative, flowering.
Crown closure (cover): 100% Plant Height: <0.5 m
Crown Diameter: 0.4 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
75	4.4	5.8	4.7	28.8	15.2	10.8

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VH-0003.



Reflectance Spectra of Desert Mallow.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Russian thistle Date Collected: 31 Aug 1987
Specific Name: Salsola kali L.
Spectrum No.: LJOR.68.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the canopy so its FOV was essentially 100% vegetative cover.

Sample: An in situ canopy of this much-branched annual herb was measured. This young canopy had blue-green stems and bluish-green leaves that were 3 cm long and 1.5-2mm wide. The canopy was an assemblage of sunlit and shaded stems and leaves. In-canopy shadow effects were minimized by taking spectra between 1000 to 1400 true solar time. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

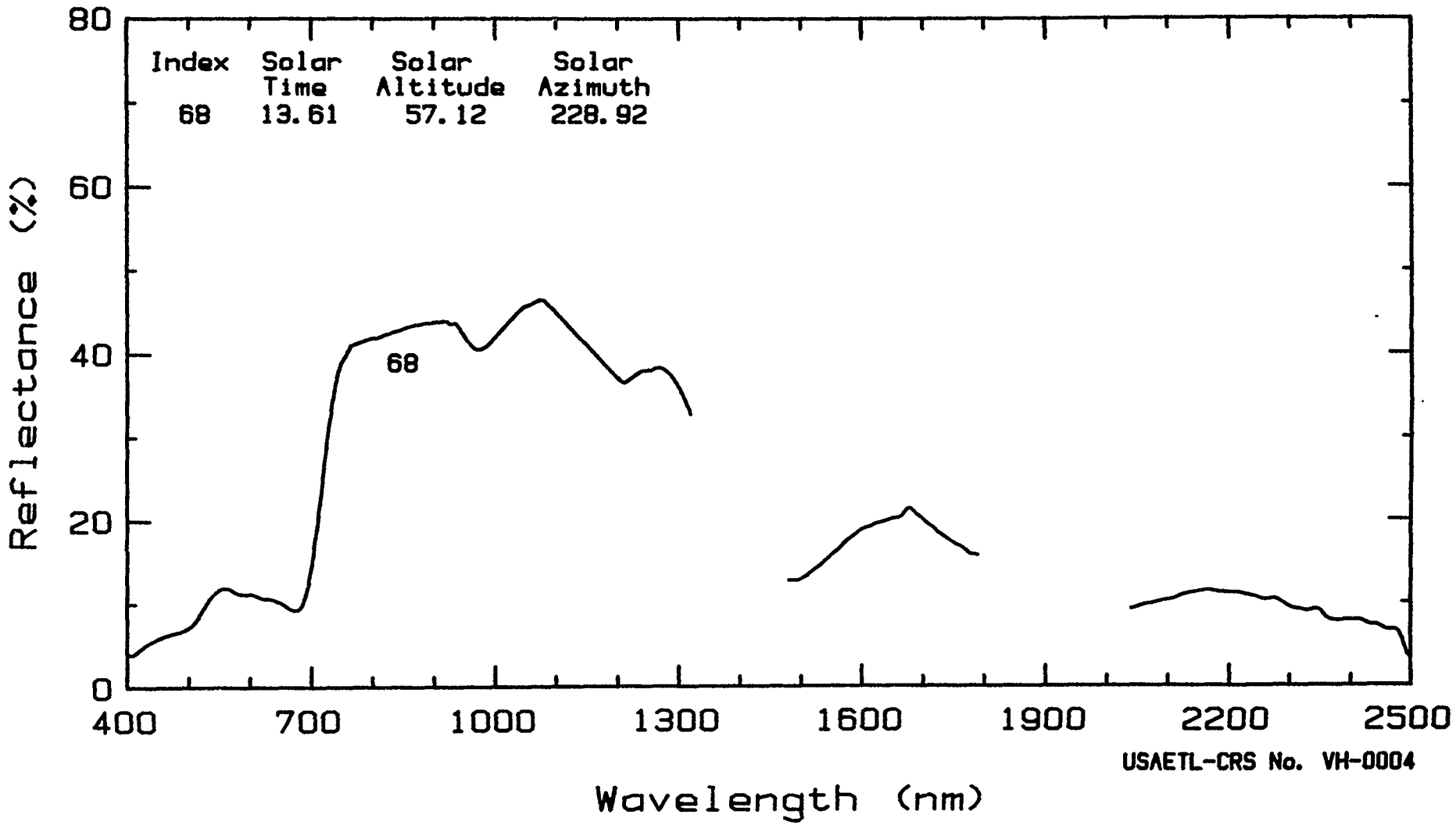
Phenological stage: vegetative, active growth.
Crown cover in the FOV: 100% Crown closure (cover): 100%
Plant Height: 0.4 m Crown Diameter: 0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
68	6.9	11.0	10.0	42.5	19.0	10.5

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VH-0004.



Reflectance Spectra of Russian Thistle.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Leaf litter Date Collected: 30 Aug 1987
Spectrum No.: LJOR.18.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude.; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the litter deposit which filled its FOV.

Sample: The windblcwn leaf litter, deposited in the lee side of a coppice dune was measured. The litter was primarily the senesced, dry, leaflets from mesquite and broom snakeweed shrubs and dry senesced grass leaves. Because leaf litter is spectrally different from the soil surface, litter materials will modify the spectral signature of the vegetation-soil mosaic. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

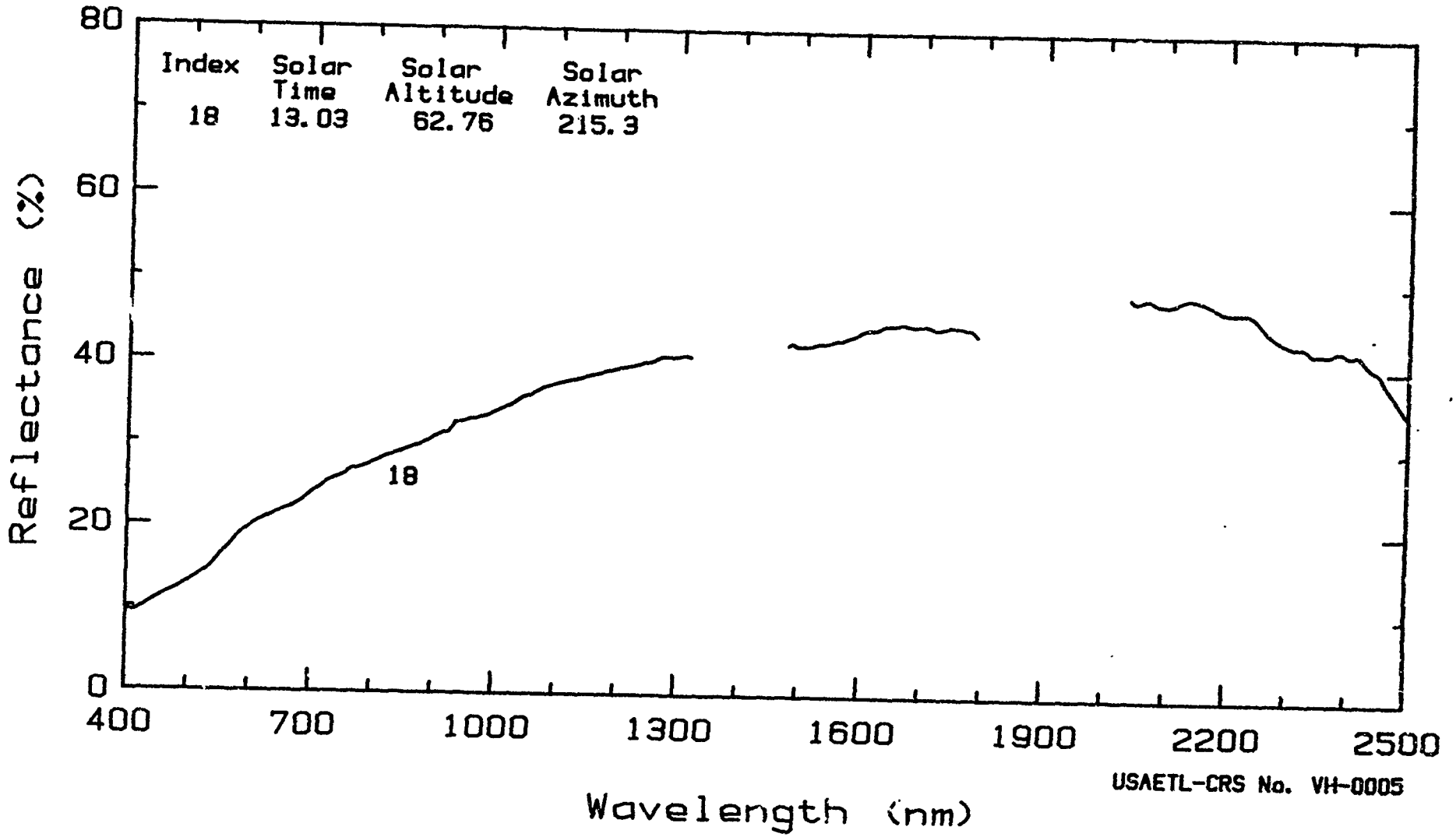
Phenological stage: dry, windblown leaf and stem materials

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
18	12.4	16.8	22.0	28.7	44.4	46.0

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VH-0005.



Reflectance Spectra of Leaf Litter.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Leaf litter Date Collected: 7 Apr 1987
Spectrum No.: 87LCA.23, .47.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the litter deposit so it filled the radiometer's FOV.

Sample: The leaf litter deposited by the wind on the lee sides of persistent shrub canopies or coppice dunes was measured. The litter matter was primarily the senesced, dry, leaflets from mesquite and broom snakeweed shrubs and dry senesced grass leaves. Because it covers the soil surface and is spectrally different, the litter can be an important component in the spectral signature of the vegetation-soil mosaic. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

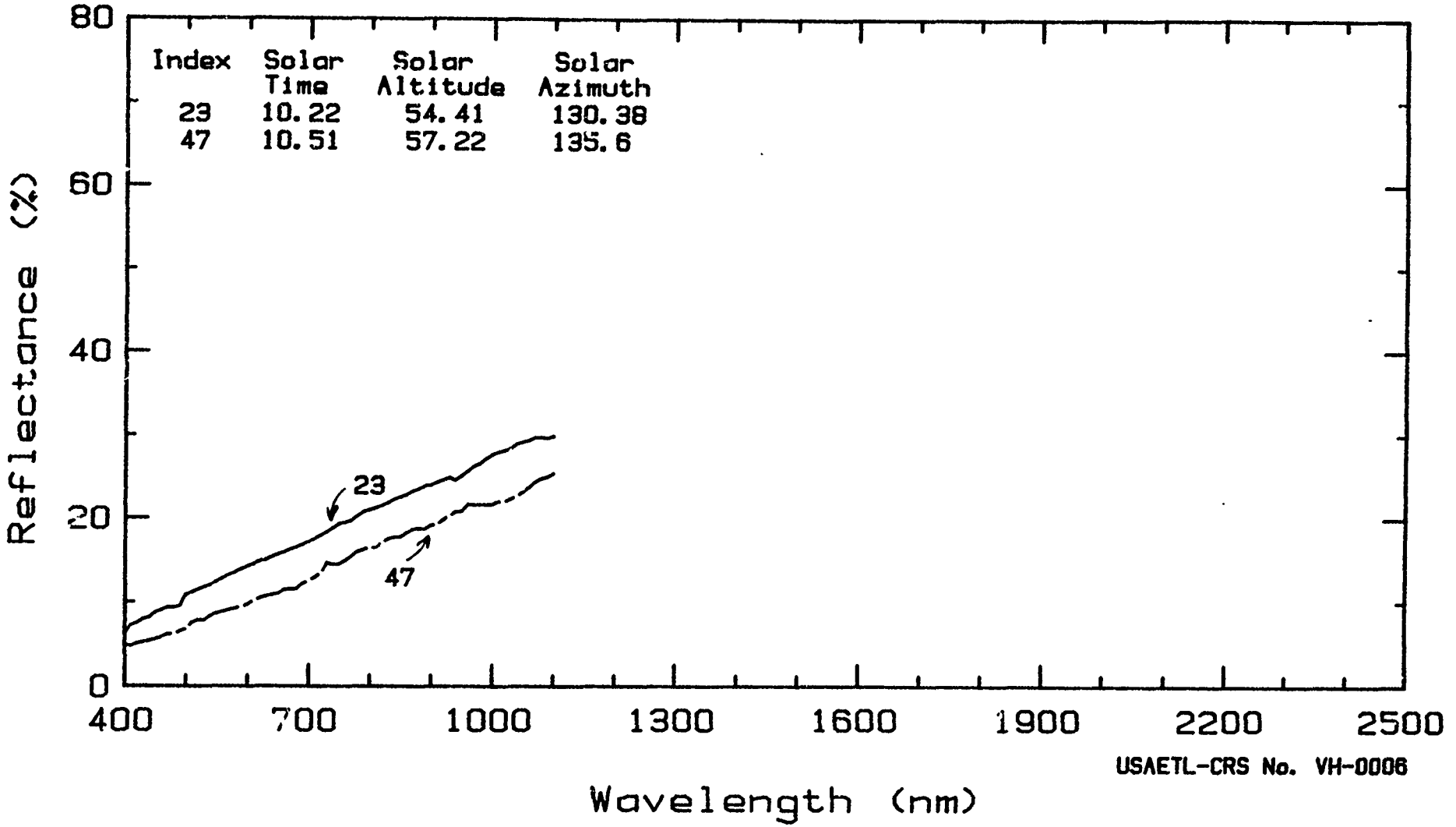
Phenological stage: dry, windblown leaf and stem materials.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
23	10.0	12.7	16.0	21.9		
47	6.6	8.8	11.3	17.3		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0006.



Reflectance Spectra of Leaf Litter.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Leaf litter Date Collected: 30 Aug 1987
Spectrum No.: 87LCS.09.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the litter deposit which filled its FOV.

Sample: The leaf litter deposited on the leeside of a shrub canopy was measured. The litter matter was primarily the senesced, dry leaflets from mesquite shrubs and dry, senesced grass leaves. These materials are often deposited in or around the persistent shrub and grass canopies. Litter deposits can make important contributions to the spectral signature of the vegetation mosaic, because they cover the soil surface and can be spectrally different from the soil.

Physical & Chemical Properties:

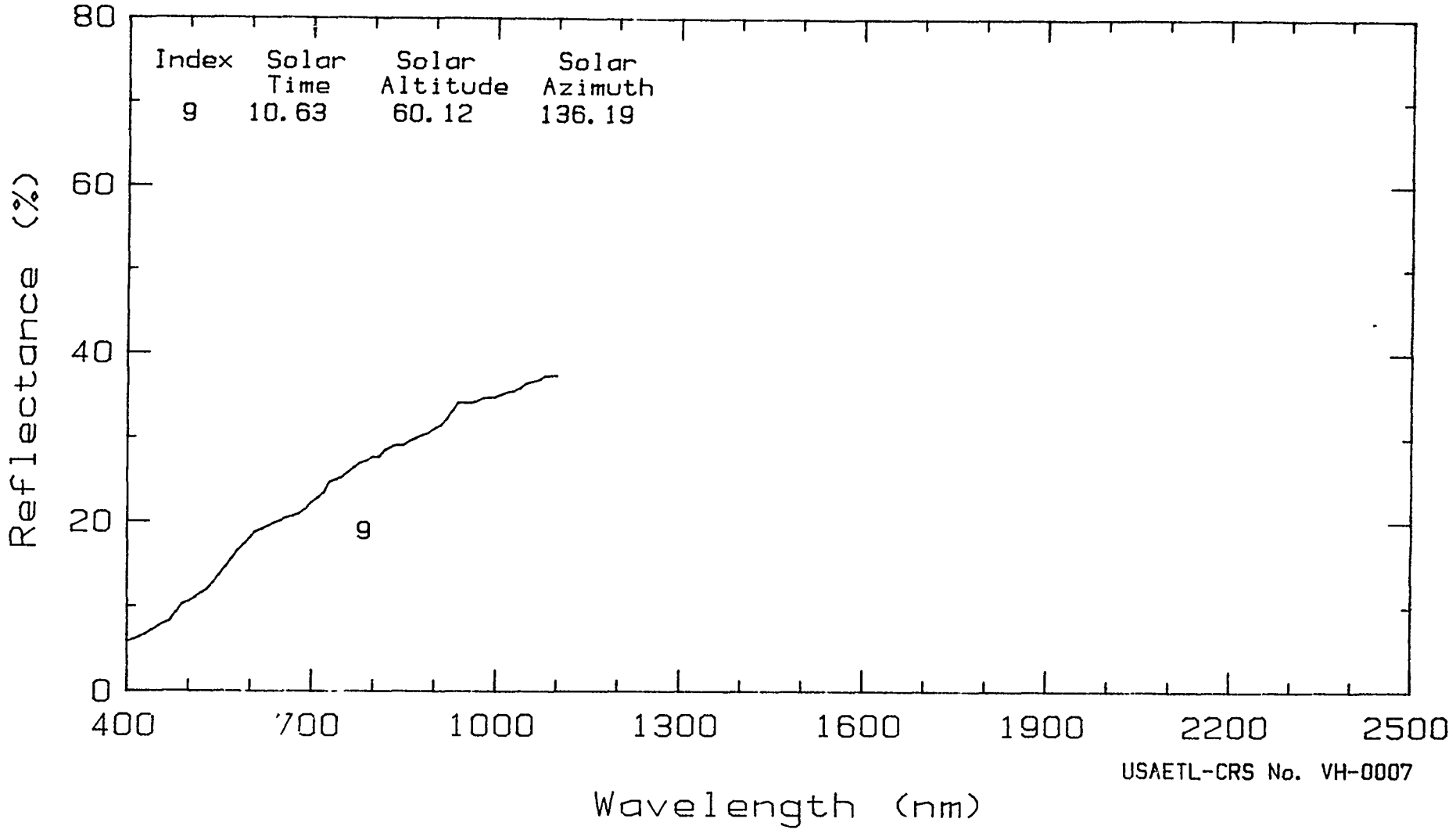
Phenological stage: dry, windblown leaf and stem materials.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
9	9.4	14.6	20.4	28.6		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0007.



Reflectance Spectra of Leaf Litter.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Leaf litter Date Collected: 25 Aug 1987
Spectrum No.: 87YAA.11.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude.; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the litter deposit which filled its FOV.

Sample: Leaf litter deposited by the wind was measured. The litter matter was primarily the senesced, dry leaflets from creosote shrubs and dry, senesced grass leaves. The materials are deposited in or around the persistent shrub and grass canopies. Because the litter covers the soil surface, these materials modify the spectral signature of the vegetation-soil mosaic.

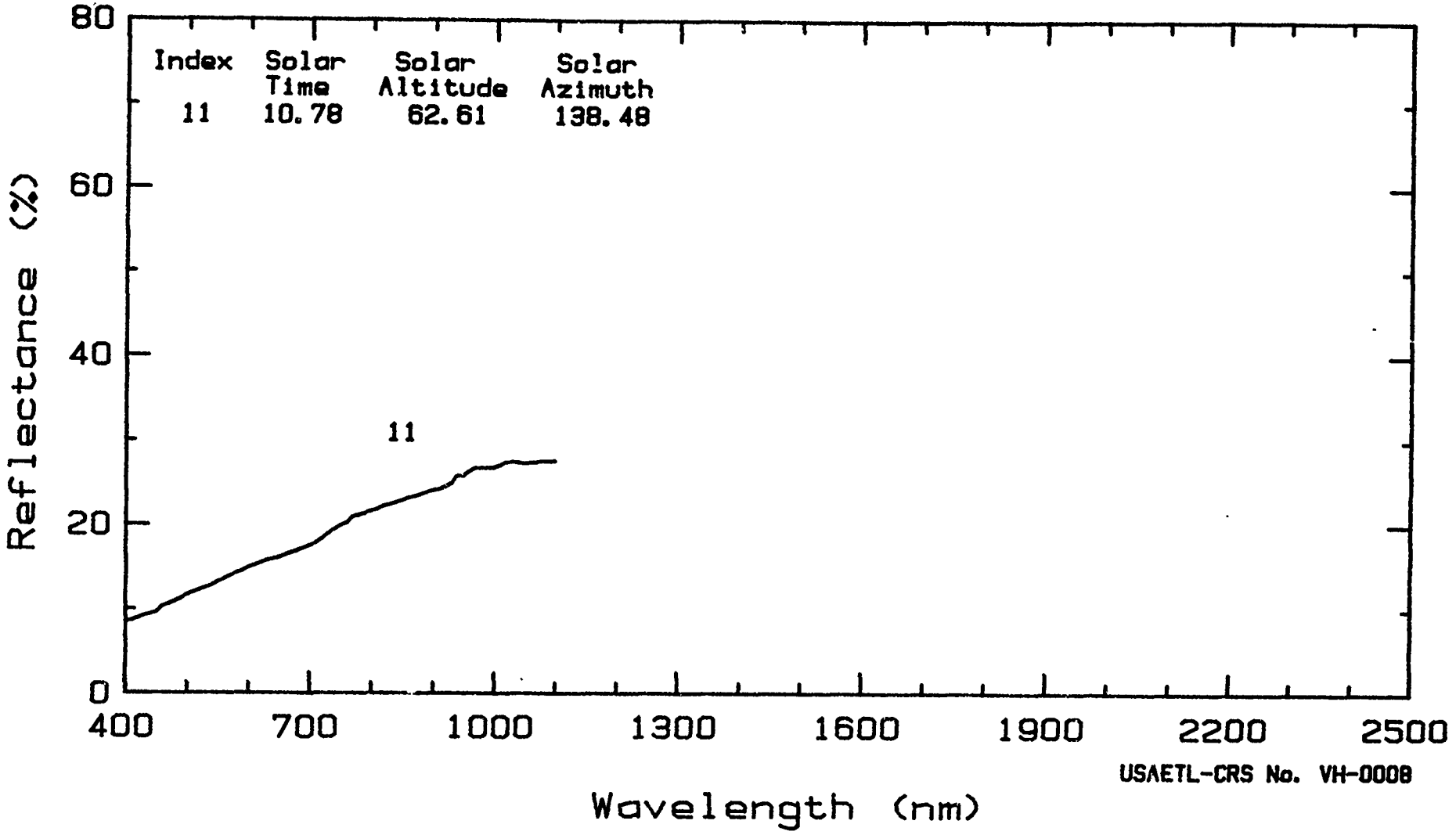
Physical & Chemical Properties:

Phenological stage: dry, windblown leaf and stem materials.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
11	11.0	13.5	16.5	22.4		

Compiled by: Melvin B. Satterwhite Sheet No. VH-0008.
USAETL-RI-RSD



Reflectance Spectra of Leaf Litter.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Leaf litter Date Collected: 25 Aug 1987
Spectrum No.: LYUM.37.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the litter deposit which filled its FOV.

Sample: Leaf litter deposited beneath a creosote shrub by the wind was measured. The litter material was primarily the senesced, dry leaflets from creosote shrubs and dry senesced grass leaves. Because it covers the soil surface, this material is a component of the spectral signature of the vegetation-soil mosaic. Breaks in the spectral curves are related to the low signal to noise ratio in these major atmospheric water absorption bands.

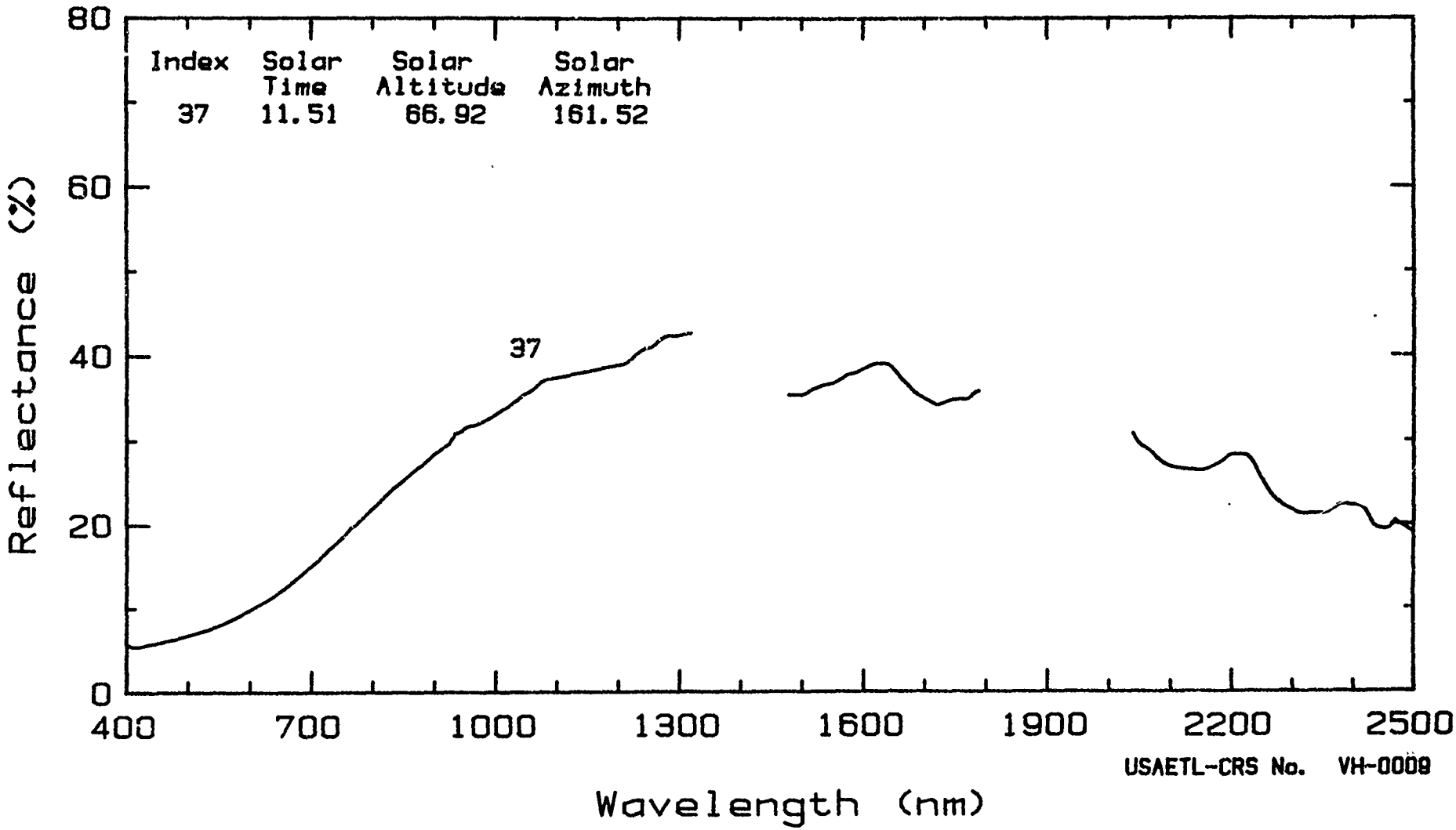
Physical & Chemical Properties:

Phenological stage: dry, windblown leaf and stem materials

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
37	6.5	8.4	12.7	23.9	36.8	25.3

Compiled by: Melvin B. Satterwhite Sheet No.: VH-0009.
USAETL-RI-RSD



Reflectance Spectra of Leaf Litter.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Algal Mat Date Collected: 30 Aug 1987
Spectrum No.: 87LCS.34.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the mat which filled its FOV.

Sample: The in situ air-dried algal mat was measured. This matter occurs on fine-grained silty soils in a playa lake. It usually occurs between clumps of Tobosa grass (VG-0008) and Burro grass (VG-0005). It is often covered by a dusting of aeolian silt. Because it covers the soil surface, this material is a component of the spectral signature of the vegetation-soil mosaic.

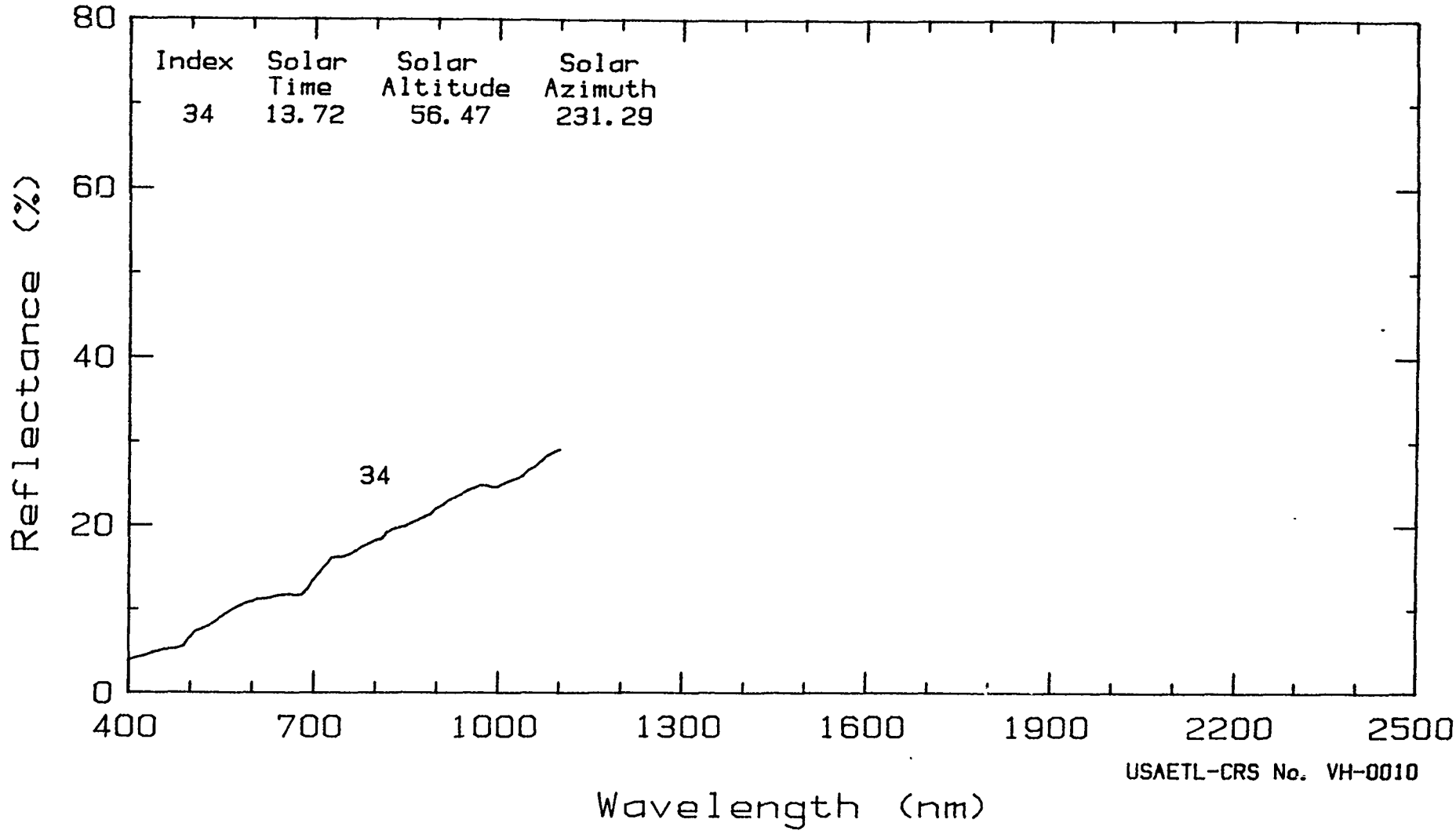
Physical & Chemical Properties:

Phenological stage: vegetative, dormant, air-dry matter.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
34	5.9	9.4	11.7	19.3		

Compiled by: Melvin B. Satterwhite Sheet No. VH-0010.
USAETL-RI-RSD



Reflectance Spectra of a Dry Algal Mat.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Moss Date Collected: 8 Apr. 1987
Specific Name: Cryptogams
Spectrum No.: 87LCA.62, .63.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude.

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the mat which filled its FOV.

Sample: The in situ air dried mat of dark-toned moss was measured. The moss occurred on fine-grained, silty soils in a playa lake. It usually occurs between clumps of tobosa grass (VG-0008) and burro grass (VG-0005). It is often covered by a dusting of aeolian silt. Because it covers the soil surface, this material is a component of the spectral signature of the vegetation-soil mosaic.

Physical & Chemical Properties:

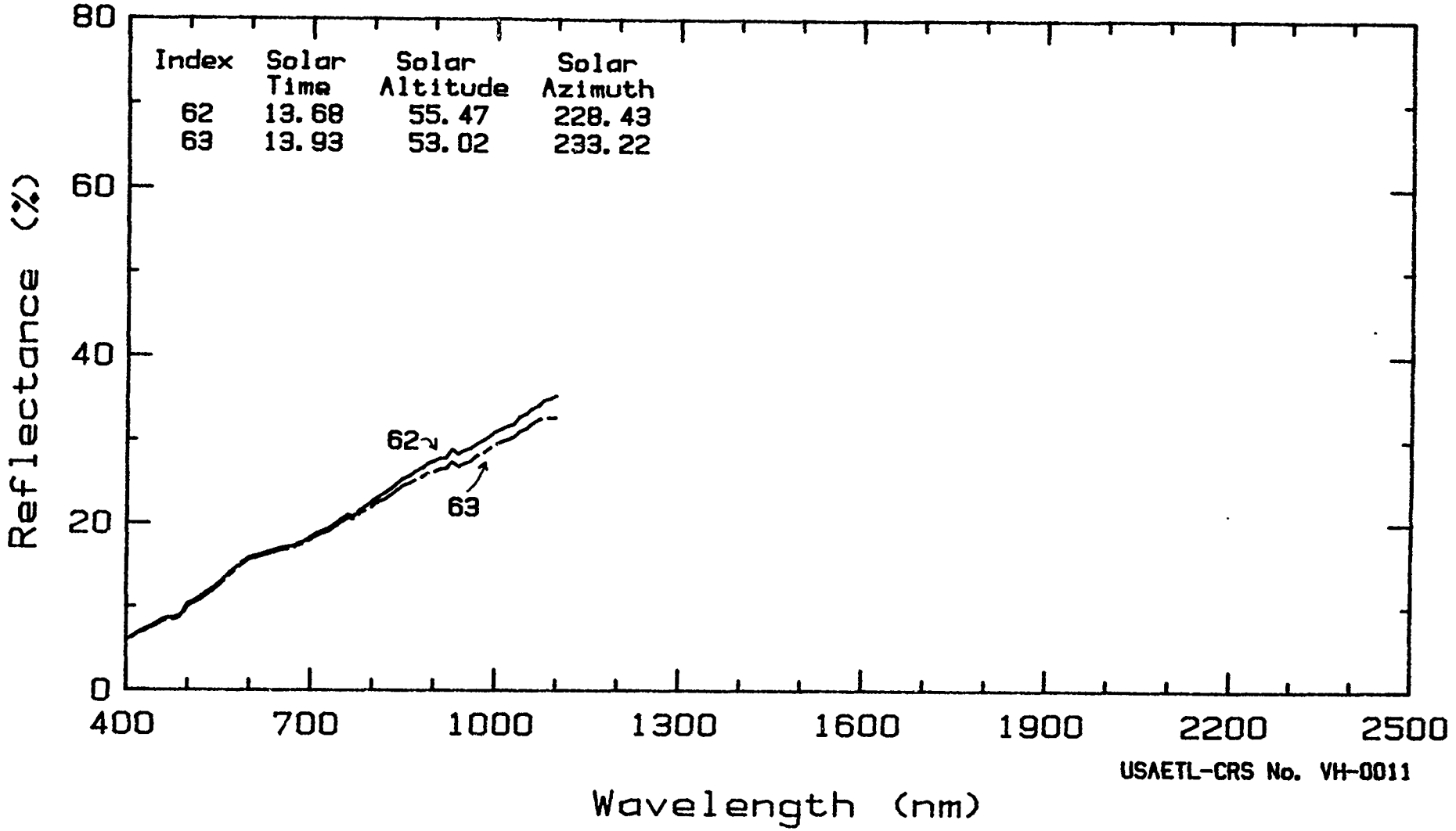
Phenological stage: vegetative, dormant, air-dry.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
62	9.4	13.4	17.1	24.1		
63	9.1	13.1	16.9	23.4		

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0011.



Reflectance Spectra of Dry Moss.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Vegetation

Plant Name: Desert unicorn plant Date Collected: 30 Aug 1987
Specific Name: Proboscidea atheaefolia Dcne.
Spectrum No.: LJOR- 35, 36, 37, 38.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA. 32.5 deg. N Latitude; 106.7 deg. W Longitude.

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The pressed Halon reference standard was horizontally positioned using a bubble level. The radiometer was positioned above the leaves so they filled the radiometer's FOV.

Sample: This plant is an perennial herb with spreading, decumbent branches. The bluish-green leaf blades are reniform to broadly ovate in shape and are 5-8 cm in diameter. Multiple leaf layers occur in the shrub canopy. Excised leaves were layered over a light trap in the field. Spectra were taken of leaves arranged in one leaf layer (35), two leaf layers (36), three leaf layers (37), and four leaf layers (38). Successive leaf layers were added to the bottom of the stack so the first leaf of the stack was the same for all three spectra. Shadows were not a factor because the leaves were held flat. All spectra were taken over a 7-minute period. Breaks in the spectral curves are related to low signal to noise ratio in these major atmospheric water absorption bands.

Physical & Chemical Properties:

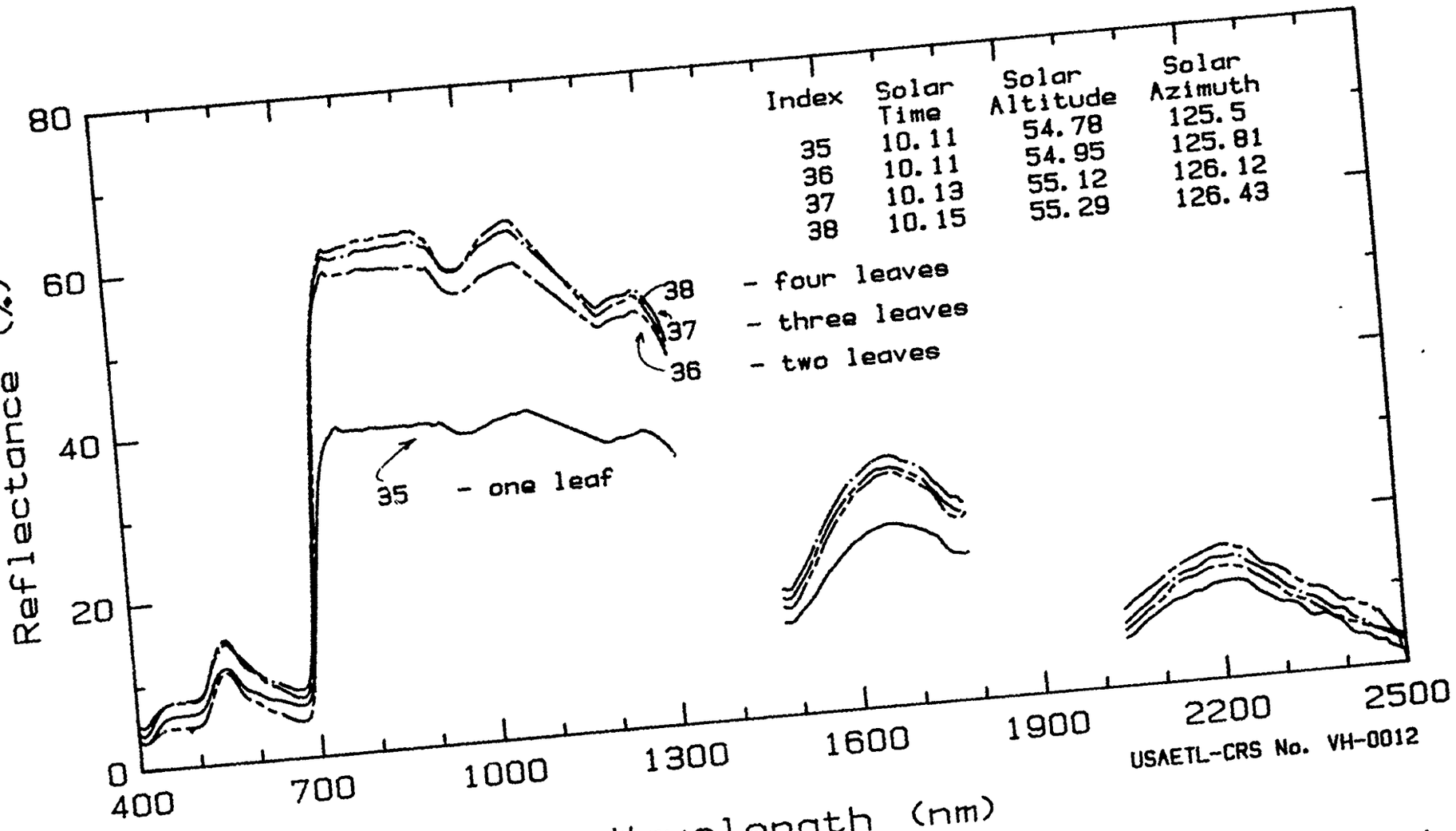
Phenological stage: grayish-green leaves from a flowering plant. The obvate leaves were nominally 5-8 cm in diameter.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
35	6.4	9.9	6.7	39.3	20.4	9.9
36	8.1	12.7	8.0	58.5	26.7	13.8
37	8.2	13.1	8.8	60.8	28.0	12.5
38	5.0	8.9	5.0	62.0	25.9	11.5

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No.: VH-0012.



Reflectance Spectra of Desert Unicorn Plant. Jornada Experimental Range, Dona Ana Co., NM: Aug. 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Bush bean Date Collected: June - Aug 1987
Specific Name: Phaseolus sp. L.
Spectrum No.: GR-BEAN.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, dual beam, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature "sun" leaves were taken periodically. All leaves were exposed to direct sunlight. Leaves were placed into a plastic bag to minimize water loss. Each leaf's spectrum was taken in the lower 1/3 of the leaf blade, but the leaf's midrib was not part of the surface. The 134 leaf samples were not statistically different from the mean spectrum at the 95% confidence level. The mean curve (#1) and those (#2, & #3) representing one standard deviation of the mean curve are shown.

Physical & Chemical Properties:

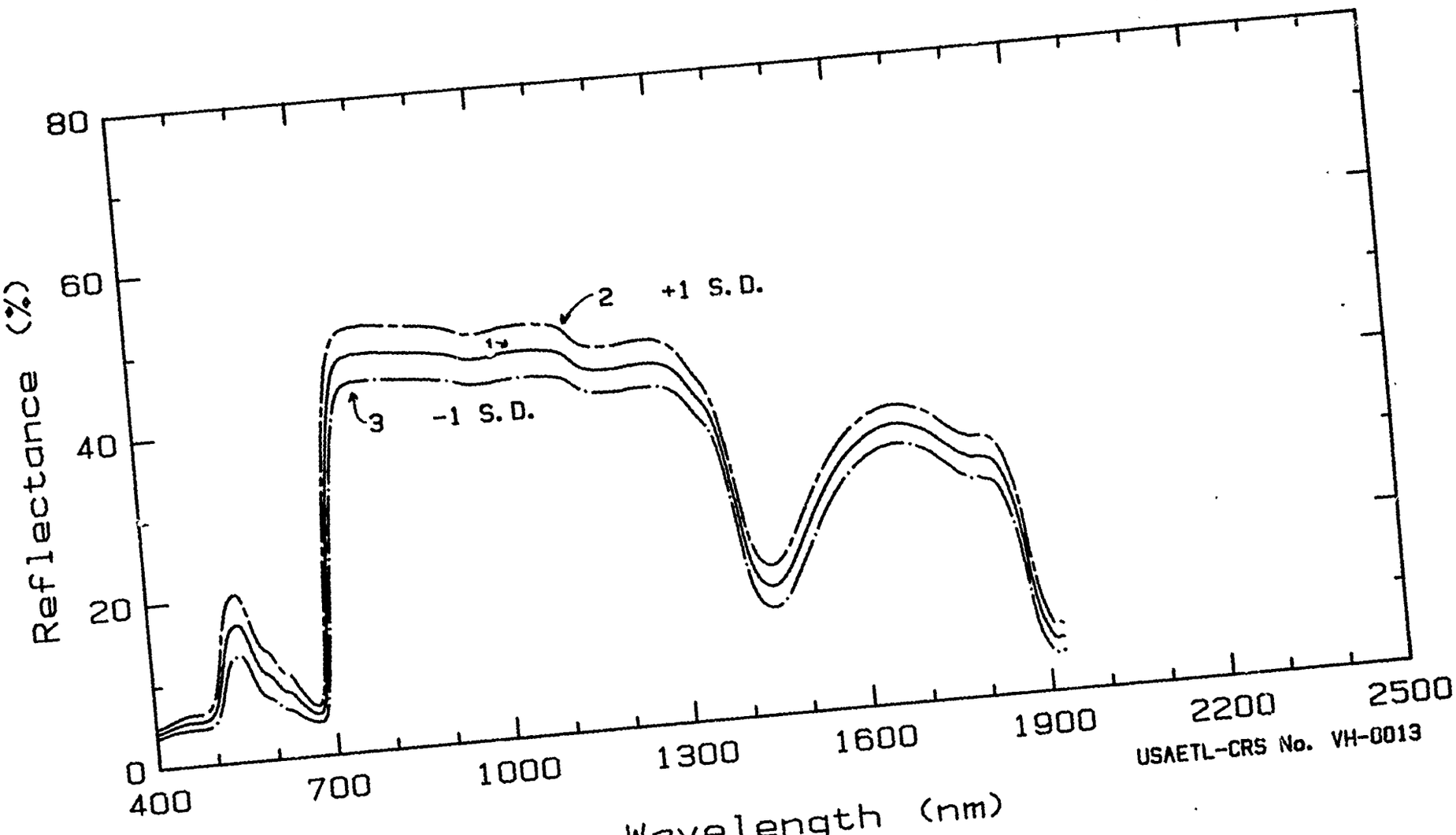
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.5	13.8	6.5	48.4	32.5	
2	7.9	17.1	8.1	51.7	34.9	
3	5.2	10.4	4.9	45.1	30.1	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0013.



Spectra of Bush Bean Leaves.
Ft. Belvoir, Fairfax Co., VA; Jun.-Aug., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Bush bean Date Collected: Aug 1986, Aug 1987
Specific Name: Phaseolus sp. L.
Spectrum No.: GR-BEAN.MEN, BEAN-YG.MEN, Y-BEAN.MEN, B-BEAN.MEN, BE868.22.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, senescing "sun" leaves were taken from the bean canopy, which was exposed to direct sunlight. The leaves were placed into a plastic bag to minimize water loss. Each leaf's spectrum was taken in the lower 1/3 of the leaf blade, but the leaf's midrib was not part of the surface. The selected leaves are representative of various leaf colors: green (#1), yellow-green (#2), yellow (#3), brown (#4), and black (#5).

Physical & Chemical Properties:

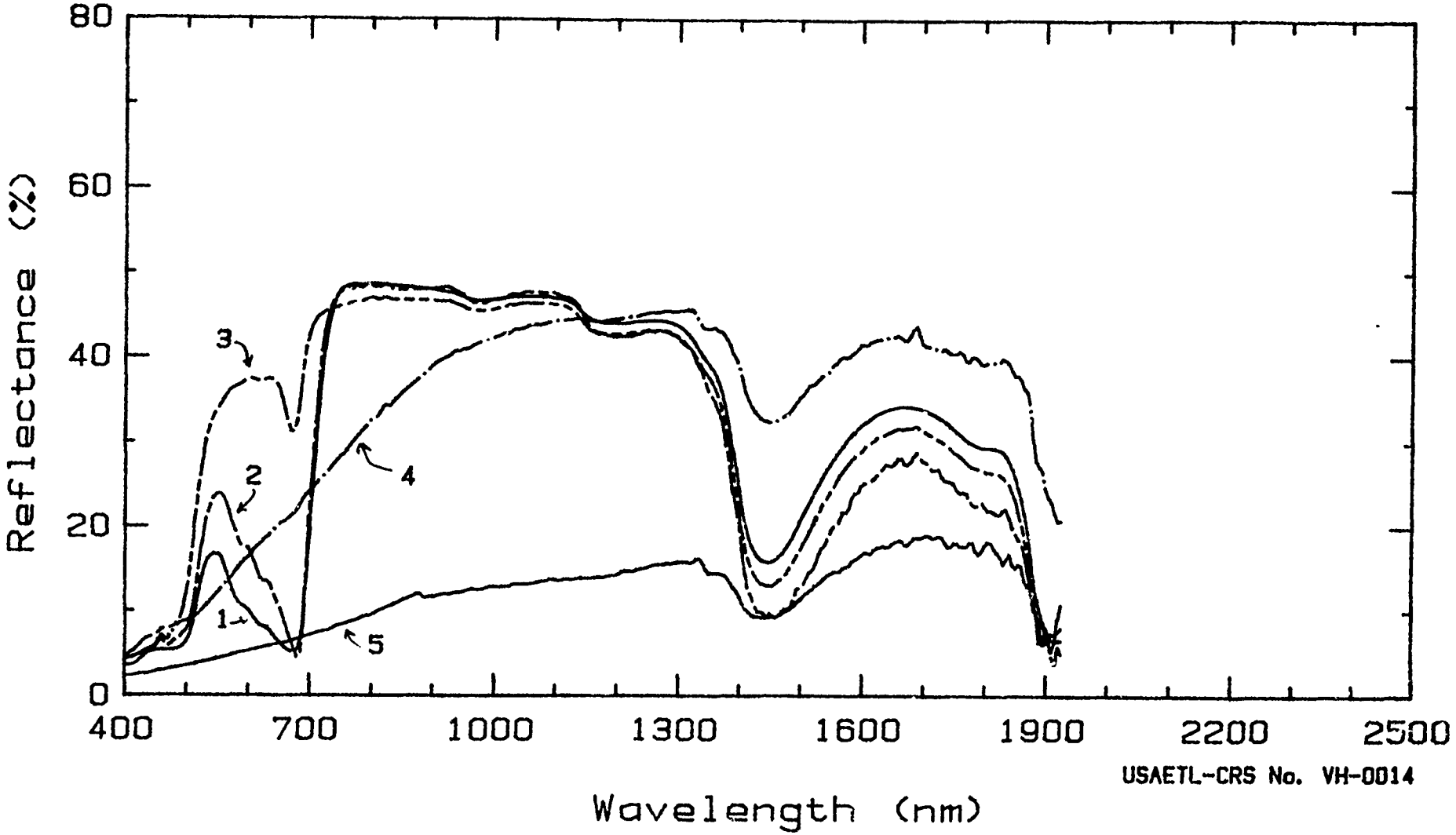
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m
Water Content: 77% - 89%; mean 82.8%.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.5	13.8	6.5	48.4	32.5	
2	9.9	22.5	11.3	51.1	33.5	
3	11.3	33.6	35.0	46.7	29.8	
4	7.9	12.9	20.8	34.3	41.4	
5	3.3	4.5	6.3	10.5	17.4	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0014



Spectra of Senescing Bush Bean Leaves.
Ft. Belvoir, Fairfax Co., VA; Aug., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Bush bean Date Collected: Aug 1987
Specific Name: Phaseolus sp. L.
Spectrum No.: SULEV.16, .17.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: A mature, green "sun" leaf was taken from the bean canopy, which was exposed to direct sunlight. The leaf was placed into a plastic bag to minimize water loss. The top (adaxial) and bottom (abaxial) surfaces were measured, curves #1 and #2, respectively. Each surface's spectrum was taken in the lower 1/3 of the leaf blade. The leaf's midrib was not part of the measured surface.

Physical & Chemical Properties:

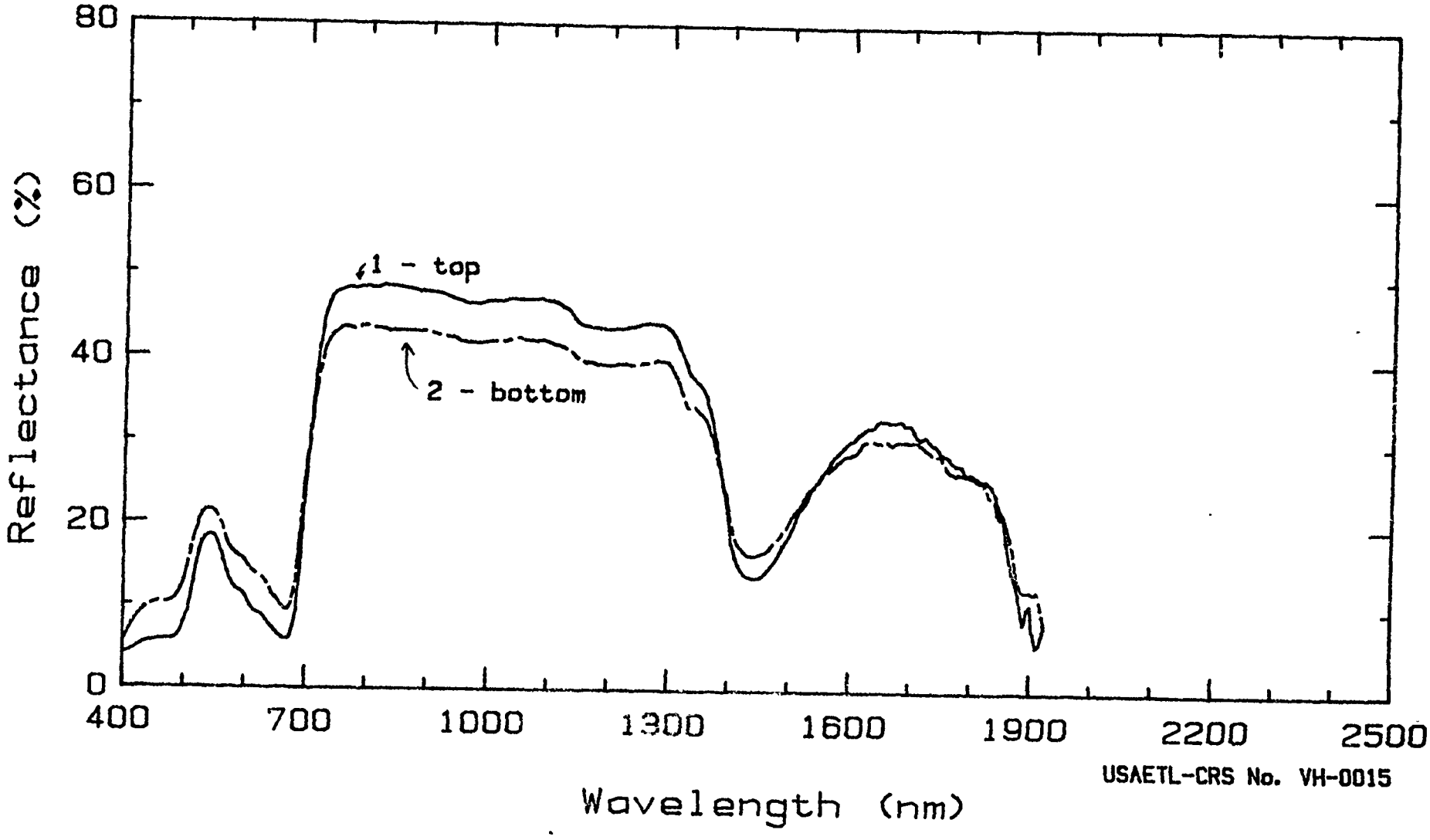
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	7.5	15.1	7.5	48.3	30.7	
2	12.4	18.8	11.6	43.4	29.2	

Compiled by: Melvin B. Satterwhite
USAETL-RI-CRS

Sheet No. VH-0015



Spectra of the Surfaces of a Bush Bean Leaf.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Bush bean Date Collected: 4 Aug 1987
Specific Name: Phaseolus sp. L.
Spectrum No.: SULEV.59, .60, .61.

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, green "sun" leaves were from the bean canopy, which was exposed to direct sunlight. The leaves were placed into a plastic bag to minimize water loss. Leaves were arranged in a stack, with each additional leaf placed at the back of the pile. The spectrum of each stack of leaves was taken in the lower 1/3 of the leaf blades. The leaves' midribs were not part of the surface. The spectra were taken of the stacks having one (#1), two (#2), and four (#3) leaf layers.

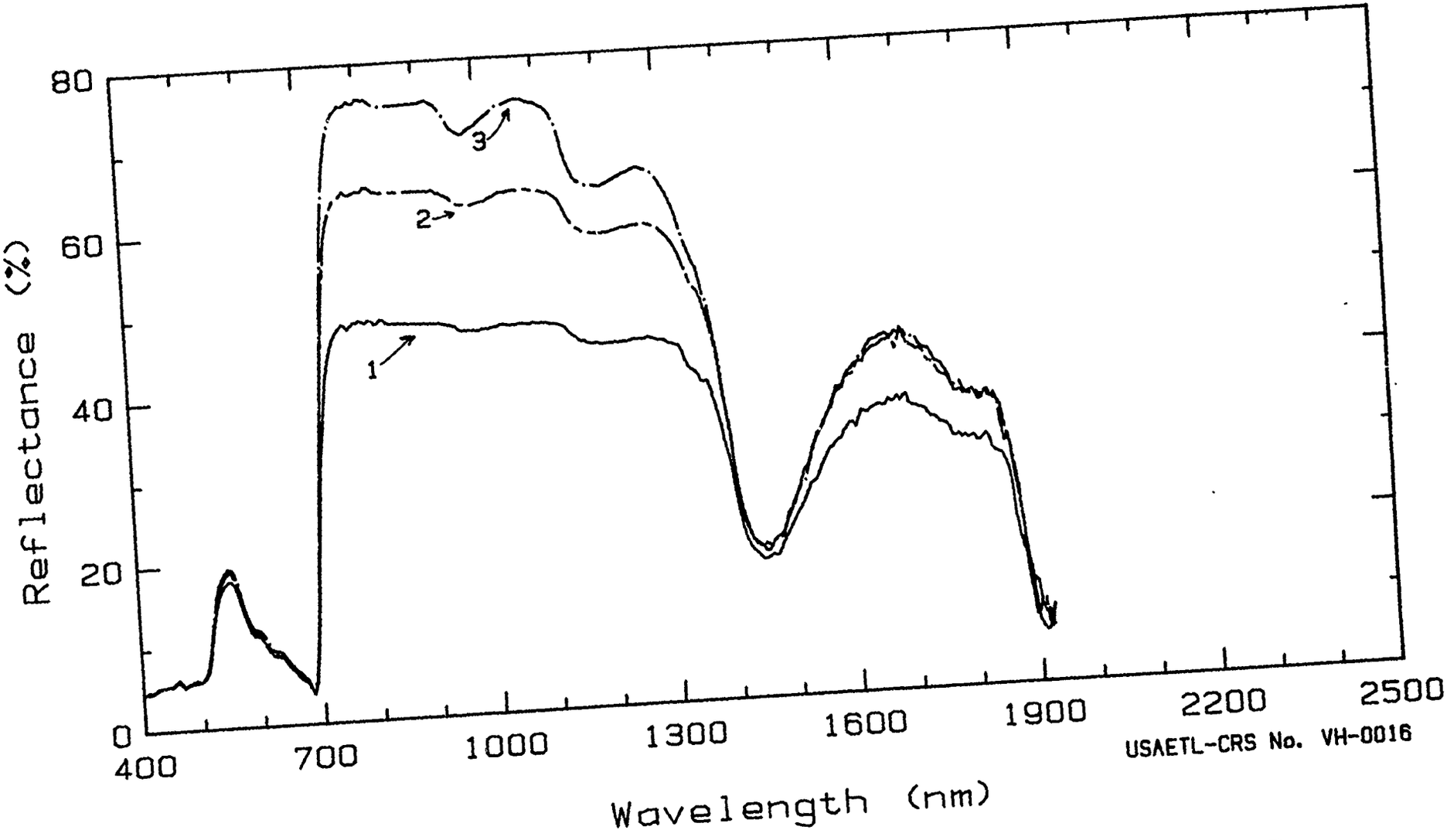
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.3	14.4	6.2	48.8	33.6	
2	6.4	15.1	6.3	64.4	40.1	
3	6.5	15.5	6.7	75.0	40.7	

Compiled by: Melvin B. Satterwhite Sheet No. VH-0016
USAETL-RI-RSD



Spectra of Layered Bush Bean Leaves.
Ft. Belvoir, Fairfax Co., VA; Aug., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Chrysanthemum Date Collected: Jun 1986
Specific Name: Chrysanthemum sp.
Spectrum No.: CHRYSAN.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, green "sun" leaves were taken periodically over a three-week period from a Chrysanthemum plant canopy that received direct sunlight. Leaves were placed into a plastic bag to minimize water loss. The spectrum of each leaf was taken in the lower 1/3 of the leaf blade. The leaf's midrib was not part of the surface. The spectra of twenty-one leaf samples were not statistically different from the group mean spectrum at the 95% confidence level. The mean curve (#1) and those (#2 & #3) representing one standard deviation of the mean curve, are shown.

Physical & Chemical Properties:

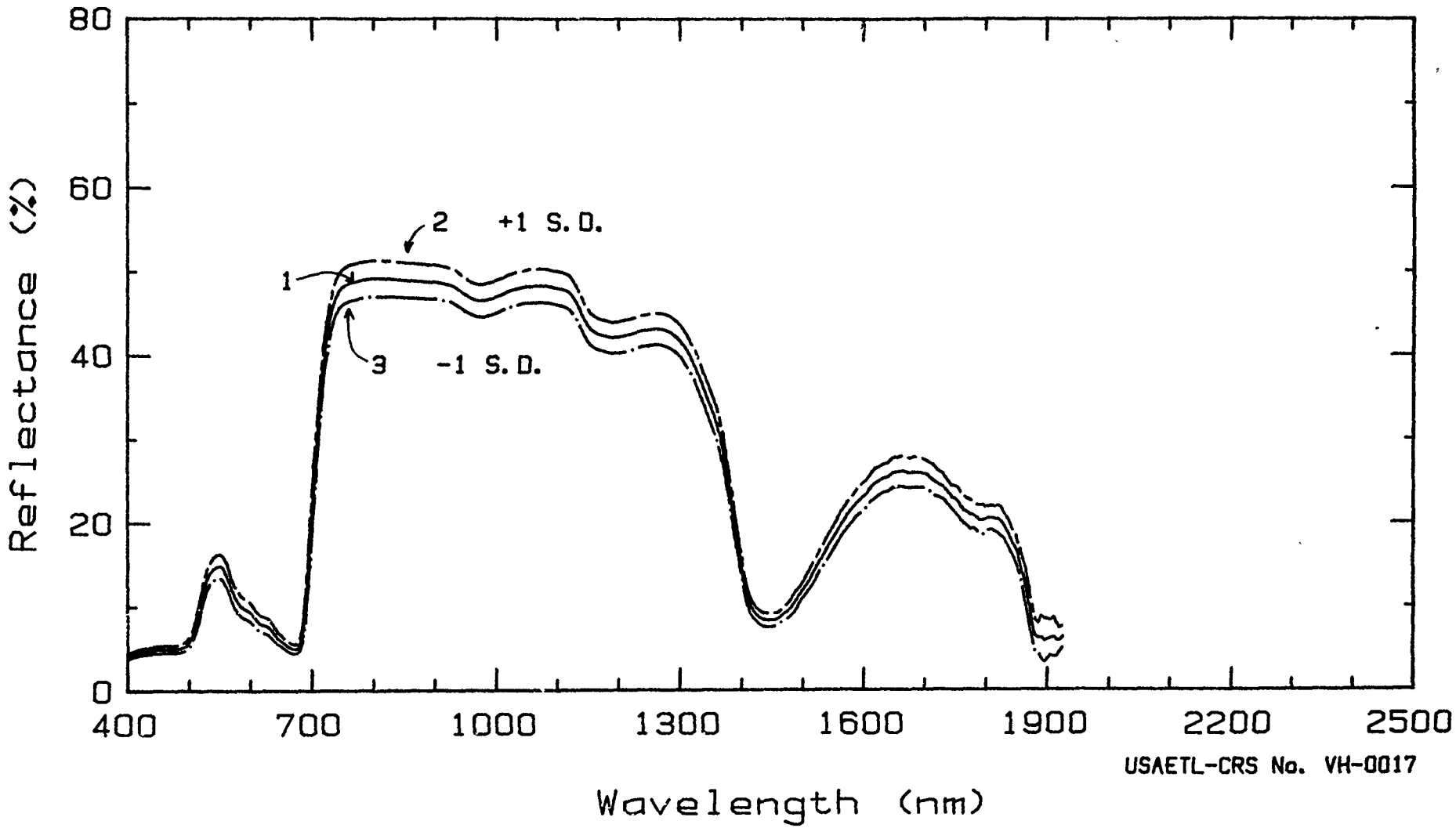
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.0	12.2	6.2	49.0	23.9	
2	6.5	13.5	7.0	51.1	25.6	
3	5.4	11.0	5.5	46.9	22.3	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VH-0017.



Spectra of Chrysanthemum Leaves.
Ft. Belvoir, Fairfax Co., VA; Jun., 1987.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Spinach Date Collected: May 1986
Specific Name: Spinacia oleracea L.
Spectrum No.: SPINACH.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate; barium sulfate reference standard.

Sample: Mature, green "sun" leaves were taken from the spinach canopy over a three-week period. All leaves were exposed to direct sunlight. Leaves were placed into a plastic bag to minimize water loss. The spectra of six leaves were taken in the lower 1/3 of the leaf blade, but the leaf's midrib was not part of the surface. The six leaf samples were not statistically different from the group mean curve at the 95% confidence level. The mean curve (#1) and those (#2 & #3) representing one standard deviation of the mean curve are shown.

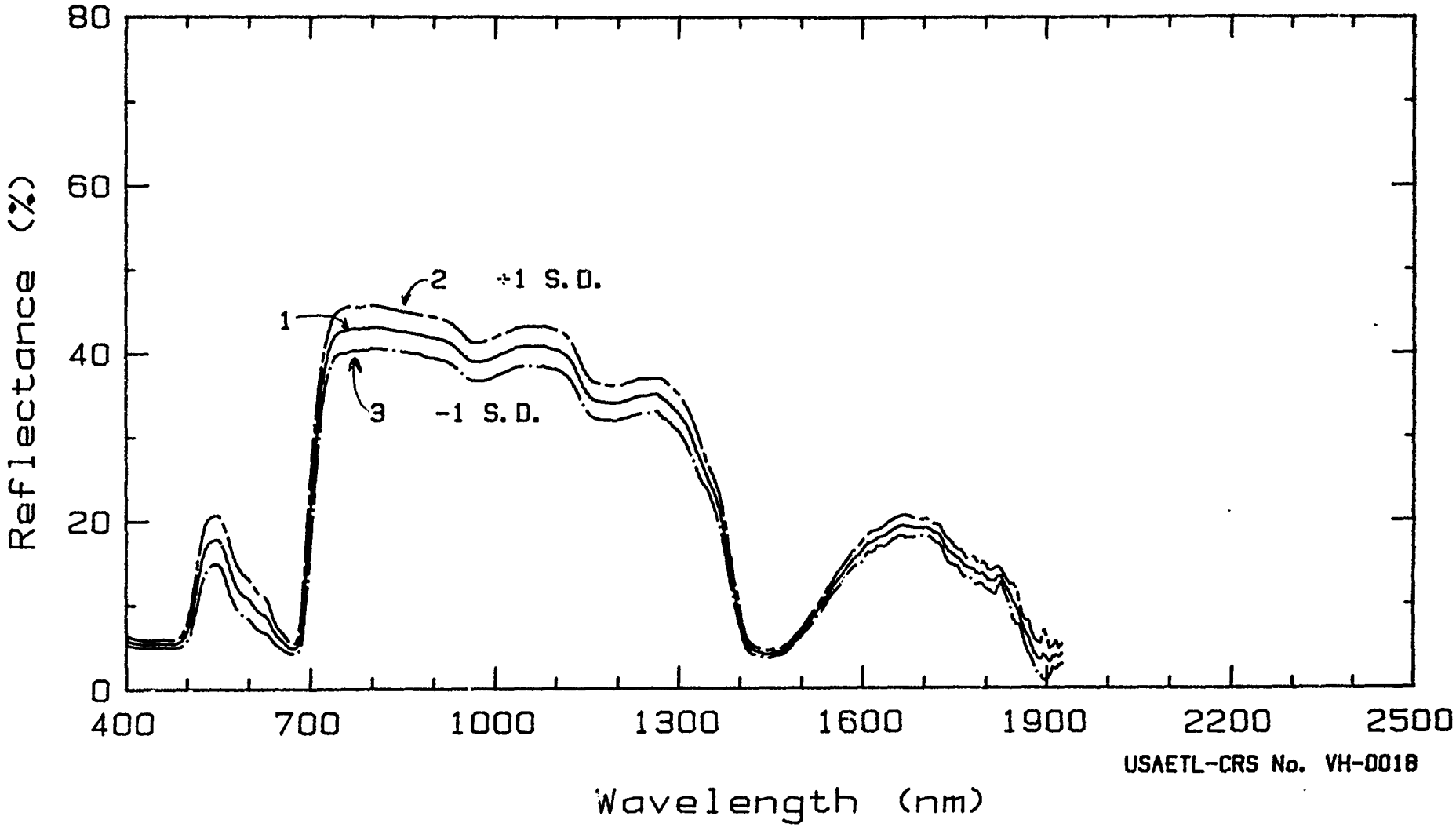
Physical & Chemical Properties:

Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: <0.7 m Crown Diameter: <0.5 m

Mean Reflectance (%) in Landsat Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	7.0	14.7	6.5	42.7	17.2	
2	8.0	17.4	7.7	45.2	18.2	
3	6.1	12.0	5.2	40.2	16.1	

Compiled by: Melvin B. Satterwhite Sheet No. VH-0018.
USAETL-RI-RSD



Spectra of Spinach Leaves.
Ft. Belvoir, Fairfax Co., VA; May., 1987.

Index of Reflectance Spectra for Soil Samples

SOIL TEXTURE	SHEET NUMBER	SPECTRUM NUMBER
Clay	S.0031	87LCA.06, .07, .56, .57
	S.0034	87LCS.50, .51, .52
	S.0035	LJOR.64, .65, .66
	S.0036	87LCA.09, .10, .15, .16
	S.0070	MOJ39.01, .10, .15
	S.0072b	MOJ04.01, .10, .15, .20
	S.0075	MOJ15.10, .15
	S.0082	MOJ36.01, .10, .15, .20
	S.0083	MOJ47.01, .10, .15
	S.0084	MOJ37.01, .10, .15, .20
	S.0093	MOJ28.01, .10, .15, .20
Silty Clay	S.0009	AU87.38, .39, .40, .41
	S.0024	AU87.41, AUW.42
	S.0047	LJOR.89, .91
	S.0047b	LJOR.92, .94, .95
	S.0069	MOJ17.01, .10, .15, .20
	S.0086	MOJ27.01, .10, .15, .20
	S.0090	MOJ51.01, .10, .15, .20
	S.0091	MOJ52.01, .10, .15, .20
Clay Loam	S.0066	MOJ01.01, .10, .15, .20
	S.0067	MOJ08.01, .10, .15, .20
	S.0068	MOJ14.01, .10, .15, .20
	S.0071	MOJ02.01, .10, .15, .20
	S.0073	MOJ12.01, .10, .15, .20
	S.0076	MOJ13.01, .10, .15, .20
	S.0079	MOJ34.01, .10, .15
Silty Clay Loam	S.0048	LJOR.105, .106, .107
	S.0063	MOJ48.01, .10, .15, .20
	S.0064	MOJ50.01, .10, .15, .20
	S.0065	MOJ20.01, .10
	S.0080	MOJ38.01, .10, .15, .20
	S.0085	MOJ26.01, .10, .15, .20
	S.0088	MOJ41.01, .10, .15, .20
	S.0089	MOJ43.01, .10, .15
Silt Loam	S.0008	AU87.33, .34, .35, .36, .37
	S.0023	AU87.37, AUW.38
	S.0072c	MOJ03.01, .10, .15, .20
	S.0074	MOJ18.01, .10, .15, .20
Silty Loam	S.0013	AU87.56, .57, .58, .59, .60
	S.0028	AU87.56, AUW.61

(continued)

Index of Reflectance Spectra for Soil Samples

SOIL TEXTURE	SHEET NUMBER	SPECTRUM NUMBER
Loam	S.0001	AU87.01, .02, .03, .04
	S.0006	AU87.25, .26, .29
	S.0016	AU87.01, AUW.04
	S.0021	AU87.29, AUW.29
	S.0032	87LCS.32, .33
	S.0033	LJOR.25, .26, .27, .28
	S.0072	MOJ07.01, .15
	S.0077	MOJ11.01, .10, .15, .20
	S.0081	MOJ06.01, .10, .15, .20
Loam (gypsiferous)	S.0051	LJOR.96, .97, .98
Sandy Loam	S.0010	AU87.42, .43, .44, .45
	S.0011	AU87.46, .47, .48, .49, .50
	S.0012	AU87.53, .54, .55
	S.0025	AU87.45, AUW.46
	S.0026	AU87.50, AUW.51
	S.0027	AU87.55, AUW.56
	S.0037	87LCA.19, .20, .22
	S.0041	87LCA.35, .36, .37
	S.0055	MOJ23.01, .10, .15, .20
	S.0061	MOJ44.01, .10, .15
	S.0062	MOJ49.01, .10, .15, .20
	S.0087	MOJ40.01, .10, .15, .20
	S.0094	MOJ22.01, .10, .15, .20
Loamy Sand	S.0002	AU87.05, .06, .07, .08, .09
	S.0003	AU87.10, .11, .12, .13, .14
	S.0004	AU87.15, .16, .17, .18, .19
	S.0005	AU87.20, .21, .22, .23, .24
	S.0017	AU87.09, AUW.09
	S.0018	AU87.14, AUW.14
	S.0019	AU87.19, AUW.19
	S.0020	AU87.24, AUW.24
	S.0042	87LCS.44, .45, .46
	S.0043	LJOR.54, .55, .56, .60, .62, .63
	S.0046	87LCA.43, .44, .45, .48, .49, .50
	S.0059	LYUM.34, .35, .36
	S.0060	MOJ57.01, .15, .20

(continued)

Index of Reflectance Spectra for Soil Samples

SOIL TEXTURE	SHEET NUMBER	SPECTRUM NUMBER
Sand	S.0007	AU87.30, .31, .32
	S.0014	AU87.61, .62, .63, .64
	S.0022	AU87.32, .AUW.33
	S.0029	AU87.64, AUW.65
	S.0038	87LCS.03, .04, .05, .11, .12,
	S.0039	LJOR.12, .13, .14
	S.0044	87LCS.23, .27
	S.0045	LJOR.48, .49, .51
	S.0054	LYUM.31, .32
	S.0056	MOJ09.01, .10, .15, .20
	S.0056b	MOJ31.01, .10, .15, .20
	S.0056c	MOJ35.01, .10, .15, .20
	S.0056d	MOJ42.10, .15
	S.0056e	MOJ46.01, .10, .15
	S.0058	87YAA.06, .09, .10
	S.0078	MOJ16.01, .10, .15, .20
	S.0092	MOJ21.01, .10, .15, .20
	S.0095	MOJ19.01, .10, .15, .20
	S.0096	MOJ24.01, .10, .15, .20
	S.0097	MOJ25.01, .10, .15, .20
Sand (Gypsum)	S.0015	AU87.65, .66, .67
	S.0030	AU87.67, AUW.69
	S.0049	87LCS.62, .63
	S.0050	LJOR.83, .84, .85, .86
Gravelly Loamy Sand	S.0057	87YAA.29, .30, .31
Gravel	S.0052	LYUM.42, .44, .45
	S.0053	87YAA.23, .24, .25
Gravel (caliche)	S.0040	LJOR.24

Laboratory Spectral Reflectance of Soil

Soil Texture: Loam
Taxonomy: Ustollic Caliciorthid
Unified System: SM-SC
Mapping Unit: Dona Ana-Reagan Association 1/
Spectrum No.: AU87.01, .02, .03, .04

Date Collected: 20 Feb 1986
Sample Number: AU-01

Site Location: Dona Ana County, NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um and pan. Each sieve separate was analyzed spectroradiometrically (curve A, B and C, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample.
Composition: 34.7% Sand, 43.0% Silt, 22.3% Clay
Moisture Content: 2% (O.D. basis)

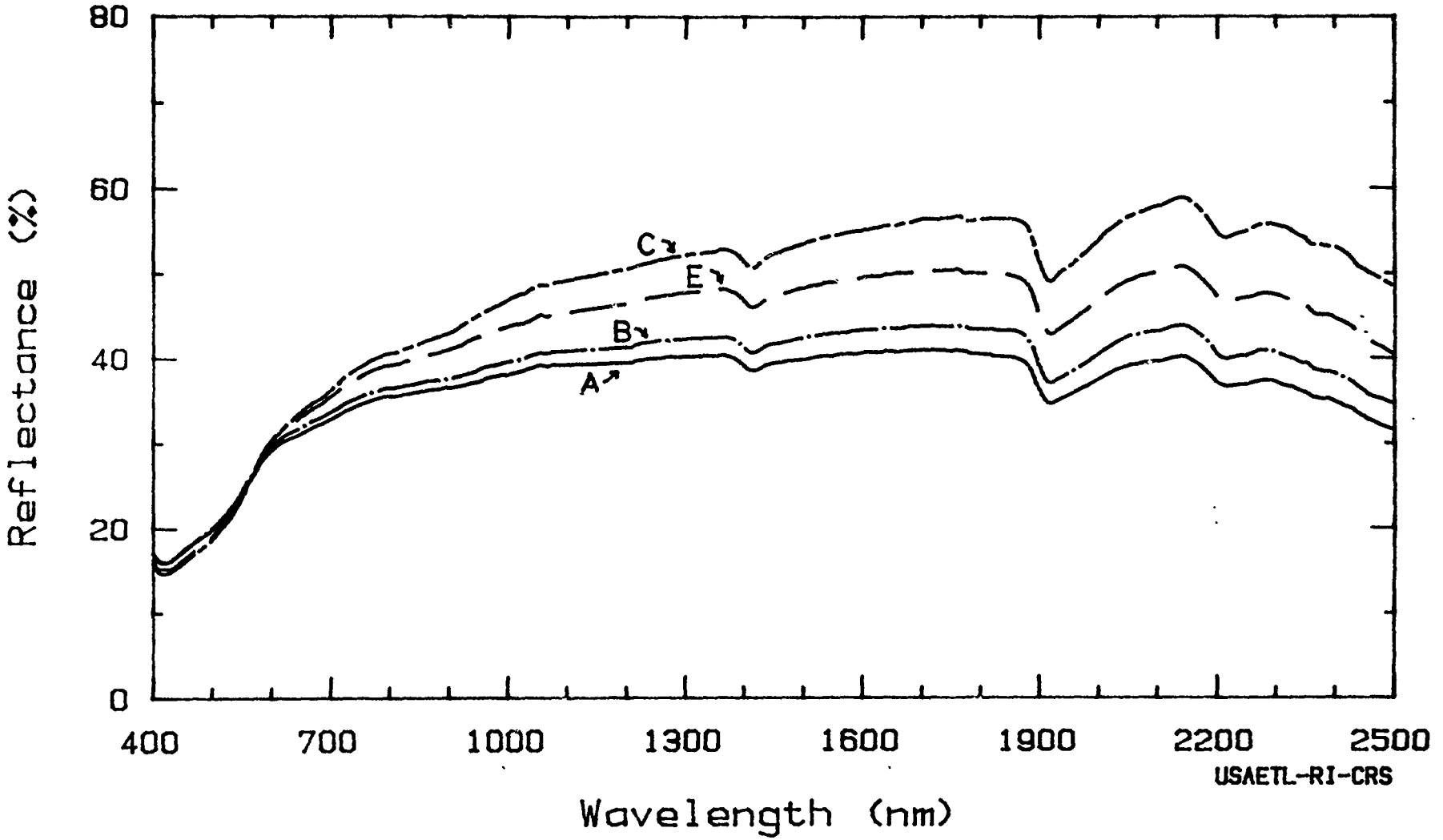
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	19.2	25.2	31.6	35.9	40.8	38.0
B	19.3	25.6	32.3	36.9	43.5	41.5
C	17.9	25.2	34.2	41.3	55.7	56.3
E	18.2	25.3	33.7	39.8	49.8	48.3

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0001.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-01, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/.
Spectrum No.: AU87.05, .06, .07, .08, .09

Date Collected: 20 Feb 86
Sample Number: AU-02

Site Location: Dona Ana County, NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um and pan. Each sieve separate was analyzed spectroradiometrically (curves A, B, C and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 82.9% Sand, 7.7% Silt, 9.4% Clay
Moisture Content: 1% (O.D. basis)

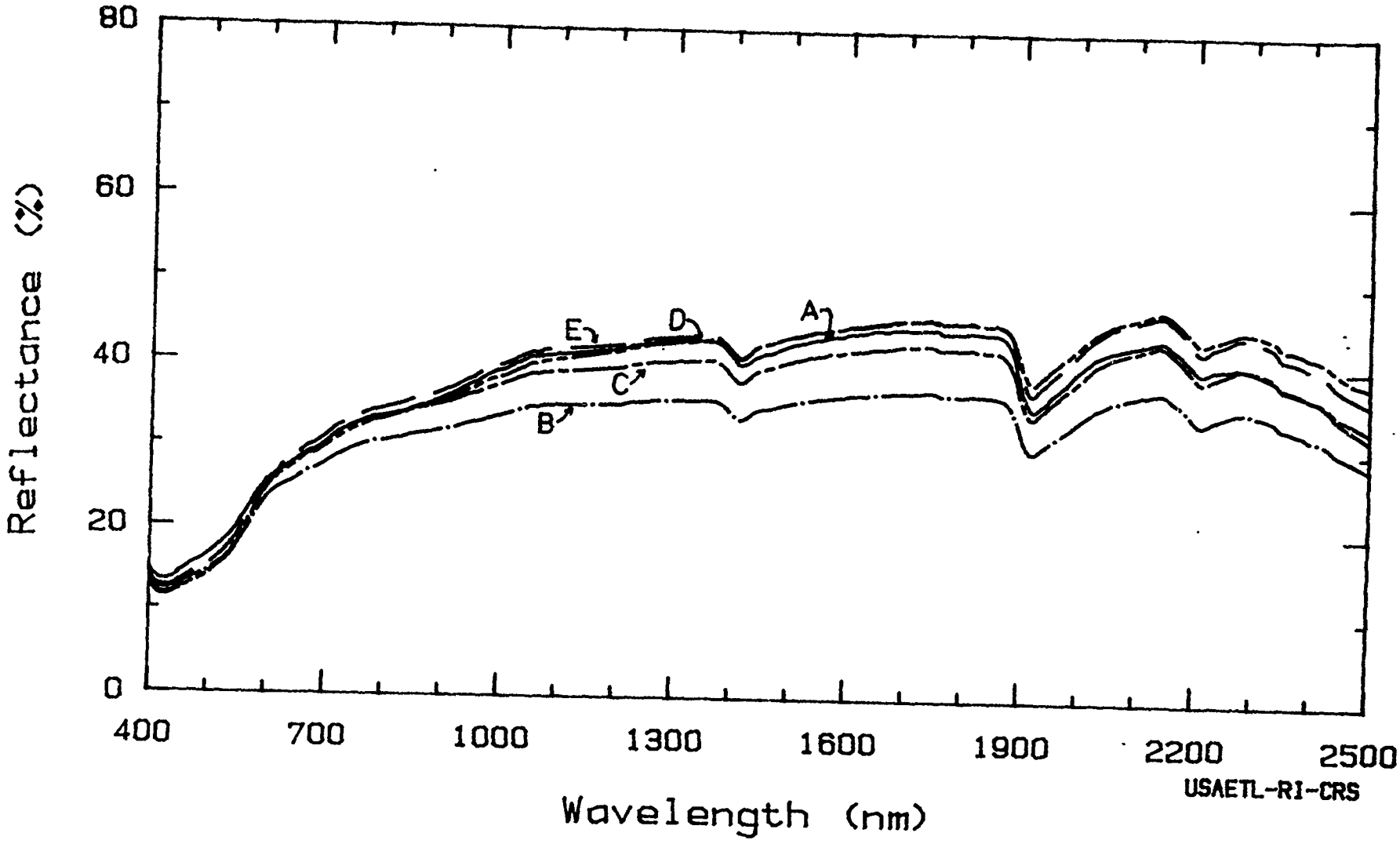
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	15.8	21.3	28.3	34.0	44.2	41.0
B	14.0	19.1	26.2	30.9	36.6	35.2
C	13.6	19.4	28.2	33.9	42.0	40.5
D	13.6	19.6	28.0	33.7	45.1	44.8
E	14.6	20.5	29.0	34.9	45.1	44.1

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0002.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-02, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SM
Mapping Unit: Berino-Bucklebar Association 1/.
Spectrum No.: AU87.10, .11, .12, .13, .14.
Site Location: Dona Ana County, New Mexico, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Date Collected: 20 Feb 86
Sample Number: AU-03

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (Index E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um and pan. Each sieve separate was analyzed spectroradiometrically (Indices A, B, C and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 85.4% Sand, 5.8% Silt, 8.8% Clay
Moisture Content: 1% (O.D. basis)

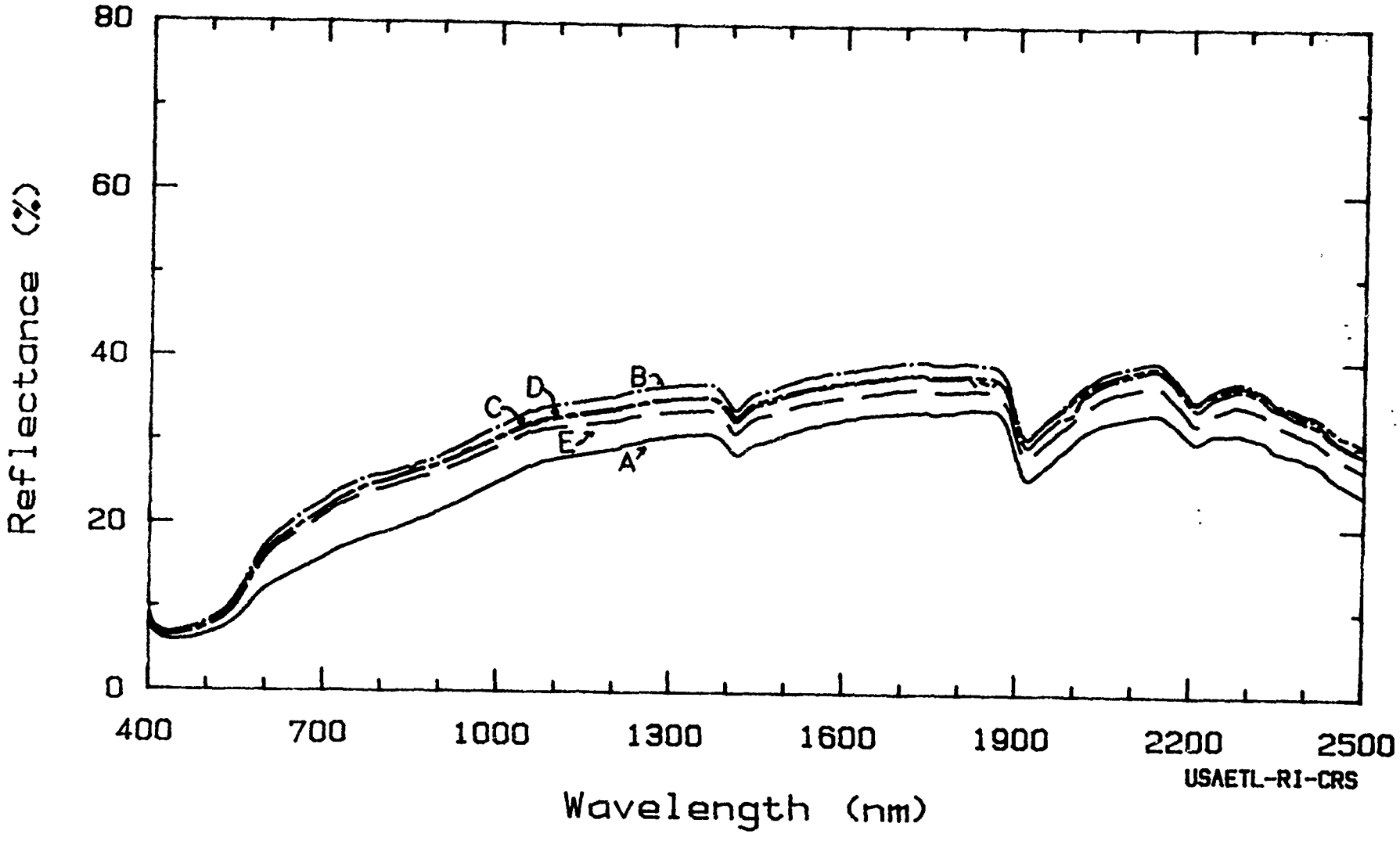
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	6.4	9.3	14.4	19.6	33.2	31.7
B	7.8	12.5	20.8	26.5	39.1	37.5
C	7.2	11.7	19.7	25.6	37.5	36.6
D	7.5	12.1	19.8	25.7	37.6	37.1
E	7.3	11.5	19.1	24.8	35.8	34.7

Compiled by: Melvin B. Satterwhite.
USAETL-RI-CRS.

Sheet No: S-0003.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-03, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SP-SM
Mapping Unit: Wink-Pintura Complex 1/
Spectrum No.: AU87.15, .16, .17, .18, .19.

Date Collected: 20 Feb 1986
Sample Number: AU-04

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um and pan. Each sieve separate was analyzed spectroradiometrically, (curves A, B, C and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 87.6% Sand, 3.1% Silt, 9.4% Clay
Moisture Content: 1% (O.D. basis)

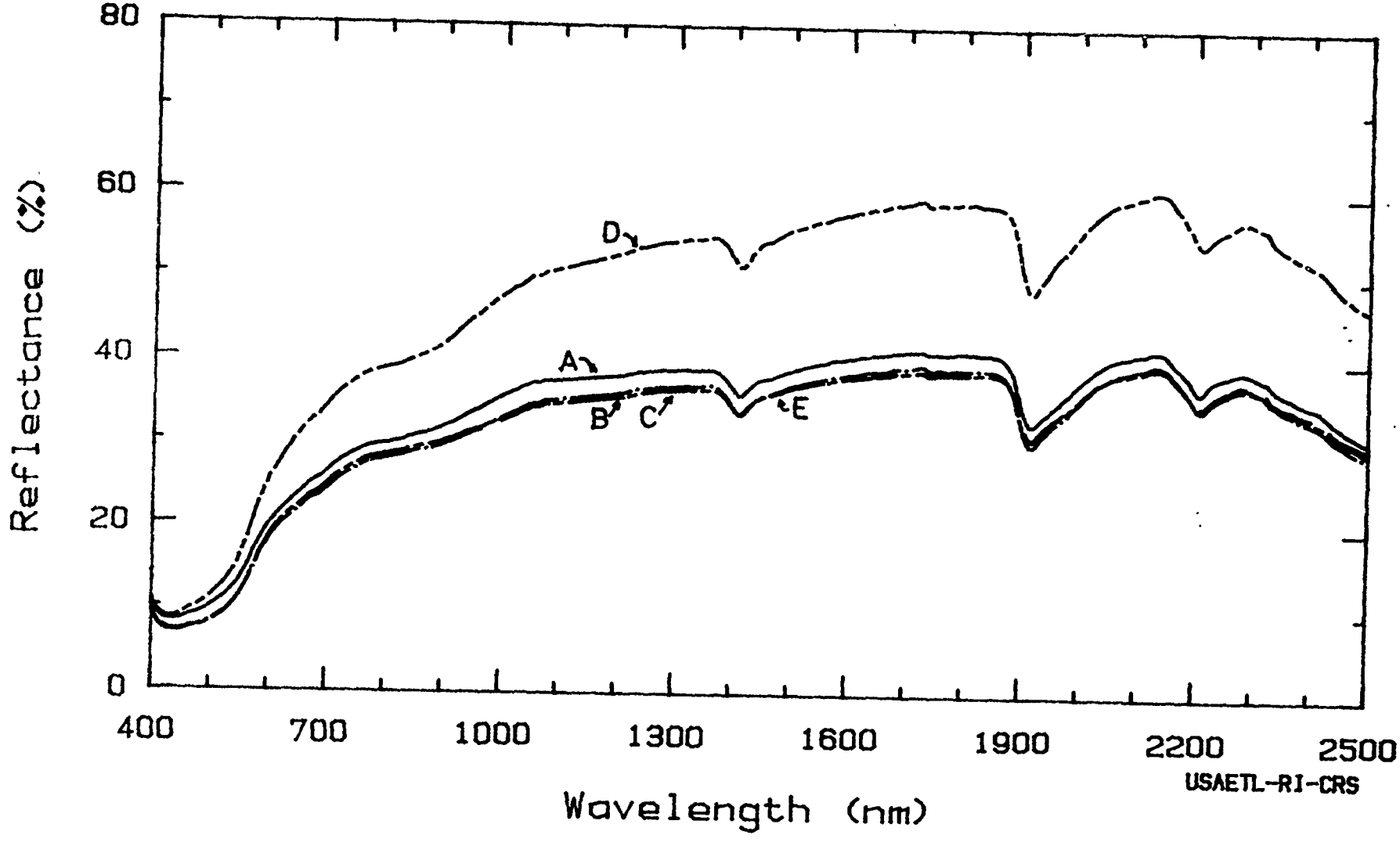
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	9.5	14.8	24.1	30.3	40.7	39.0
B	7.9	12.9	22.1	28.4	38.8	37.2
C	7.8	13.0	22.6	28.9	38.2	37.1
D	10.5	18.0	31.2	39.5	58.3	57.2
E	8.0	12.9	22.2	28.4	38.3	37.4

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0004.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-04, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Paleorthid
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/
Spectrum No.: AU87.20, .21, .22, .23, .24.

Date Collected: 20 Feb 1986
Sample Number: AU-05

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um and pan. Each sieve separate was analyzed spectroradiometrically (curve A, B, C and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 80.0% Sand, 11.9% Silt, 8.1% Clay
Moisture Content: 1% (O.D. basis)

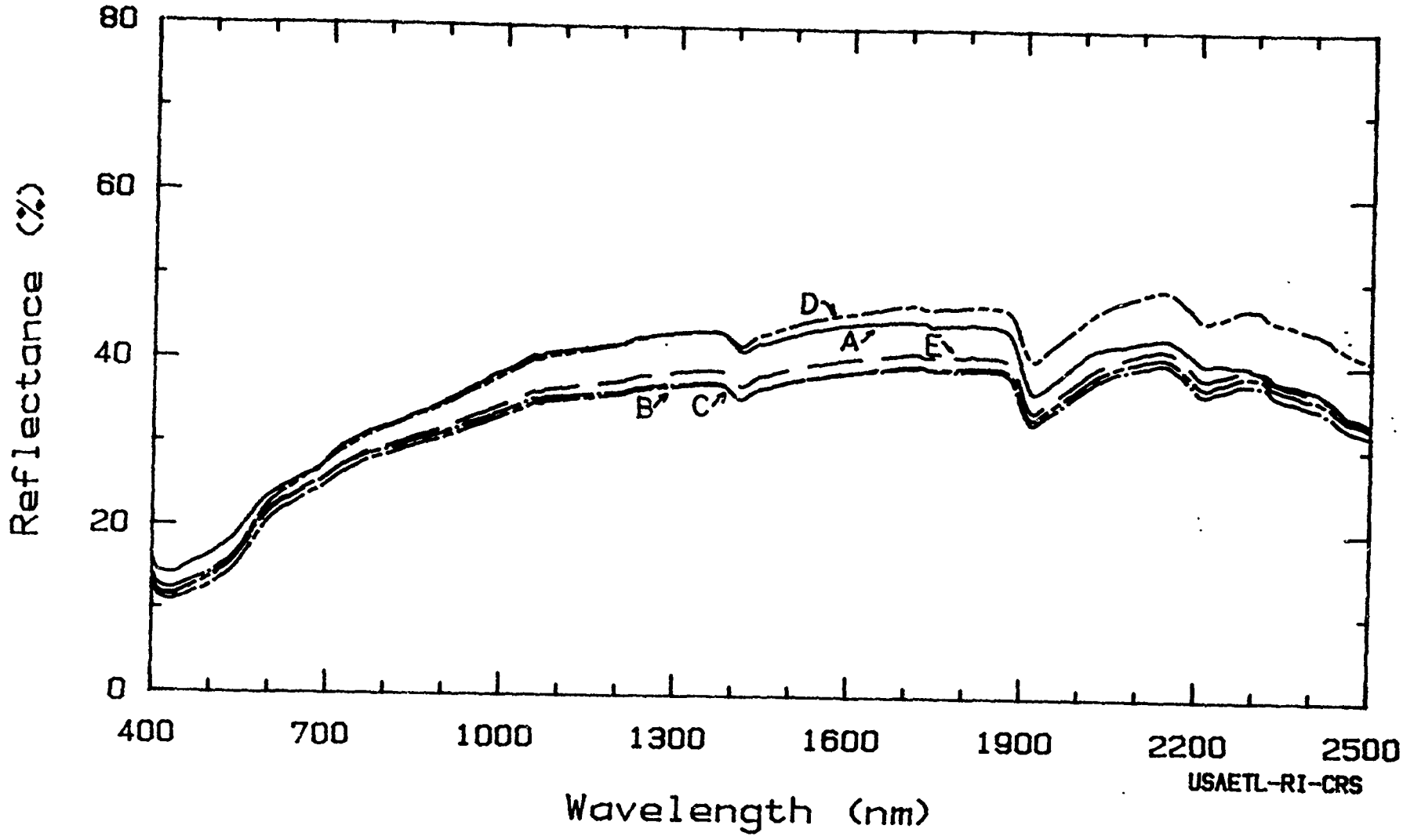
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	16.0	20.4	25.9	32.8	44.7	40.9
B	13.8	18.3	24.3	29.8	39.1	38.1
C	12.4	16.9	23.4	29.2	39.2	38.9
D	13.3	18.5	25.7	32.6	46.3	46.9
E	13.2	17.9	24.3	30.2	40.6	39.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0005.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-05, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loam
Taxonomy: Ustollic Calciorthid
Unified System: SM
Mapping Unit: Dona Ana-Reagan Association 1/
Spectrum No.: AU87.25, .26, .29.

Date Collected: 20 Feb 1986
Sample Number: AU-06

Site Location: Dona Ana County, NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um and 210 um. Each sieve separate was analyzed spectroradiometrically (curves A and B, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 45.6% Sand, 32.9% Silt, 21.5% Clay
Moisture Content: 3% (O.D. basis)

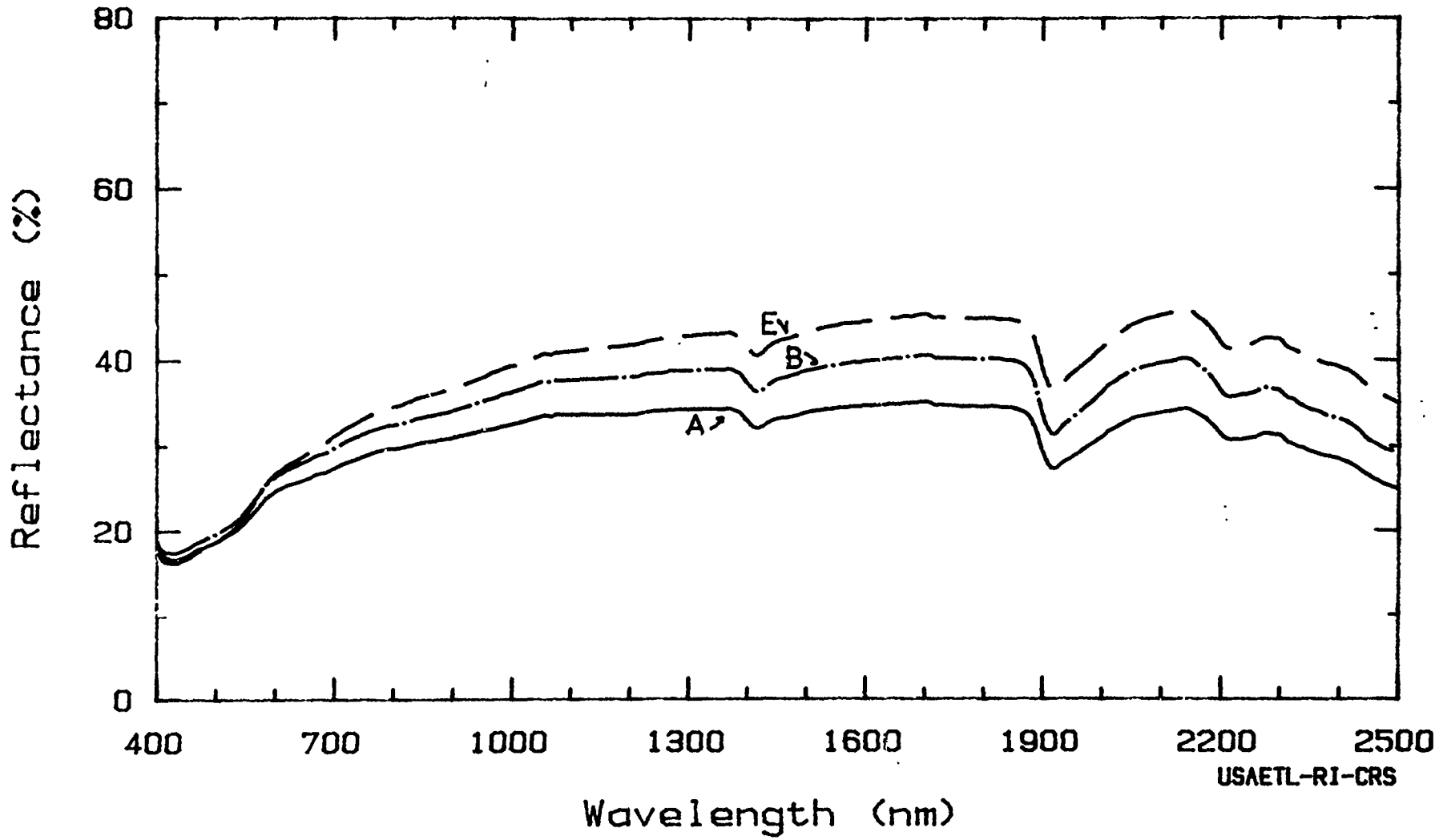
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	18.2	22.0	26.4	30.2	34.9	32.0
B	19.2	23.3	28.6	33.1	40.2	37.4
E	18.1	23.0	29.4	35.3	44.8	43.1

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0006.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-06, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand
Taxonomy: Aridisol
Unified System: SP-SM
Mapping Unit: Onite-Pintura Association 1/
Spectrum No.: AU87.30, .31, .32.

Date Collected: 20 Feb 1986
Sample Number: AU-07

Site Location: Dona Ana County, NM, USA.
32.8 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 210 um and 74 um. Each sieve separate was analyzed spectroradiometrically (curves B and C, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 93.4% Sand, 2.7% Silt, 4.0% Clay
Moisture Content: 3% (O.D. basis)

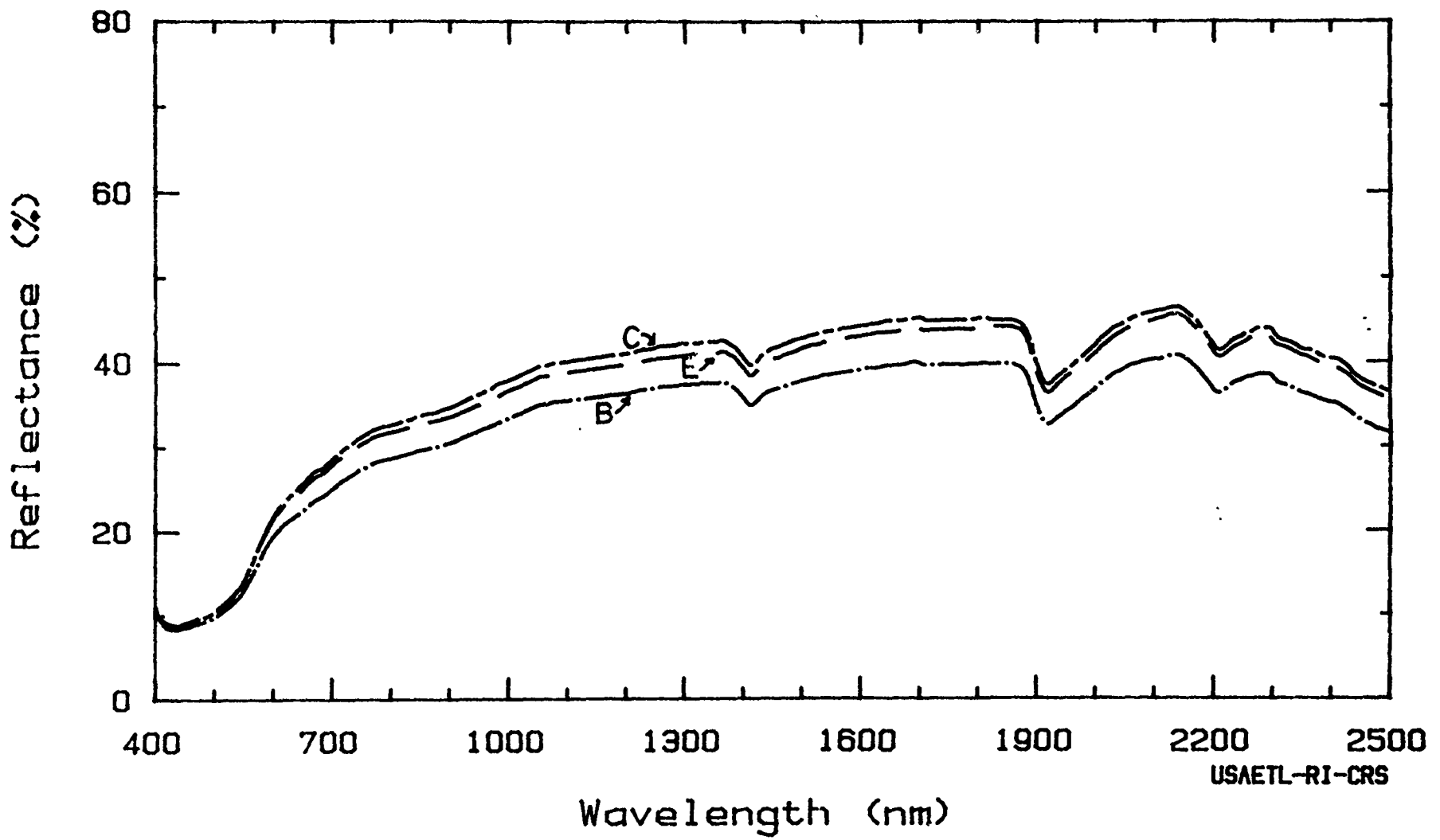
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 [illegible]-0 nm	Band 7 2080-2350 nm
B	3.5	14.6	23.1	29.3	39.5	38.6
C	9.9	16.0	26.3	33.3	44.7	9
E	10.1	15.9	25.7	32.3	43.5	43.1

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0007.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-07, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silt Loam
Taxonomy: Aridisol
Unified System: ML
Mapping Unit: Dona Ana-Reagan Association 1/
Spectrum No.: AU87.33, .34, .35, .36, .37.

Date Collected: 20 Feb 1986
Sample Number: AU-08

Site Location: Dona Ana County, NM, USA
32.7 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curves A, B, C, and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 40.0% Sand, 54.0% Silt, 6.1% Clay
Moisture Content: 4% to 11% (O.D. basis)

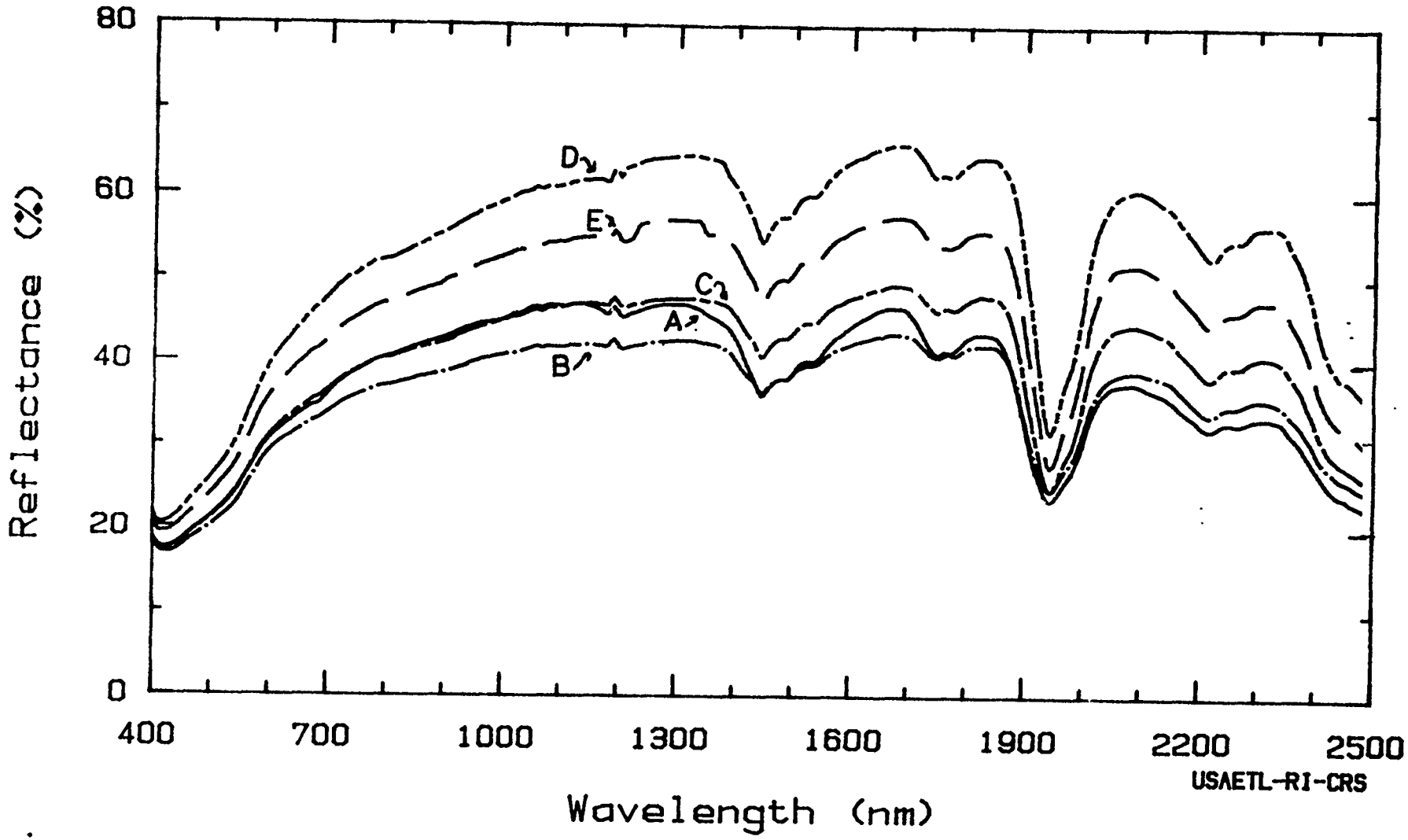
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	20.4	26.5	33.9	41.3	44.4	34.1
B	19.4	25.0	32.1	37.6	42.3	36.0
C	20.3	26.5	34.5	41.0	47.9	41.0
D	24.8	33.3	44.8	53.2	64.4	56.4
E	23.0	30.4	40.2	47.8	56.0	47.7

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0008.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-08, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Unified System: CL
Mapping Unit: Lake Bed (ephemeral) 1/
Spectrum No.: AU87.38, .39, .40, .41.

Date Collected: 20 Feb 1986
Sample Number: AU-09

Site Location: Dona Ana County, NM, USA
32.7 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um and 74 um. Each sieve separate was analyzed spectroradiometrically (curves A, B, and C, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 3.6% Sand, 40.2% Silt, 56.2% Clay
Moisture Content: 5% (O.D. basis)

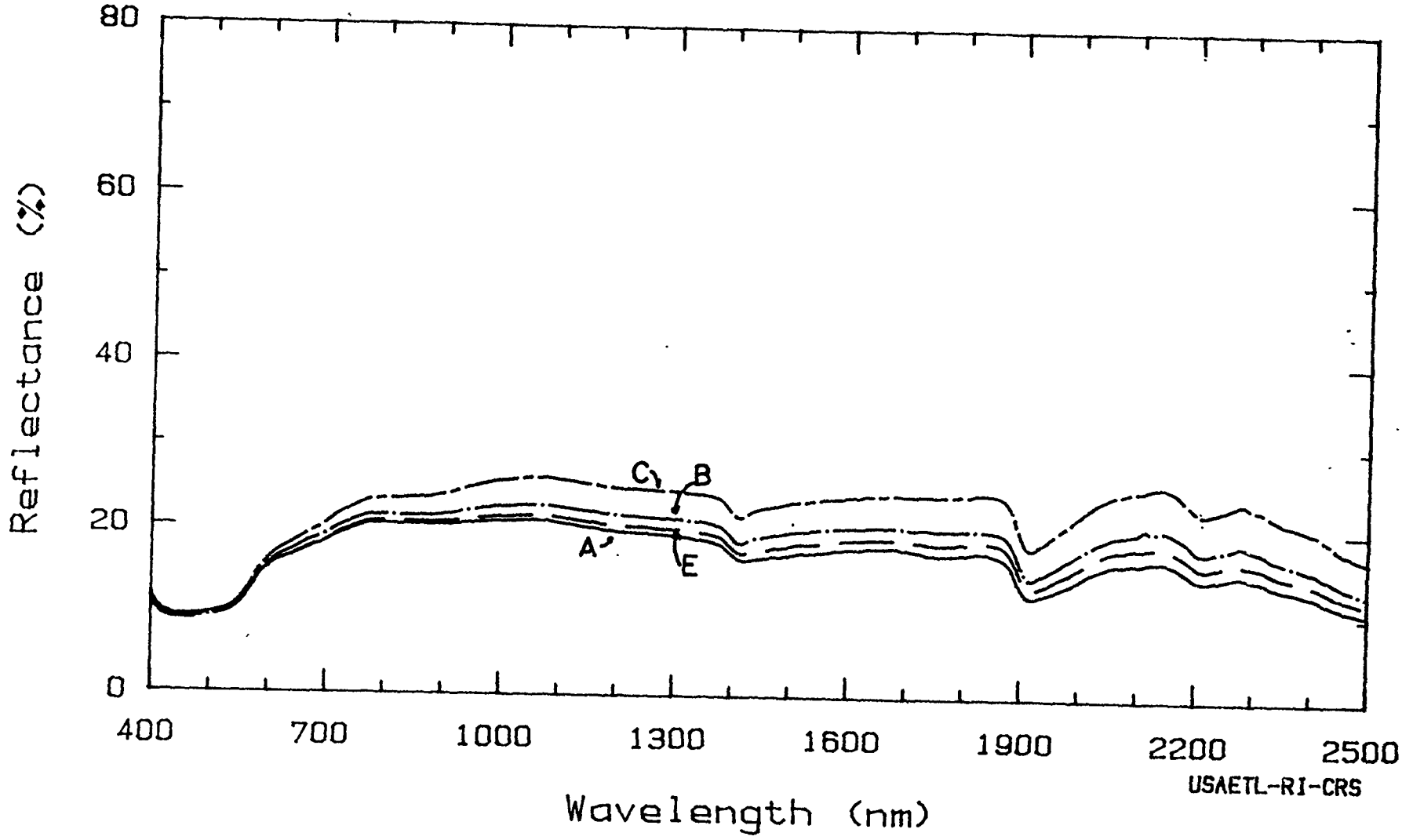
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	9.3	11.9	17.0	20.3	17.6	15.2
B	9.0	11.9	17.7	21.3	20.2	18.7
C	9.1	12.2	18.7	23.4	24.1	23.6
E	8.8	11.6	17.1	20.5	18.7	16.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0009.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-09, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/
Spectrum No.: AU87.42, .43, .44, .45.

Date Collected: 20 Feb 1986
Sample Number: AU-10

Site Location: Dona Ana County, NM, USA.
32.8 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 210 um, 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curves B, C, and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 71.9% Sand, 22,6% Silt, 5.5% Clay
Moisture Content: 5% (O.D. basis)

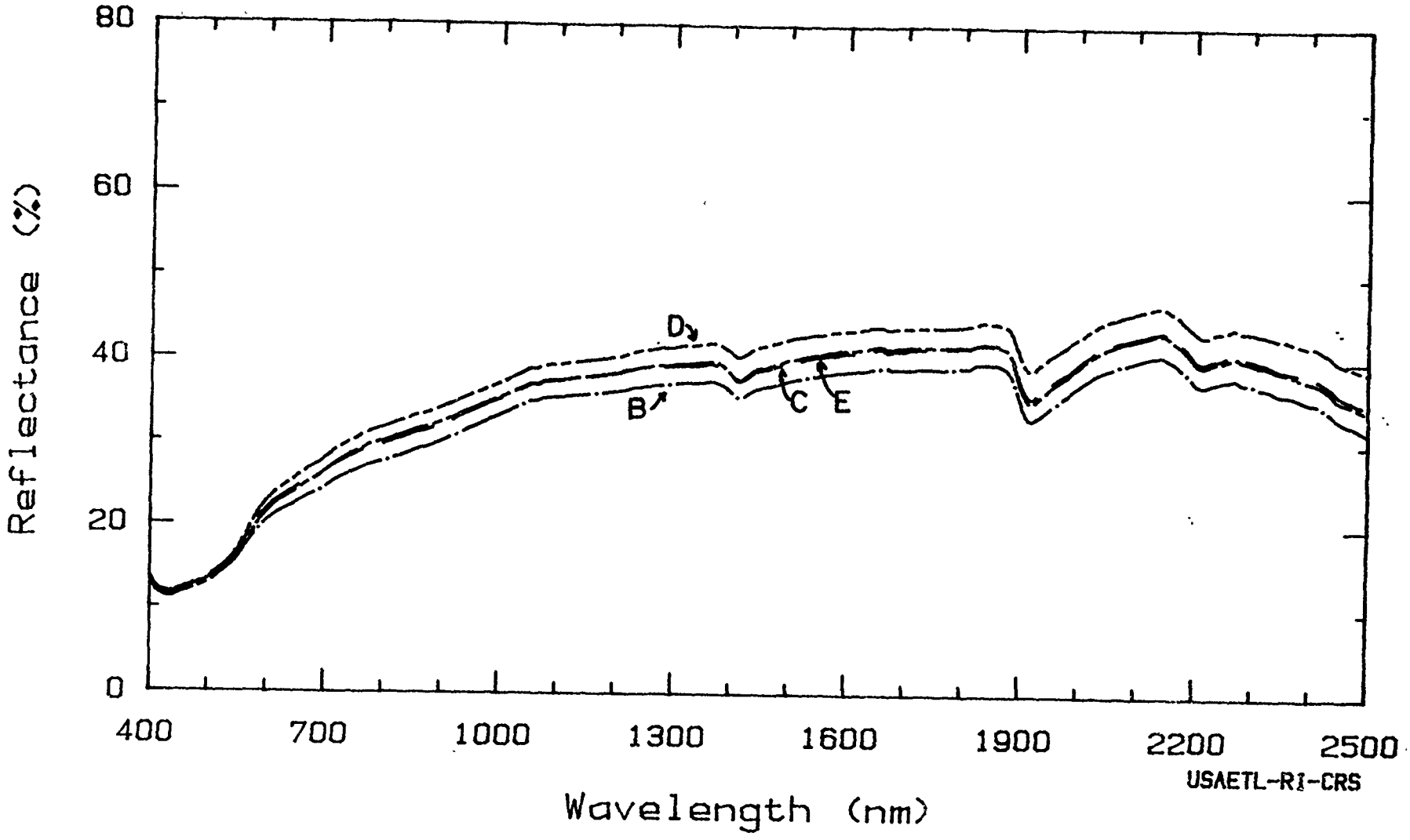
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
B	13.0	17.1	22.9	28.3	38.8	38.5
C	12.6	17.3	24.4	30.7	41.4	41.0
D	12.9	18.3	26.0	32.4	43.7	44.5
E	13.2	17.9	24.7	30.4	41.0	41.3

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0010.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-10, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: SM
Mapping Unit: Onite-Pajarito Association 1/
Spectrum No.: AU87.46, .47, .48, .49, .50.

Date Collected: 20 Feb 1986
Sample Number: AU-11

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curve A, B, C, and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:
Composition: 76.8% Sand, 12.9% Silt, 10.3% Clay
Moisture Content: 2% (O.D. basis)

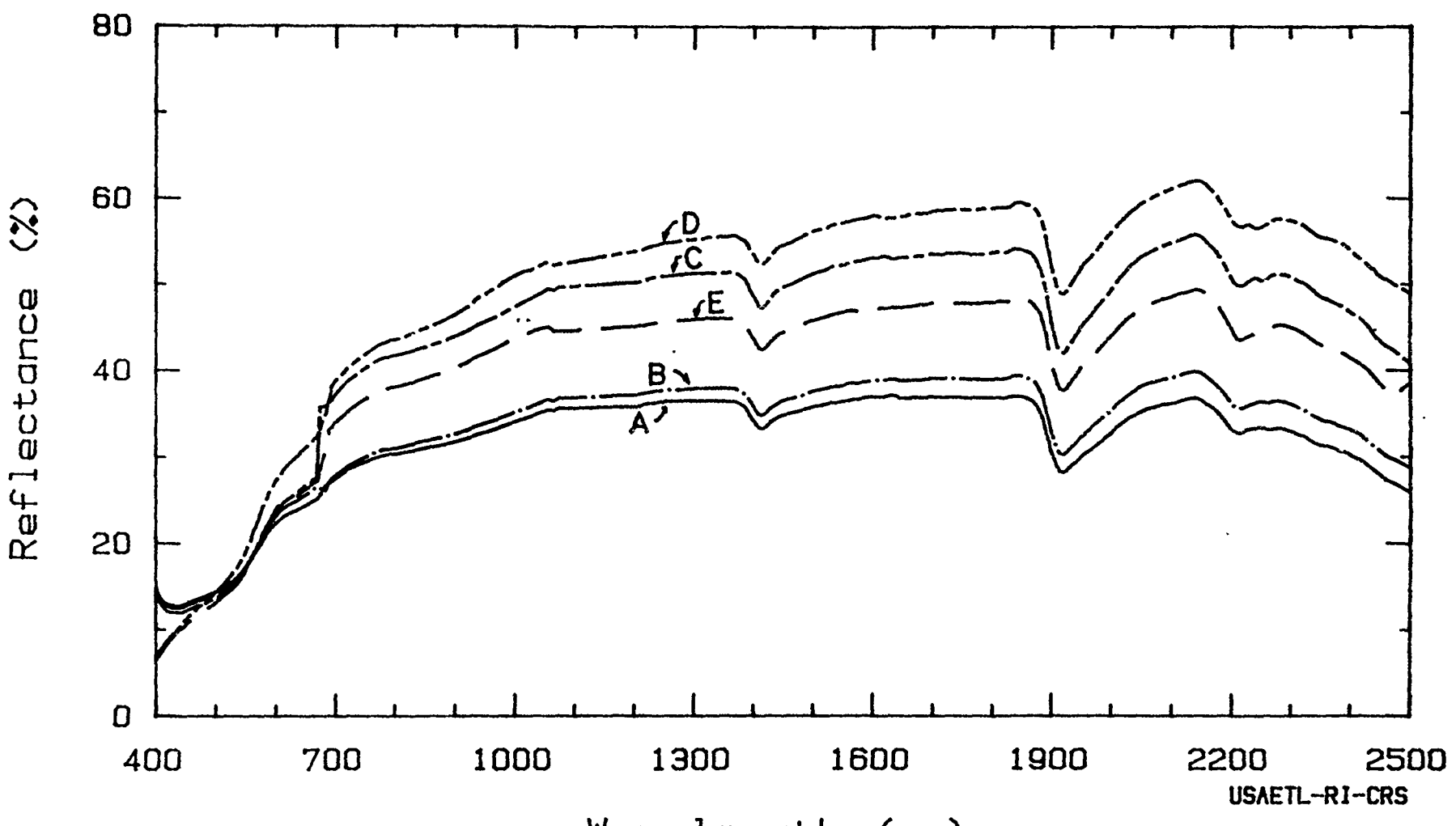
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	14.0	18.4	25.0	30.8	36.9	34.2
B	13.8	18.7	25.8	31.5	38.9	37.2
C	13.2	18.6	29.5	42.3	53.2	52.4
D	13.4	21.0	32.2	44.4	58.1	58.6
E	12.4	18.4	27.6	38.7	47.4	46.1

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0011.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-11, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: GM, GP-GM
Mapping Unit: Nickel, Tencee, Delnorte Complex 1/
Spectrum No.: AU87.53, .54, .55.

Date Collected: 20 Feb 1986
Sample Number: AU-12

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 107.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curves C, and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 69.2% Sand, 22.1% Silt, 8.7% Clay
Moisture Content: 2% (O.D. basis)

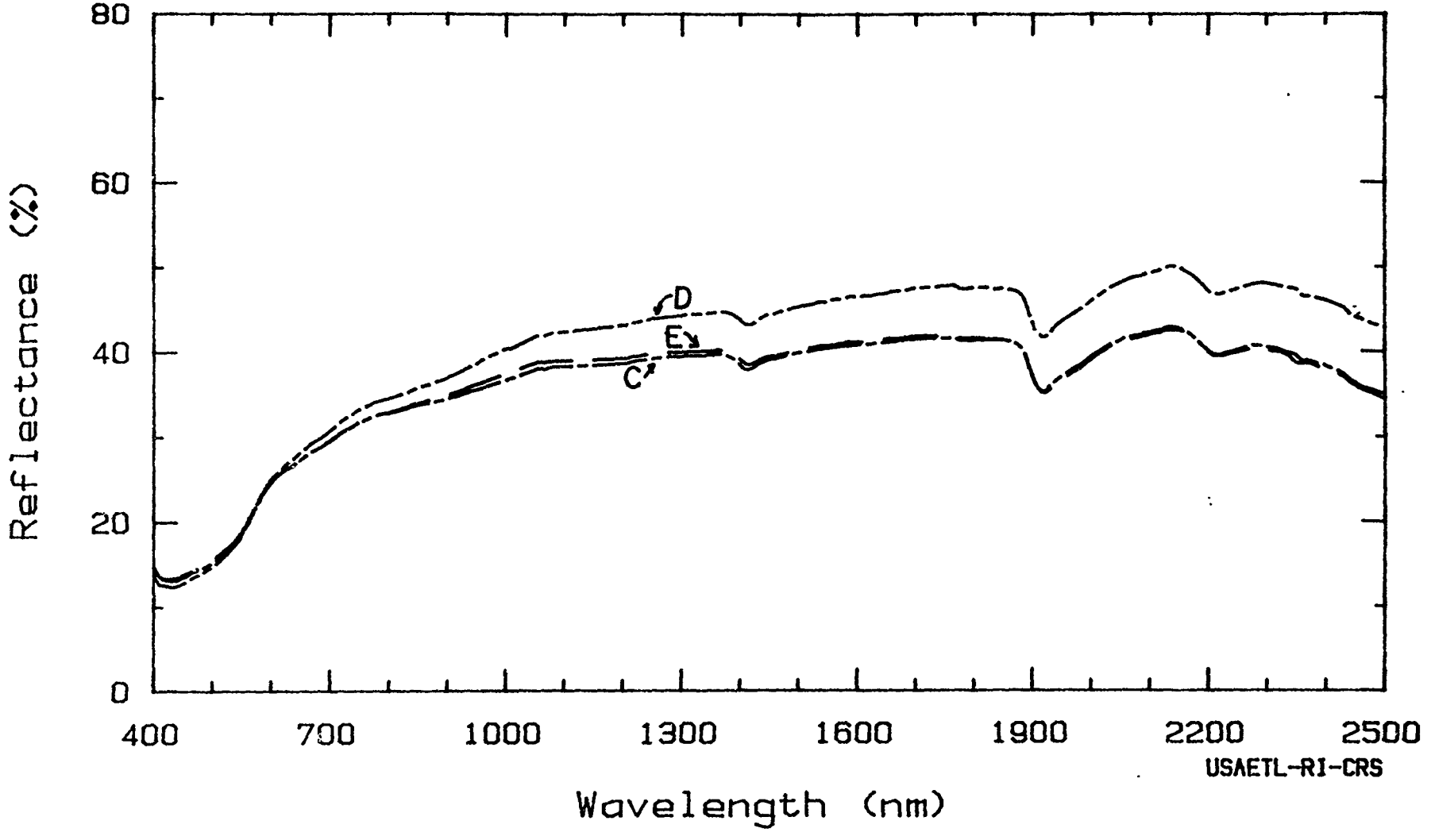
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
C	14.8	20.1	27.8	33.4	41.2	41.0
D	14.2	20.1	28.7	35.4	47.0	48.3
E	15.0	20.3	27.8	33.6	41.5	40.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0012.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-12, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silty Loam
Taxonomy: Typic Camborthid
Unified System: CL
Mapping Unit: Marconi 1/
Spectrum No.: AU87.56, .57, .58, .59, .60.

Date Collected: 20 Feb 1986
Sample Number: AU-13

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 107.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 500 um, 210 um, 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curves A, B, C, and D, respectively). Moisture contents were determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 9.7% Sand, 71.9% Silt, 18.4% Clay
Moisture Content: 3% (O.D. basis)

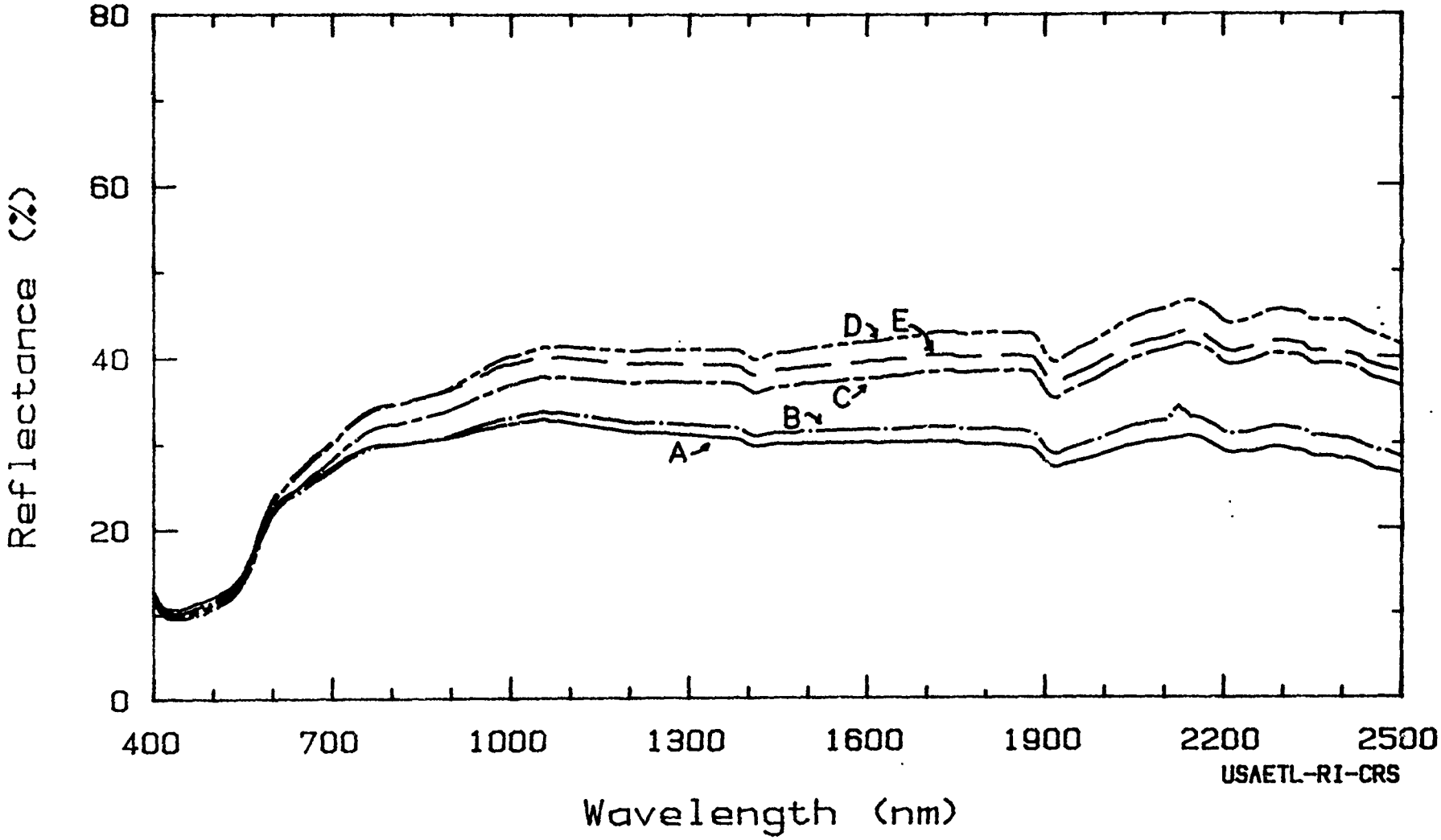
Ref: 1/ SCS-UDSA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A	11.7	17.0	25.7	30.2	30.2	29.7
B	11.2	16.4	25.2	30.2	31.8	32.1
C	10.4	15.8	25.9	32.8	37.9	40.3
D	10.8	16.6	27.6	35.1	42.3	45.2
E	11.2	17.1	28.0	35.1	39.8	41.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0013.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-13, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamments
Unified System: SM
Mapping Unit: Bluepoint 1/
Spectrum No.: AU87.61, .62, .63, .64.

Date Collected: 20 Feb 1986
Sample Number: AU-14

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 210 um, 74 um, and pan. Each sieve separate was analyzed spectroradiometrically (curves B, C, and D, respectively). Moisture contents were determined gravimetrically at the time that the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 88.8% Sand, 6.4% Silt, 4.8% Clay
Moisture Content: <1% (O.D. basis)

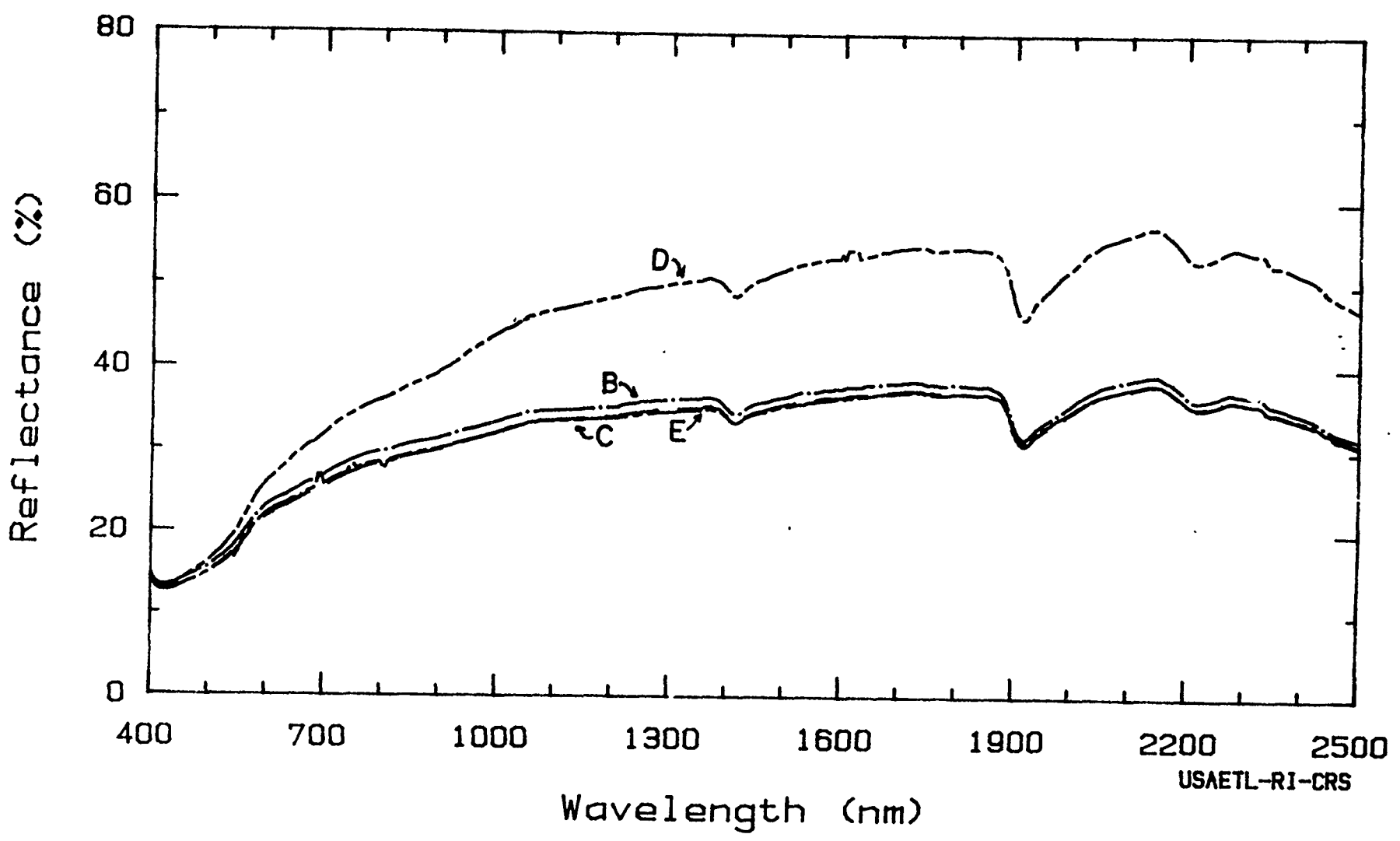
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
B	15.2	19.7	25.4	30.3	37.9	37.5
C	14.4	18.8	24.4	29.0	36.7	36.5
D	15.6	21.5	29.7	37.1	53.9	54.7
E	14.4	19.7	24.0	28.8	36.9	36.4

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0014.



Reflectance Spectra of Air Dry Sieved Soil Separates, Sample AU-14, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand (gypsum) Date Collected: 10 Apr 1986
Taxonomy: Torripsammids Sample Number: 00015
Unified System: SP-SM
Mapping Unit: Active Dune Land, Gypsum 1/
Spectrum No.: AU87.65, .66, .67.

Site Location: Otero County, NM, USA
32.7 deg. N Latitude; 106.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um and a subsample was taken (curve E). Remaining sample was passed through a nest of soil sieves with openings of 210 um and 74 um. Each sieve separate was analyzed spectroradiometrically (curves B and C, respectively). Moisture contents were determined gravimetrically at the time that the spectra were taken.

Physical & Chemical Properties of Composite Sample.

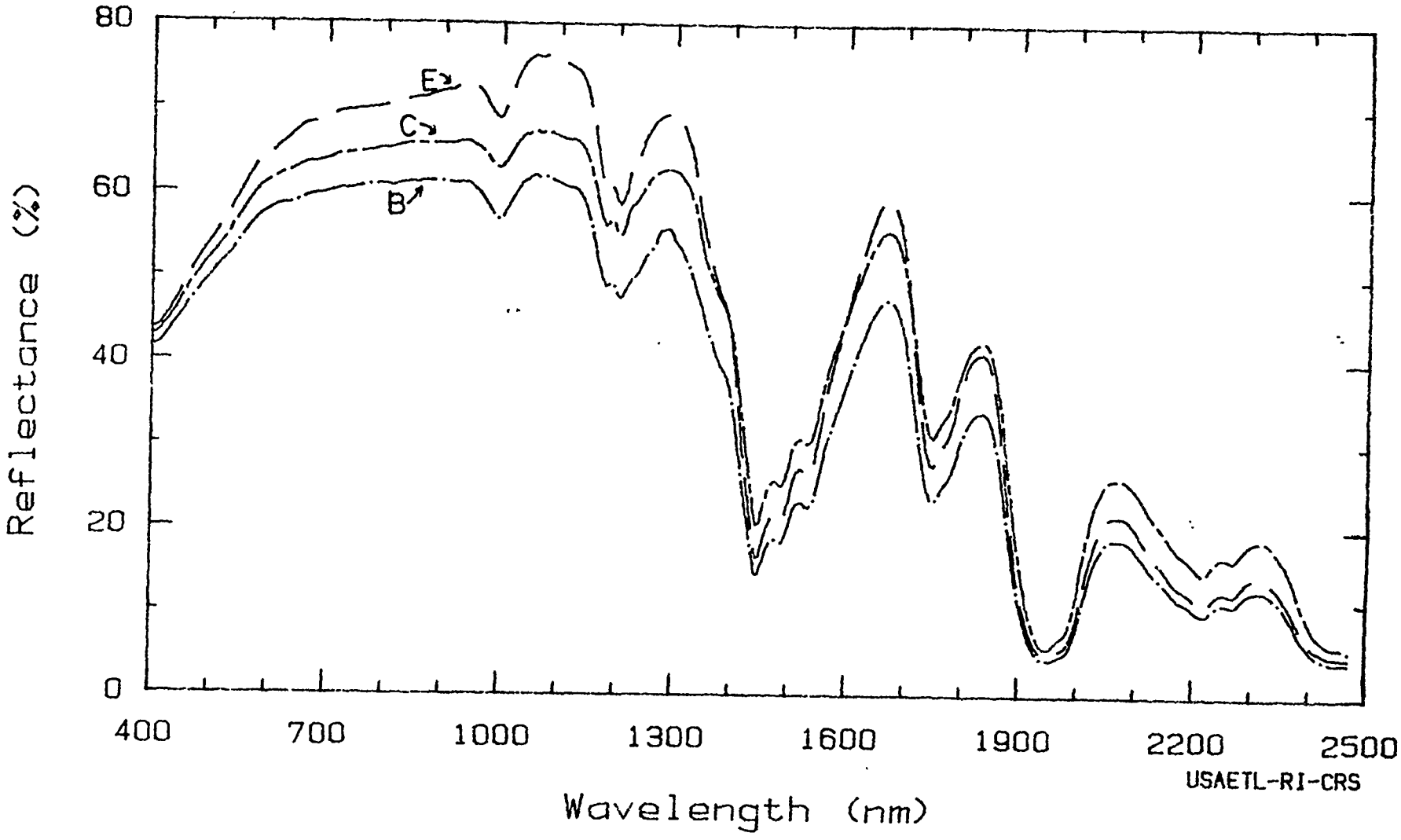
Composition: 100% Sand, <1% Fines (Silt + Clay)
Moisture Content: 24% (O.D. basis)
Mineralogy: Gypsum >95% (est.)

Ref: 1/ SCS-USDA, 1976, Soil Survey of White Sands Missile Range, New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
B	48.7	55.0	59.3	61.1	37.6	12.8
C	50.8	58.0	63.2	65.5	45.7	18.7
E	52.4	60.8	67.6	70.8	46.1	14.4

Compiled by: Melvin B. Satterwhite. Sheet No: S-0015.
USAETL-RI-RSD.



Reflectance Spectra of Air Dry Sieved Separates of, Gypsum Sand from White Sands National Monument, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loam
Taxonomy: Ustollic Caliciorthid
Unified System: SM-CL
Mapping Unit: Dona Ana-Reagan Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-01
Spectrum No.: AU87.01, AUW.04.

Site Location: Dona Ana County, NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 34.7% Sand, 43.0% Silt, 22.3% Clay
Moisture Content: dry, 2.4% (O.D. basis)
wet, 28.5% (O.D. basis)

Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	18.3	25.3	33.7	39.8	49.8	48.3
B-wet	7.0	10.5	15.5	20.4	24.8	18.3

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

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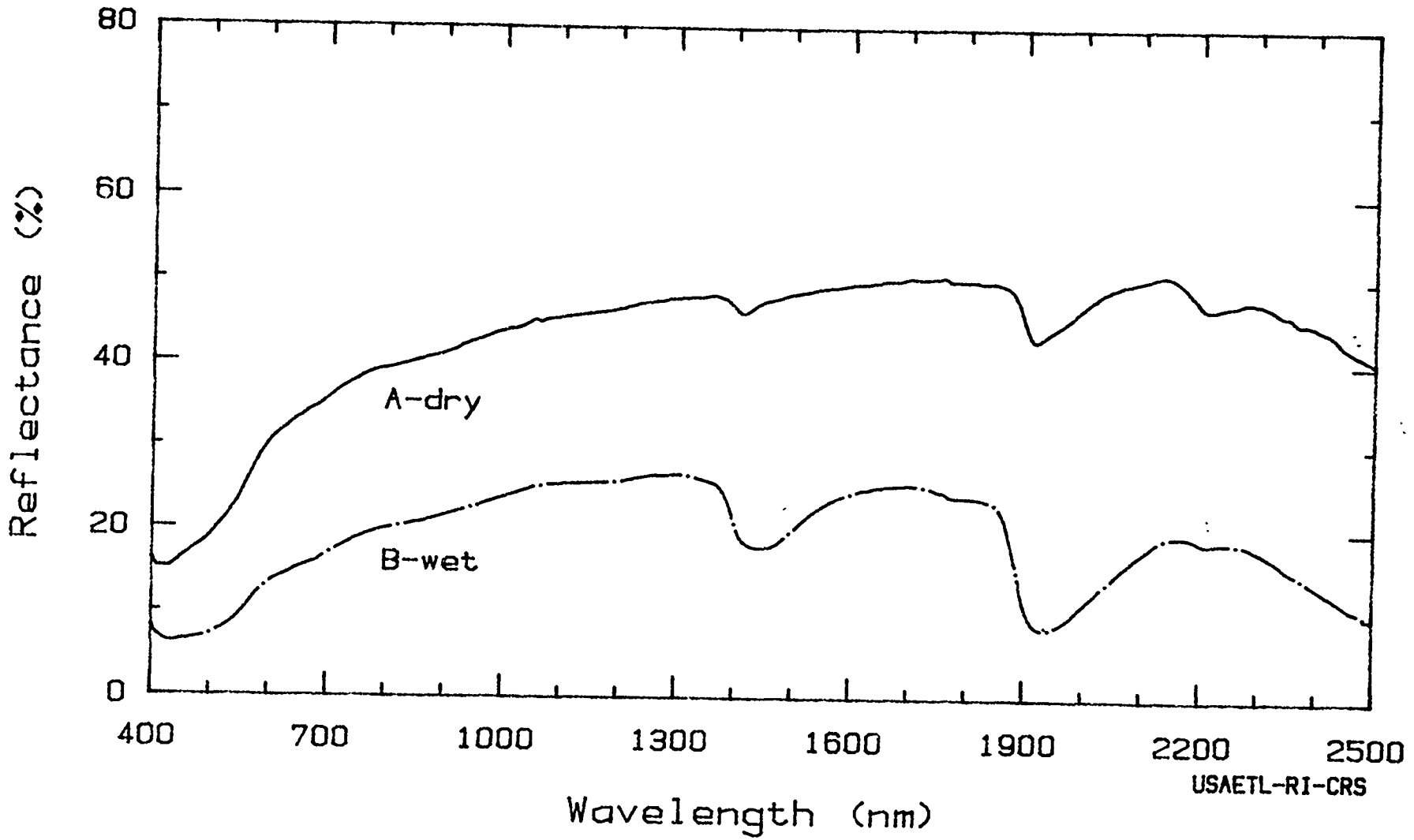


Reflectance Spectra of Air Dry and Wet Loam Soil, Sample AU-01, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/.

Date Collected: 20 Feb 86
Sample Number: AU-02
Spectrum No.: AU87.09, AUW.09.

Site Location: Dona Ana County, NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 82.9% Sand, 7.7% Silt, 9.4% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 19.9% (O.D. basis)

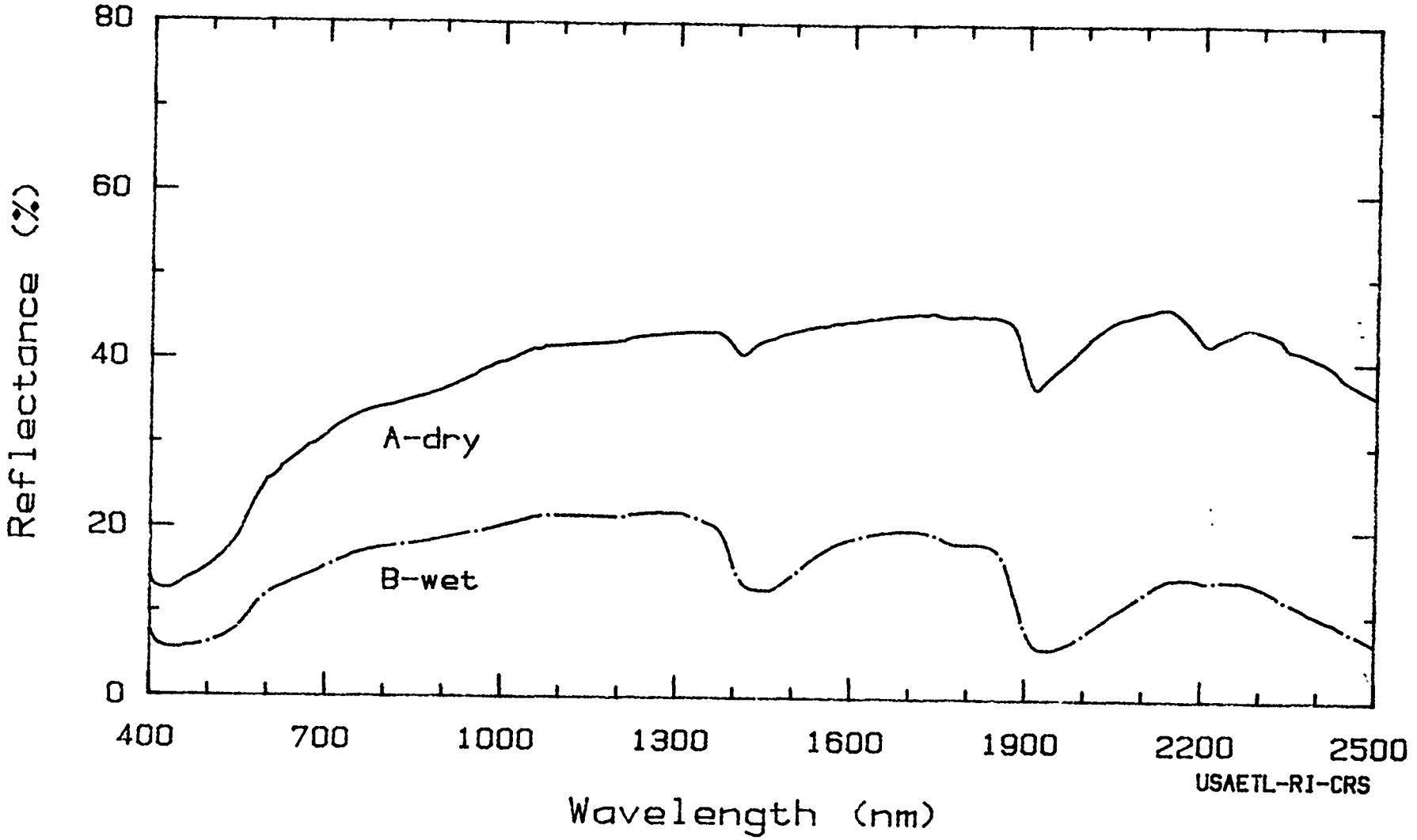
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	14.6	20.5	29.0	34.9	45.1	44.1
B-wet	6.1	9.1	14.0	17.9	19.2	13.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0017.



Reflectance Spectra of Air Dry and Wet Loamy Sand Soil Sample AU-02, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SM
Mapping Unit: Berino-Bucklebar Association 1/.

Date Collected: 20 Feb 86
Sample Number: AU-03
Spectrum No.: AU87.14, AUW.14.

Site Location: Dona Ana County, NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 85.4% Sand, 5.8% Silt, 8.8% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 27.3% (O.D. basis)

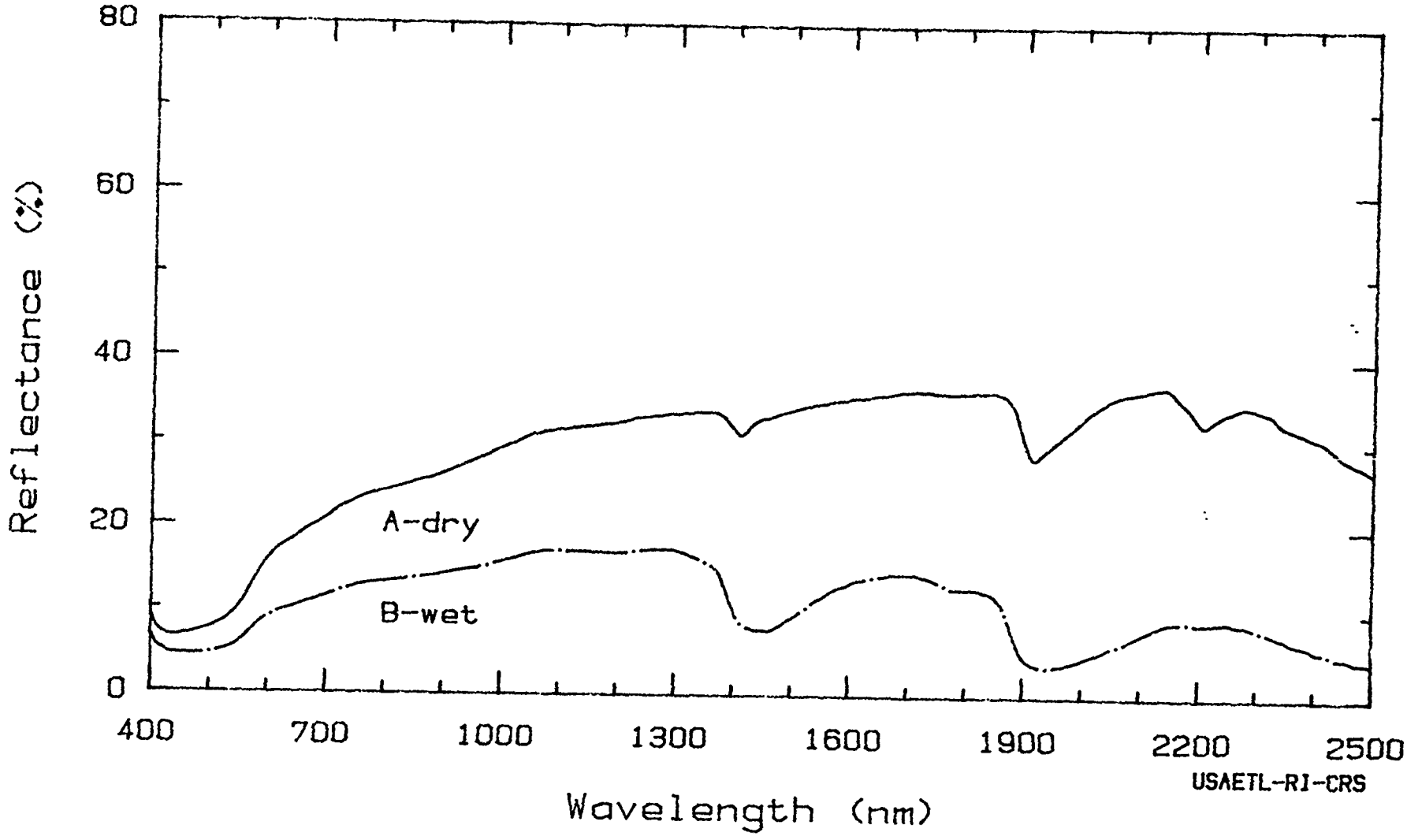
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	7.3	11.5	19.1	24.8	35.8	34.7
B-wet	4.6	6.7	10.6	13.6	13.8	8.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0018.



Reflectance Spectra of Air Dry and Wet Loamy Sand Soil Sample AU-03, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Haplargid
Unified System: SP-SM
Mapping Unit: Wink-Pintura Complex 1/

Date Collected: 20 Feb 1986
Sample Number: AU-04
Spectrum No.: AU87.19, AUW.19.

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 87.6% Sand, 3.1% Silt, 9.4% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 21.4% (O.D. basis)

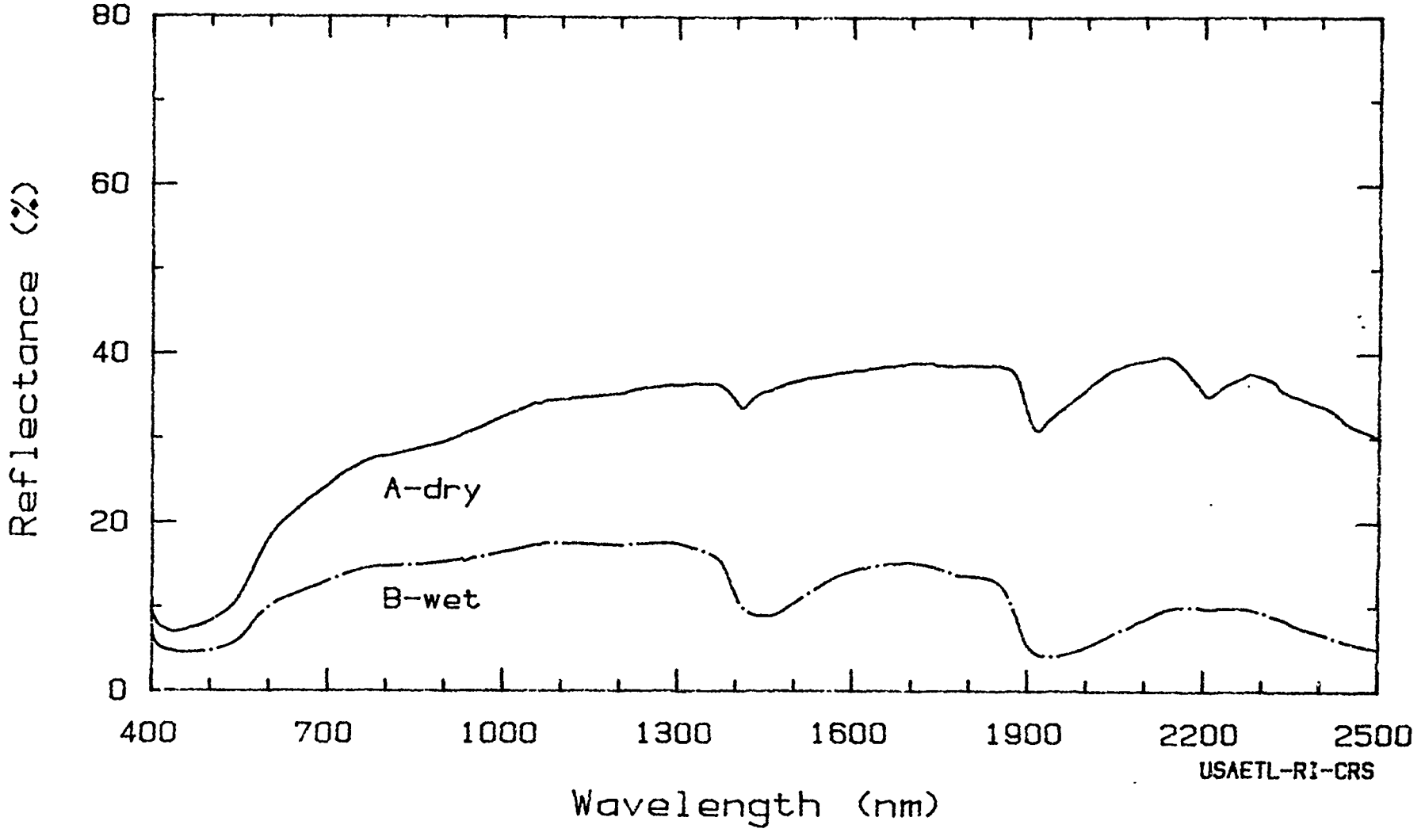
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	8.0	12.9	22.2	28.4	38.3	37.4
B-wet	4.7	7.2	11.9	15.0	14.5	9.4

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0019.



Reflectance Spectra of Air Dry and Wet Loamy Sand Soil Sample AU-04, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Paleorthid
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-05
Spectrum No.: AU87.24, AUW.24.

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 80.0% Sand, 11.9% Silt, 8.1% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 19.3% (O.D. basis)

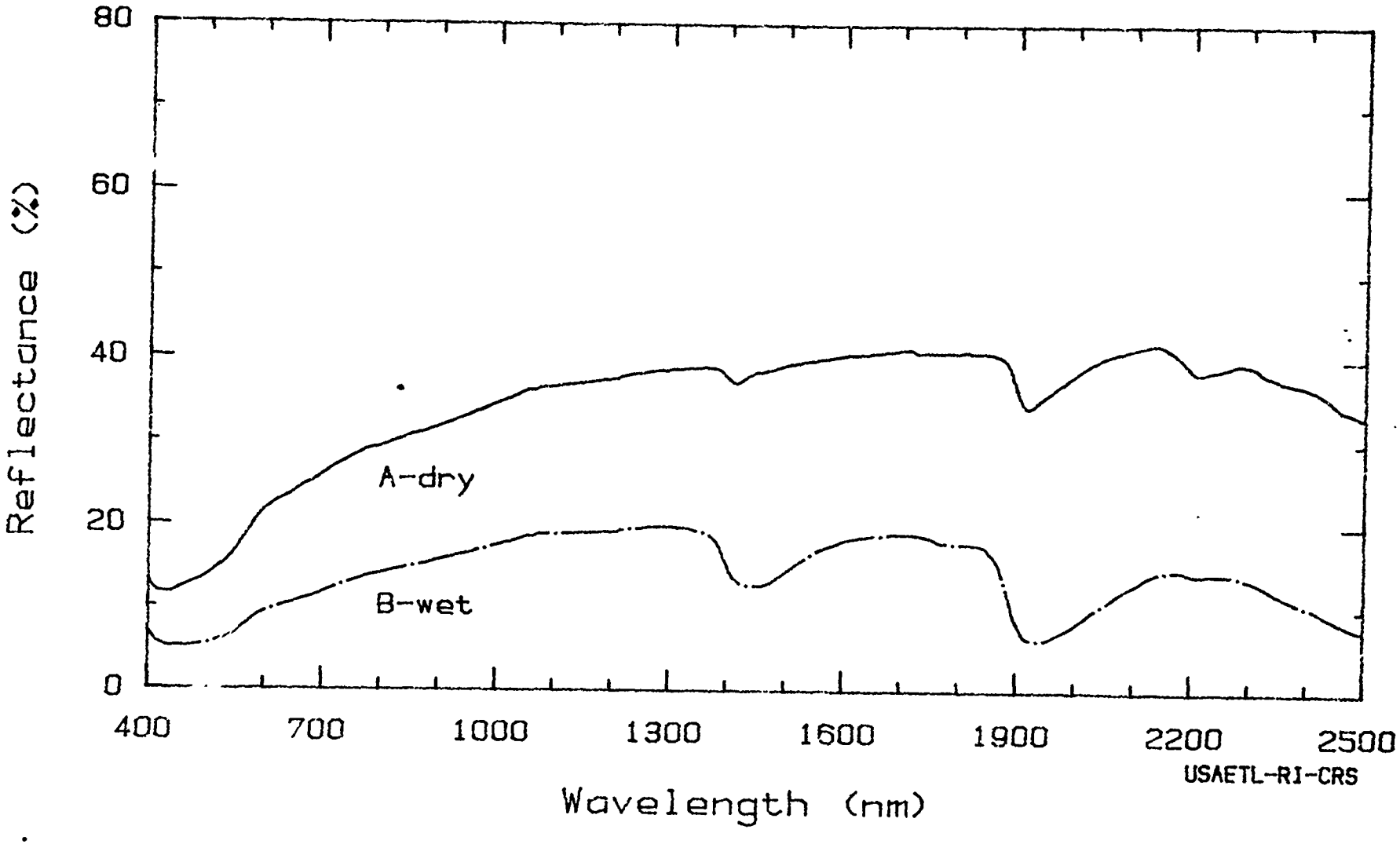
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance(%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	13.2	17.9	24.3	30.2	40.6	39.8
B-wet	5.3	7.4	10.7	14.6	18.5	13.9

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0020.



Reflectance Spectra of Air Dry and Wet Loamy Sand Soil Sample AU-05, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Loam
Taxonomy: Ustollic Calciorthid
Unified System: SM
Mapping Unit: Dona Ana-Reagan Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-06
Spectrum No.: AU87.29, AUW.29

Site Location: Dona Ana County, NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 45.6% Sand, 32.9% Silt, 21.5% Clay
Moisture Content: dry, 2.4% (O.D. basis)
wet, 33.4% (O.D. basis)

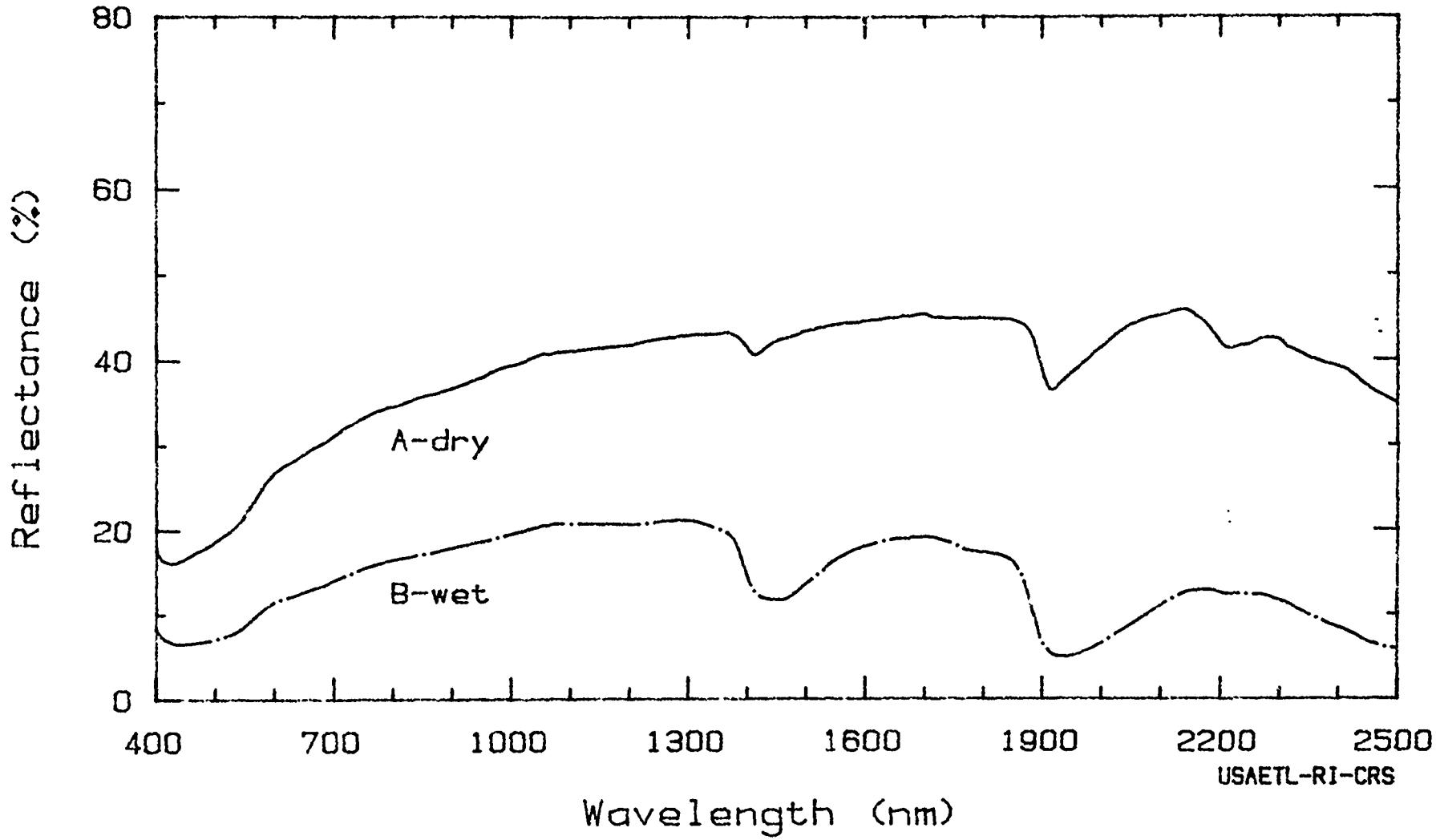
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	18.1	23.0	29.4	35.3	44.8	43.1
B-wet	7.0	9.4	13.0	16.9	18.4	11.9

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0021.



Reflectance Spectra of Air Dry and Wet Loam Soil Sample AU-06, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand
Taxonomy: Aridisol
Unified System: SP-SM
Mapping Unit: Onite-Pintura Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-07
Spectrum No.: AU87.32, AUW.33.

Site Location: Dona Ana County, NM, USA.
32.8 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 93.4% Sand, 2.7% Silt, 4.0% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 20.2% (O.D. basis)

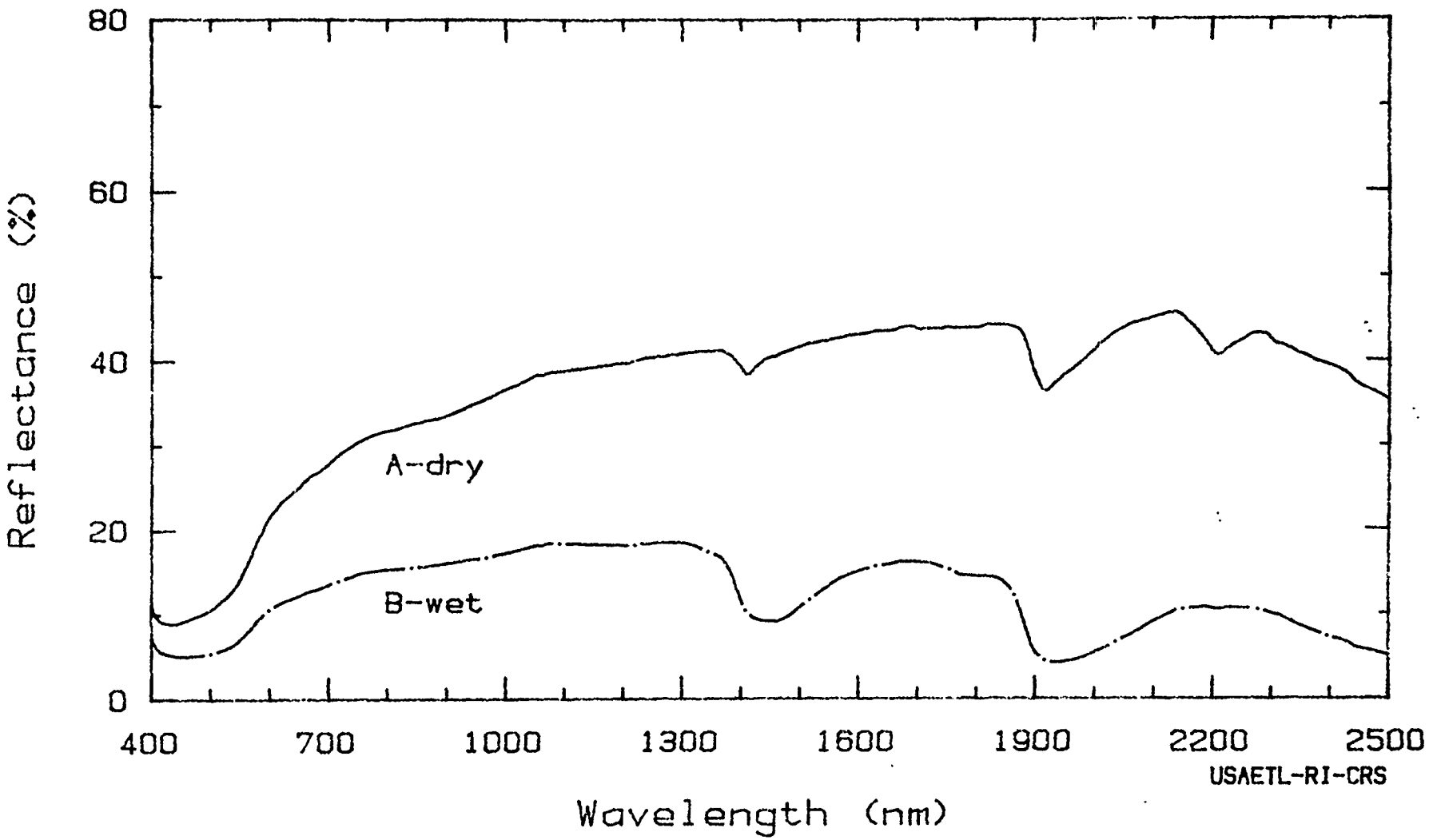
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	10.1	15.9	25.7	32.3	43.5	43.1
B-wet	5.3	7.9	12.5	15.6	15.4	10.1

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0022.



Reflectance Spectra of Air Dry and Wet Sand Soil Sample AU-07, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silt Loam
Taxonomy: Aridisol
Unified System: ML
Mapping Unit: Dona Ana-Reagan Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-08
Spectrum No.: AU87.37, AUW.38.

Site Location: Dona Ana County, NM, USA
32.7 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 40.0% Sand, 54.0% Silt, 6.1% Clay
Moisture Content: dry, 7.6% (O.D. basis)
wet, 42.7% (O.D. basis)

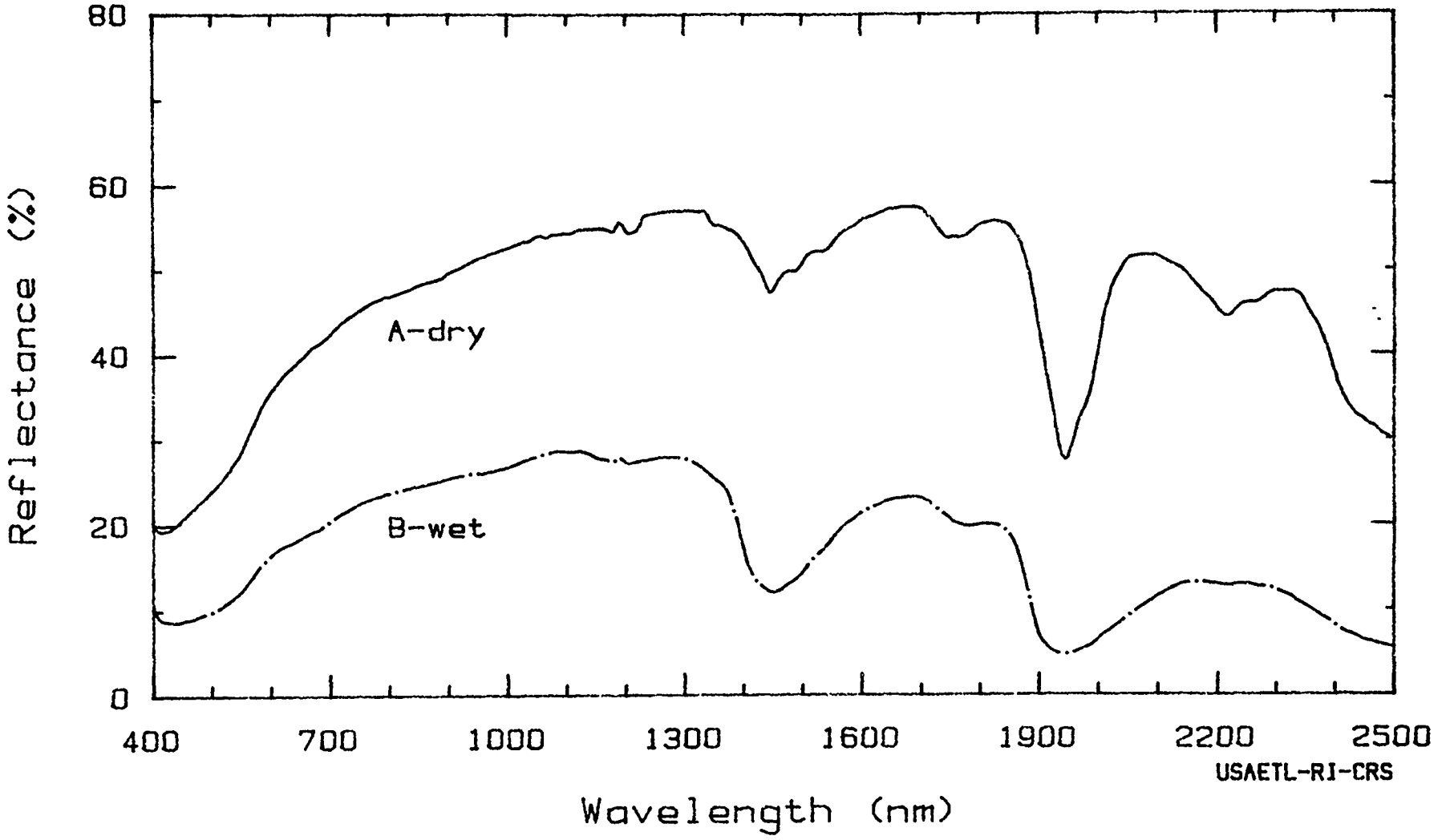
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	23.0	30.4	40.2	47.8	56.0	47.7
B-wet	9.6	13.4	18.9	24.3	21.8	12.3

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0023.



Reflectance Spectra of Air Dry and Wet Silt Loam Soil Sample AU-08, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Unified System: CL
Mapping Unit: Lake Bed (ephemeral) 1/

Date Collected: 20 Feb 1986
Sample Number: AU-09
Spectrum No.: AU87.41, AUW.42.

Site Location: Dona Ana County, NM, USA
32.7 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample.

Composition: 3.6% Sand, 40.2% Silt, 56.2% Clay
Moisture Content: dry, 5.2% (O.D. bais)
wet, 45.2 (O.D. basis)

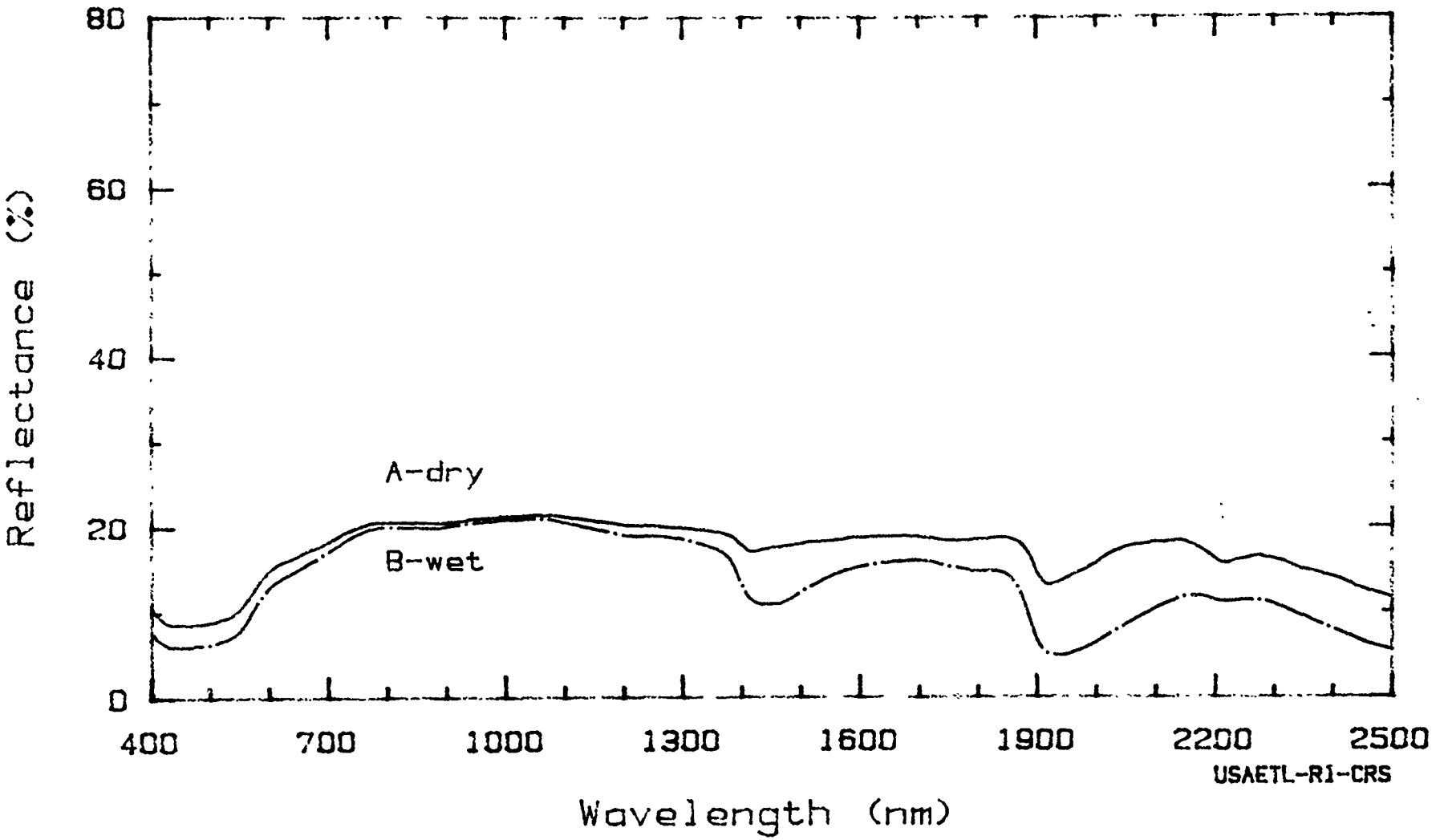
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	8.8	11.6	17.1	20.5	18.7	16.8
B-wet	6.2	9.3	15.6	20.0	15.5	11.0

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0024.



Reflectance Spectra of Air Dry and Wet Silty Clay Soil Sample AU-09, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: SM
Mapping Unit: Wink-Harrisburg Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-10
Spectrum No.: AU87.45, AUW.46.

Site Location: Dona Ana County, NM, USA.
32.8 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 71.9% Sand, 22,6% Silt, 5.5% Clay
Moisture Content: dry, 1% (O.D. basis)
wet, 21.1% (O.D. basis)

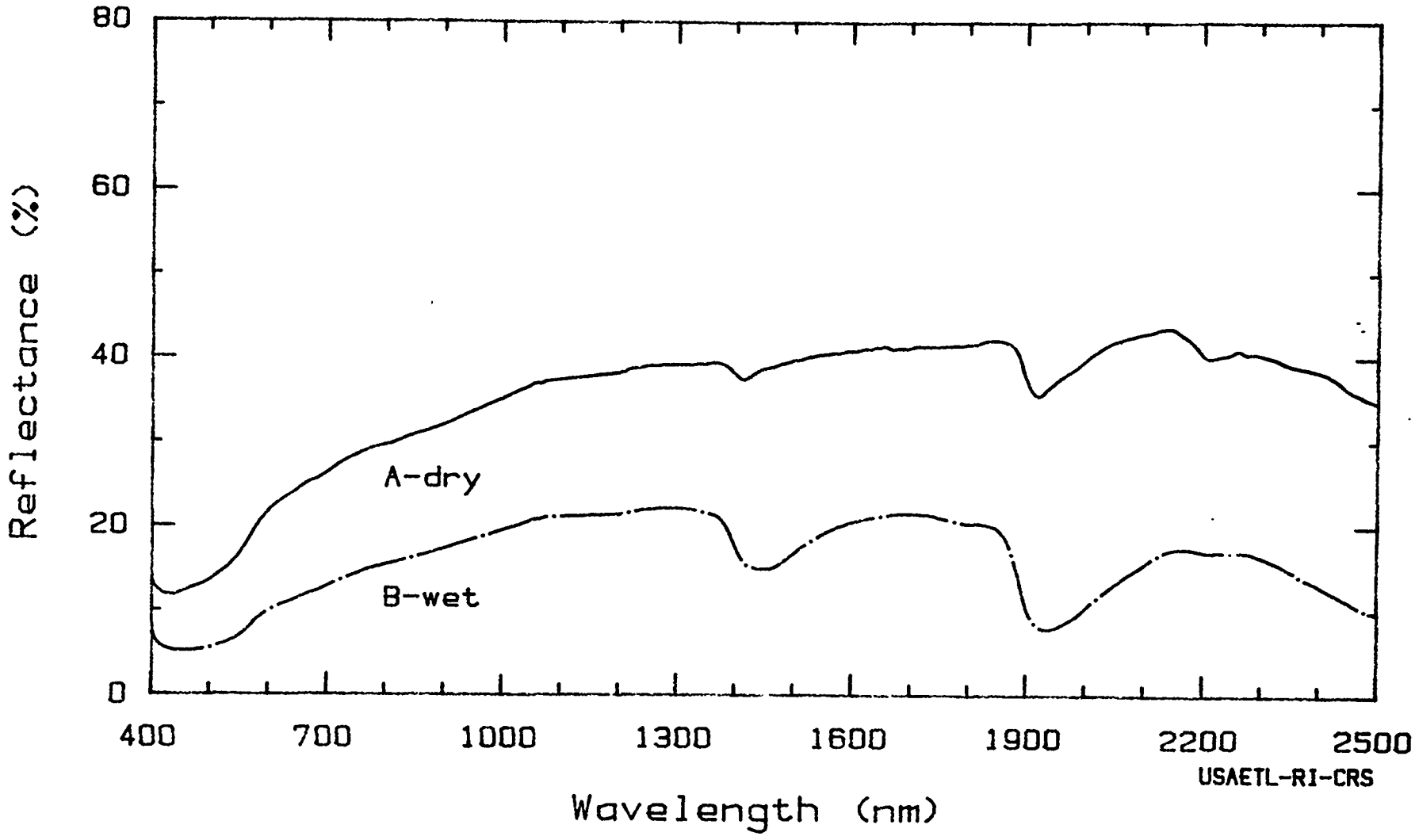
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	13.2	17.9	24.7	30.4	41.0	41.3
B-wet	5.4	7.8	11.7	16.0	20.9	16.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0025.



Reflectance Spectra of Air Dry and Wet Sandy Loam Soil Sample AU-10, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: SM
Mapping Unit: Onite-Pajarito Association 1/

Date Collected: 20 Feb 1986
Sample Number: AU-11
Spectrum No.: AU87.50, AUW.51.

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 76.8% Sand, 12.9% Silt, 10.3% Clay
Moisture Content: dry, 1.3% (O.D. basis)
wet, 21.7% (O.D. basis)

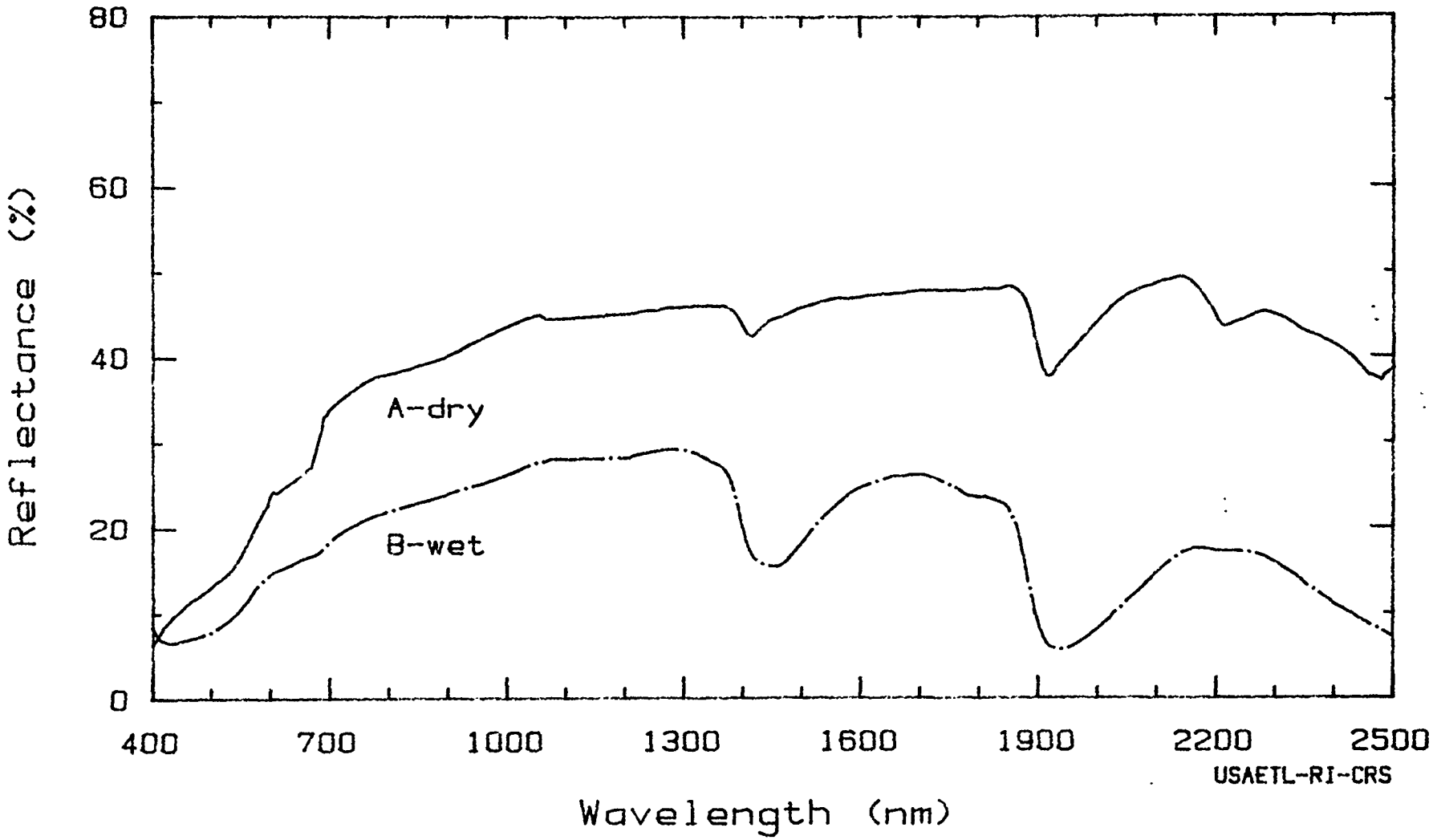
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	12.4	18.4	27.6	38.7	47.4	46.1
B-wet	7.6	11.6	16.6	22.6	25.2	16.2

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0026.



Reflectance Spectra of Air Dry and Wet Sandy Loam Soil Sample AU-11, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Unified System: GM, GP-GM
Mapping Unit: Nickel, Tencee, Delnorte Complex 1/

Date Collected: 20 Feb 1986
Sample Number: AU-12
Spectrum No.: AU87.55, AUW.56.

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 107.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 69.2% Sand, 22.1% Silt, 8.7% Clay
Moisture Content: dry, 1.3% (O.D. basis)
wet, 24.1 (O.D. basis)

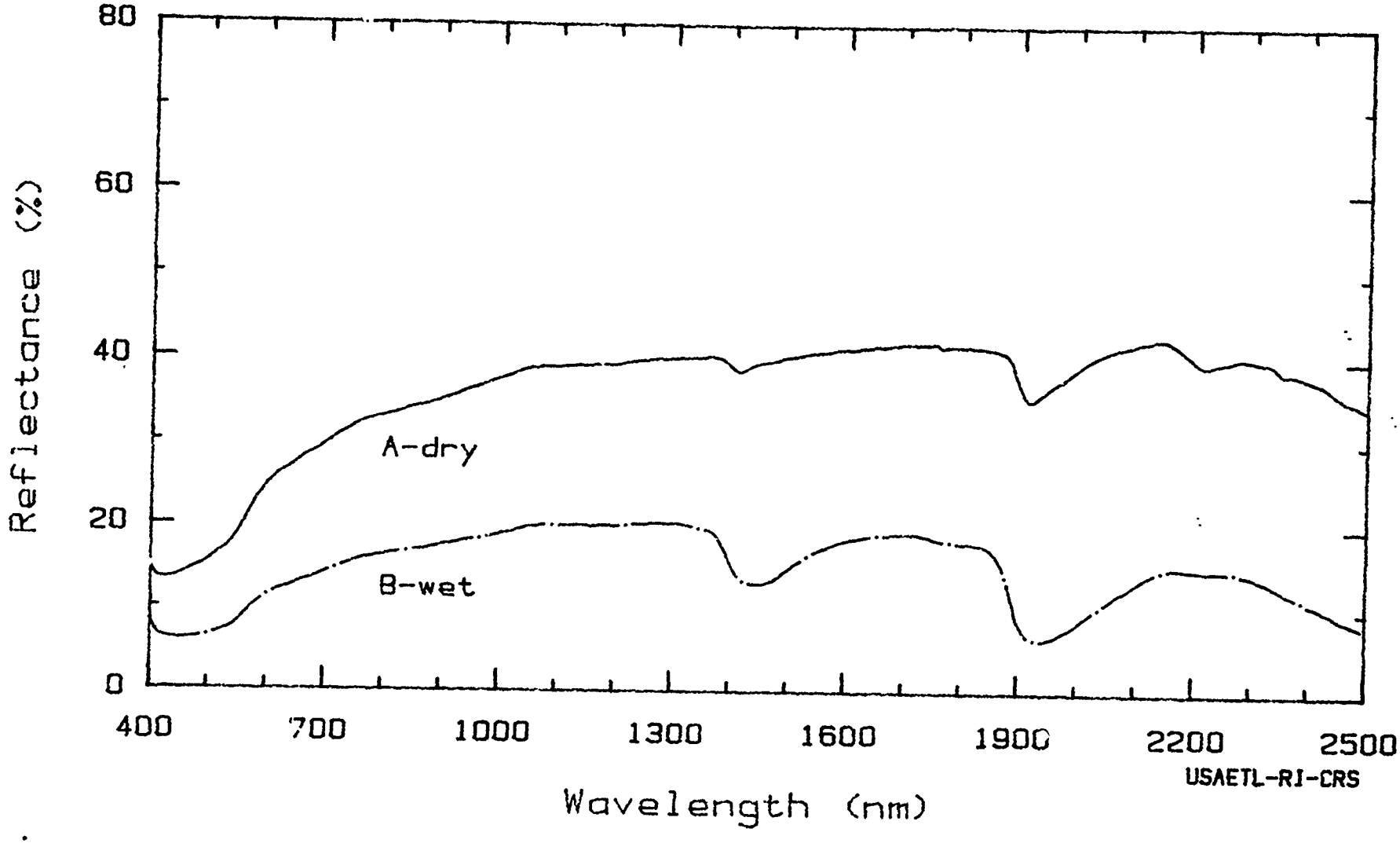
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	15.0	20.3	27.8	33.6	41.5	40.8
B-wet	6.3	8.9	13.1	16.7	18.7	14.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0027.



Reflectance Spectra of Air Dry and Wet Sandy Loam Soil Sample AU-12, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Silty Loam
Taxonomy: Typic Camborthid
Unified System: CL
Mapping Unit: Marconi 1/

Date Collected: 20 Feb 1986
Sample Number: AU-13
Spectrum No.: AU87.56, AUW.61.

Site Location: Dona Ana County, NM, USA
32.8 deg. N Latitude; 107.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

Composition: 9.7% Sand, 71.9% Silt, 18.4% Clay
Moisture Content: dry, 2.9% (O.D. basis)
wet, 30.8% (O.D. basis)

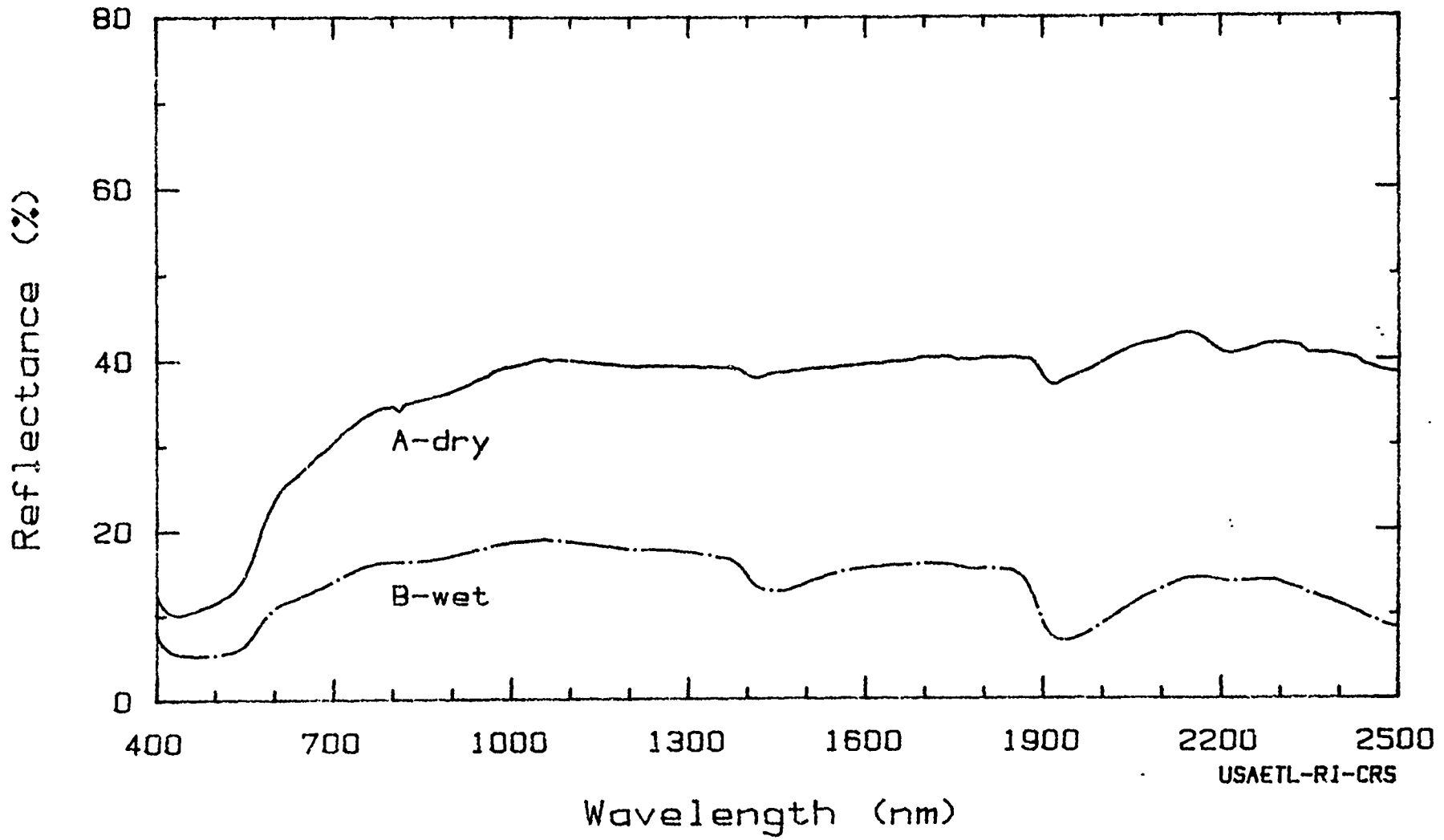
Ref: 1/ SCS-UDSA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	11.2	17.1	28.0	35.1	39.8	41.8
B-wet	5.4	7.7	12.8	16.5	15.7	13.7

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0028.



Reflectance Spectra of Air Dry and Wet Silty Loam Soil Sample AU-13, Jornada Experimental Range, N. M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamments
Unified System: SM
Mapping Unit: Bluepoint 1/

Date Collected: 20 Feb 1986
Sample Number: AU-14
Spectrum No.: AU87.64, AUW.65.

Site Location: Dona Ana County, NM, USA
32.5 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample.

Composition: 88.8% Sand, 6.4% Silt, 4.8% Clay
Moisture Content: dry, <1% (O.D. basis)
wet, 20% (O.D. basis)

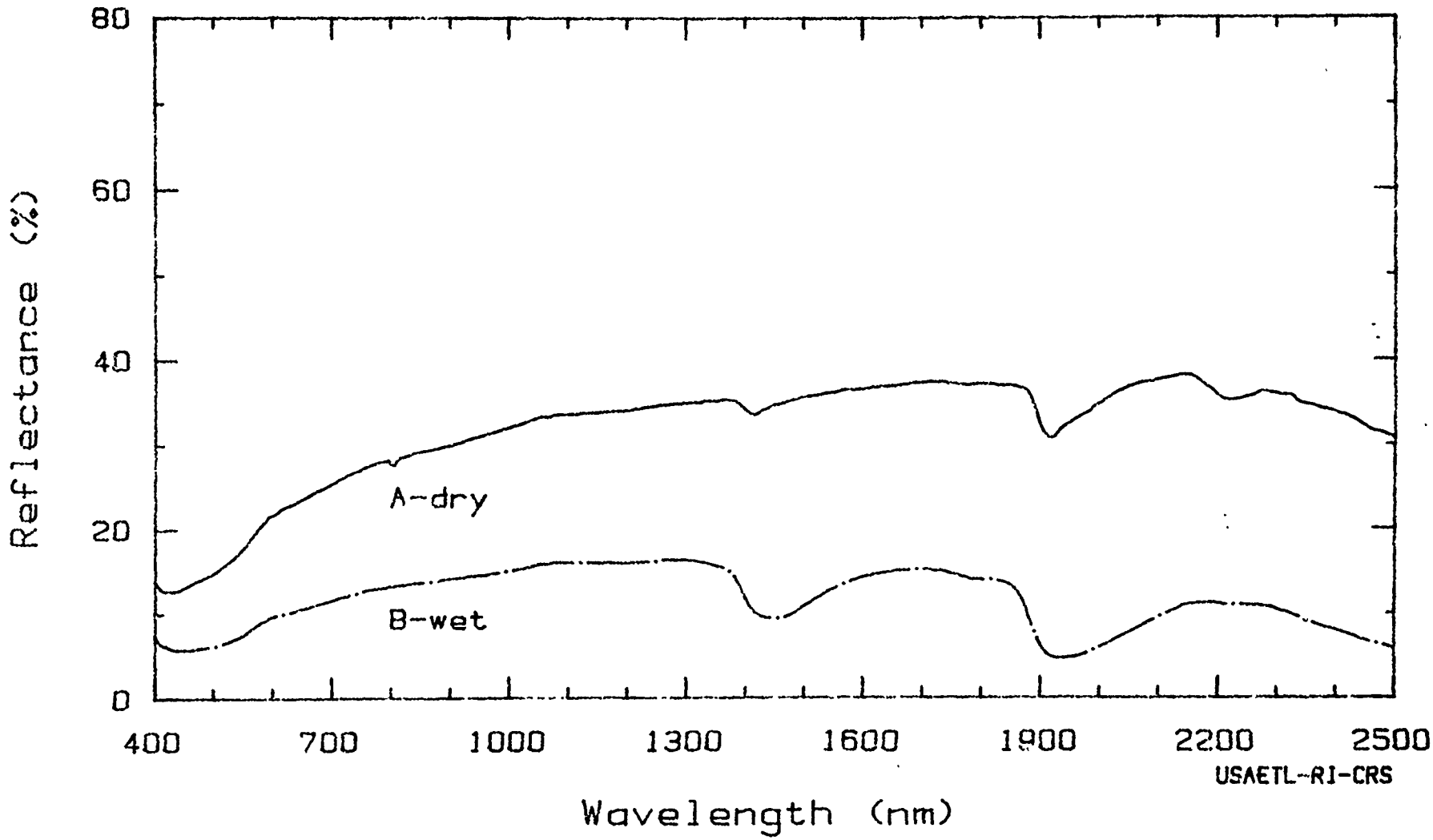
Ref: 1/ SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	14.4	18.7	24.0	28.8	36.9	36.4
B-wet	6.1	8.1	10.8	13.5	14.6	10.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0029.



Reflectance Spectra of Air Dry and Wet Sand Soil Sample AU-14, Jornada Experimental Range, N.M.

Laboratory Spectral Reflectance of Soil

Soil Texture: Sand (gypsum) Date Collected: 10 Apr 1986
Taxonomy: Torripsammids Sample Number: 00015
Unified System: SP-SM Spectrum No.: AU87.67, AUW.69
Mapping Unit: Active Dune Land, Gypsum 1/

Site Location: Otero County, NM, USA
32.7 deg. N Latitude; 106.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:FBV-024; 4 degree field of view, spectral resolution 1.5 nm between 360 & 1300 nm, and 3.5 to 4.5 nm between 1300 & 2500 nm. Nadir viewing angle. Viewing height, 48.5 cm. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degree K. Pressed Halon reference standard.

Sample: The air-dried composite soil sample was passed through a soil sieve with openings of 2000 um. The spectra were taken of an air-dried subsample. Deionized water was applied and the spectra of the wet subsample were taken. The moisture content of the subsample was determined gravimetrically at the time the spectra were taken.

Physical & Chemical Properties of Composite Sample:

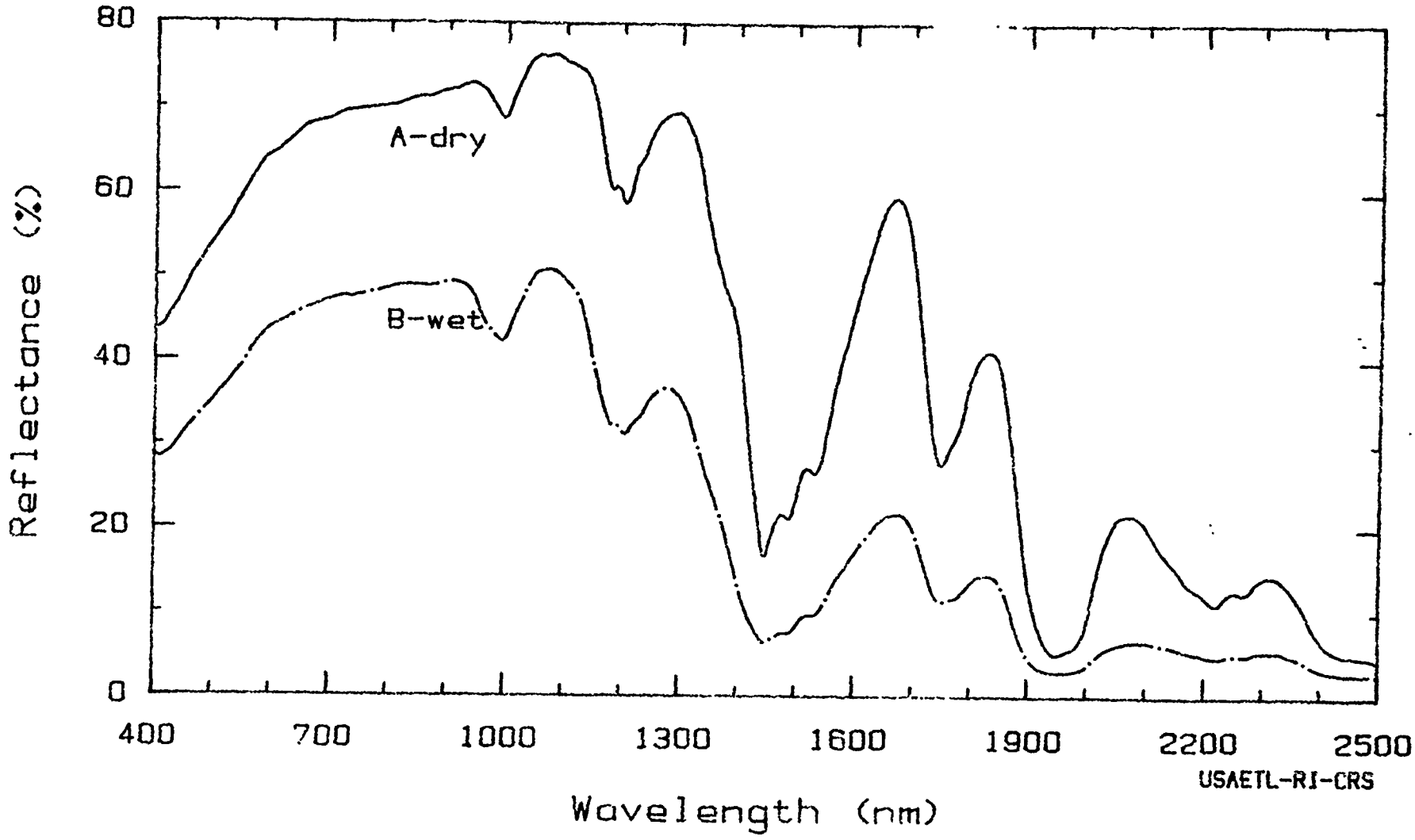
Composition: 100% Sand, <1% Fines (Silt + Clay)
Moisture Content: dry, 24.3% (O.D. basis)
wet, 51.9% (O.D. basis)
Mineralogy: Gypsum >95% (est.)

Ref: 1/ SCS-USDA, 1976, Soil Survey of White Sands Missile Range, New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
A-dry	52.4	60.8	67.6	70.8	46.1	14.4
B-wet	33.9	40.4	46.1	48.8	17.2	5.5

Compiled by: Melvin B. Satterwhite. Sheet No: S-0030.
USAETL-RI-RSD.



Reflectance Spectra of Air Dry and Wet Gypsum Sand from White Sands National Monument, N. M.

Field Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: 87LCA.06, .07, .56, .57.

Date Collected: 5 Apr 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA
32.6 deg. N Latitude; 106.9 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra of the sunlit air-dry, undisturbed surfaces (6, 56) were taken. The spectra of the sunlit, moist soil were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (7, 57). Textural analysis was performed by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 14.9 % Sand, 37.0 % Silt, 48.1 % Clay
Moisture Content: air dry

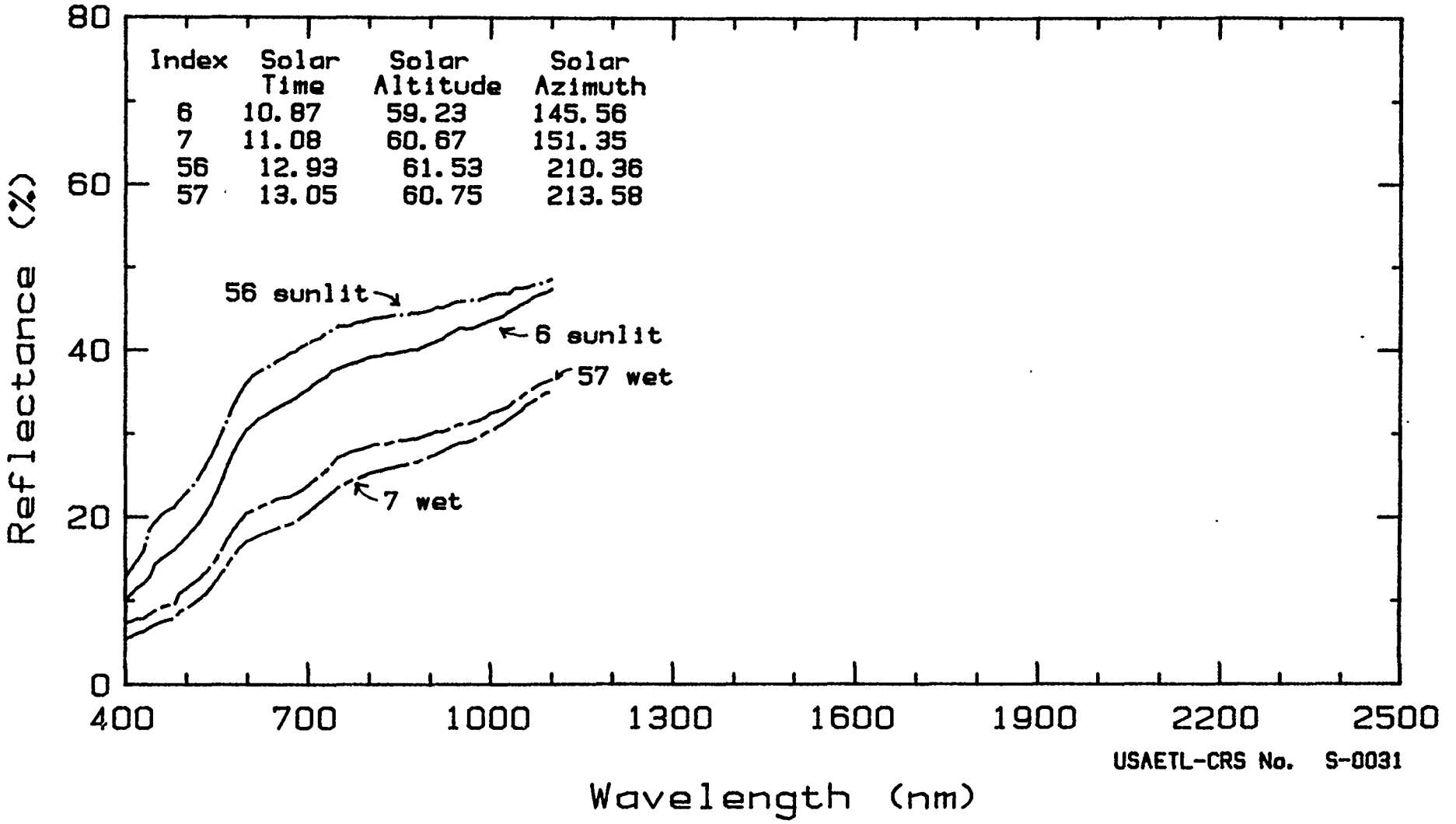
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
6	16.6	24.7	33.5	39.5		
7	8.4	13.5	19.0	25.7		
56	21.8	30.4	39.1	44.0		
57	15.0	16.3	22.3	28.8		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0031.



Reflectance Spectra of Clay Soils.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loam
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: 87LCS.32, .33.

Date Collected: 30 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N. Latitude; 106.8 deg. W. Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit air-dry, undisturbed soil surface (32). The spectrum was then taken of the sunlit, moist soil after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (33). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 32.9 % Sand, 48.0 % Silt, 19.6 % Clay
Moisture Content: air dry

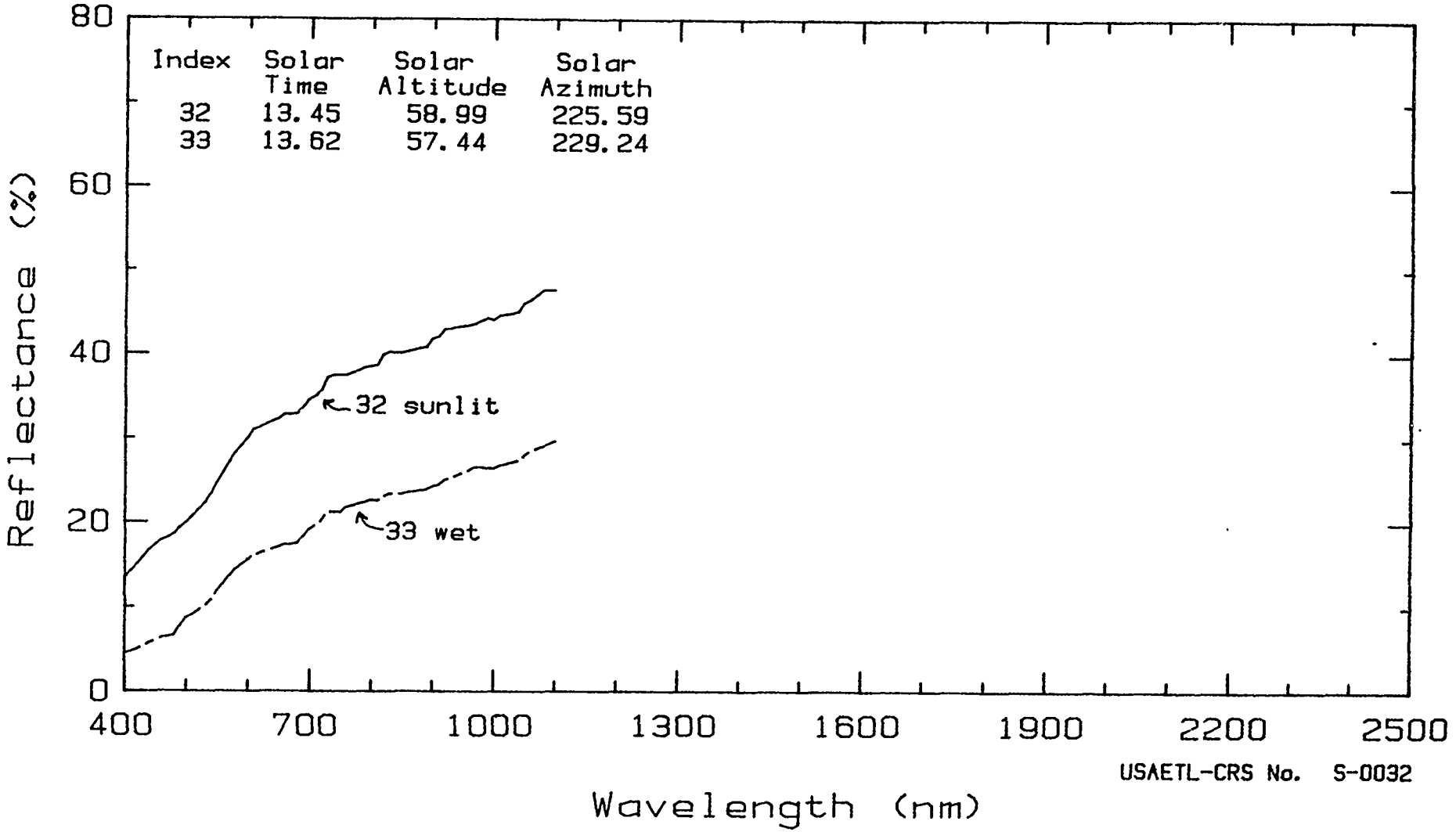
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
32	19.1	25.7	32.6	39.6		
33	7.4	12.6	17.3	23.1		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0032.



Reflectance Spectra of Loam Soil.

Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loam
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: LJOR.25, .26, .27, .28.

Date Collected: 30 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of a sunlit air-dry, undisturbed soil surface (25). Shaded soil surface was the air-dry surface with a shadow cast on it (26). The spectra of the sunlit, moist soil were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (27, 28). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 32.4 % Sand, 48.0 % Silt, 19.6 % Clay
Moisture Content: air dry

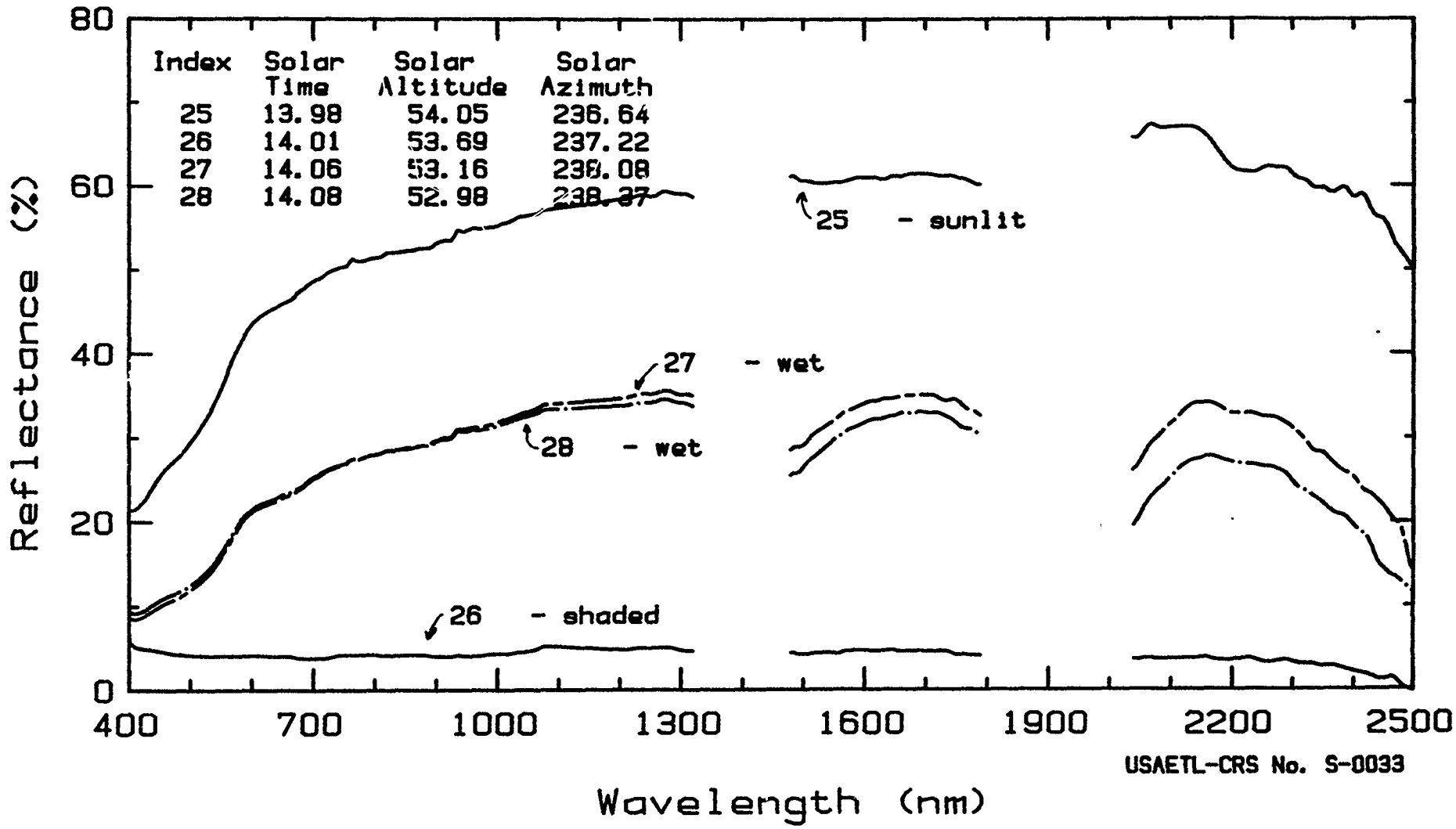
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
25	28.2	37.5	46.7	52.0	61.1	63.4
26	4.2	4.1	3.9	4.2	4.6	3.4
27	11.3	17.0	23.2	28.5	34.3	32.1
28	12.0	17.5	23.5	28.5	32.2	25.9

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0033.



Reflectance Spectra of Loam Soil

Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: 87LCS.50, .51, .52.

Date Collected: 31 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit air-dry, undisturbed soil surface (50). Shaded soil surface was the air-dry surface with a shadow cast on it (51). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (52). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 23.9 % Sand, 35.0 % Silt, 41.0 % Clay
Moisture Content: air dry

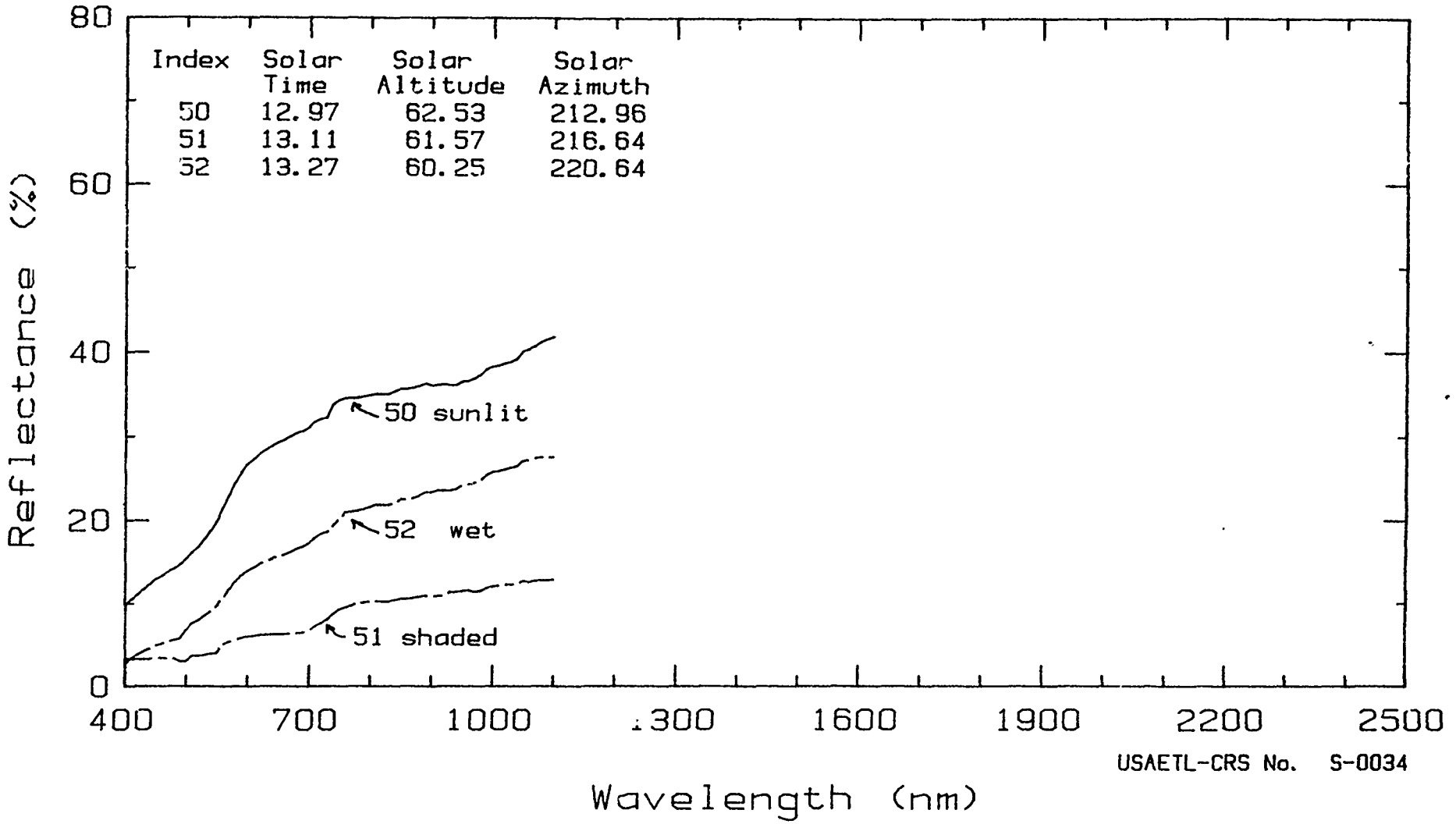
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
50	14.6	21.6	29.6	35.3		
51	3.3	4.8	6.4	10.4		
52	6.0	10.8	16.0	22.1		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0034.



Reflectance Spectra of a Clay Soil.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: LJOR.64, .65, .66.

Date Collected: 31 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of a sunlit, air-dry, undisturbed surface (64). Shaded soil surface was the air-dry surface with a shadow cast on it (65). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (66). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 23.9 % Sand, 35.0 % Silt, 41.1 % Clay
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
64	14.6	22.8	32.8	39.8	48.7	51.5
65	2.8	3.3	3.9	4.7	5.2	4.9
66	6.8	10.5	15.3	19.4	23.6	23.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

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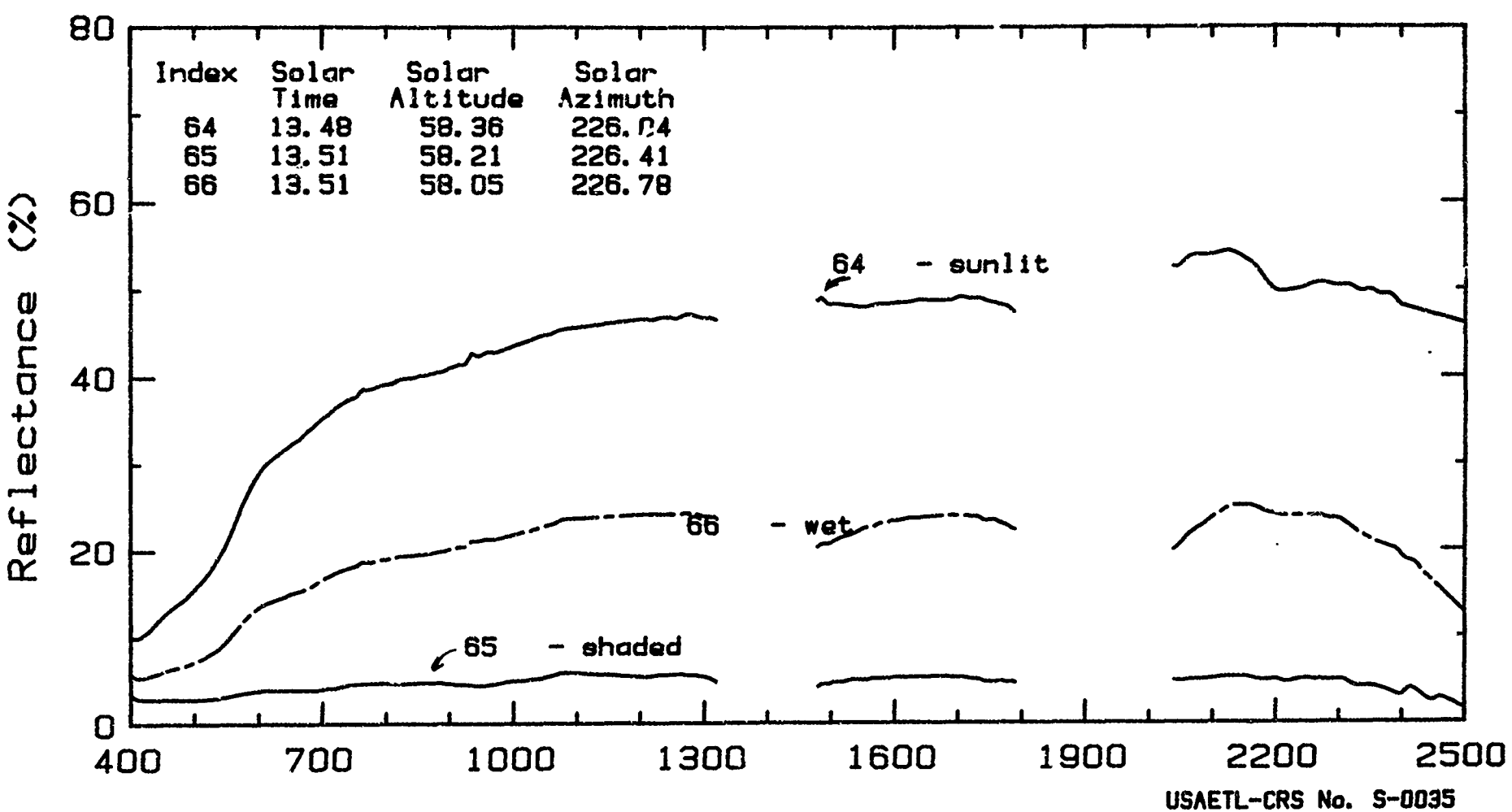


Reflectance Spectra of Clay Soil

Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Calciorthid
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: 87LCA.09, .10, .15, .16.

Date Collected: 5 Apr 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra were taken of two sunlit, air-dry, undisturbed surfaces (9, 15). The spectra of the sunlit, moist soil were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (10, 16). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 23.9 % Sand, 35.0 % Silt, 41.0 % Clay
Moisture Content: air dry

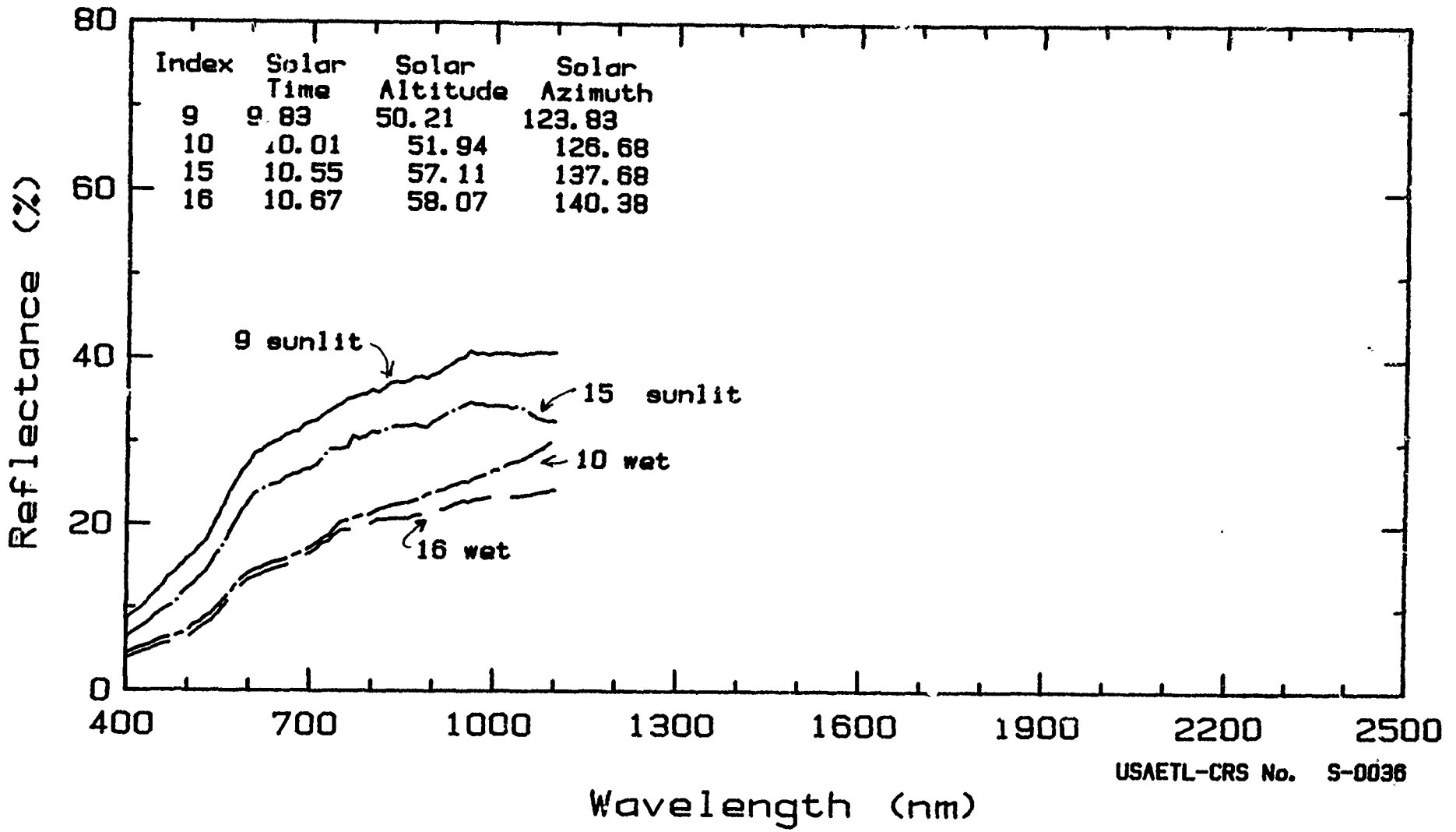
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
9	14.6	22.3	30.6	36.7		
10	6.9	11.8	15.9	22.1		
15	11.2	17.9	25.5	31.3		
16	6.1	10.2	15.2	20.6		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0036.



Reflectance Spectra of Clay Soils.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sandy Loam Date Collected: 7 Apr 1987
Taxonomy: Typic Paleorthid Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc 1/
Spectrum No.: 87LCA. 19, .20, .22.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Two spectra were taken of the sunlit, air-dry, undisturbed soil surface (19, 22). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (20). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

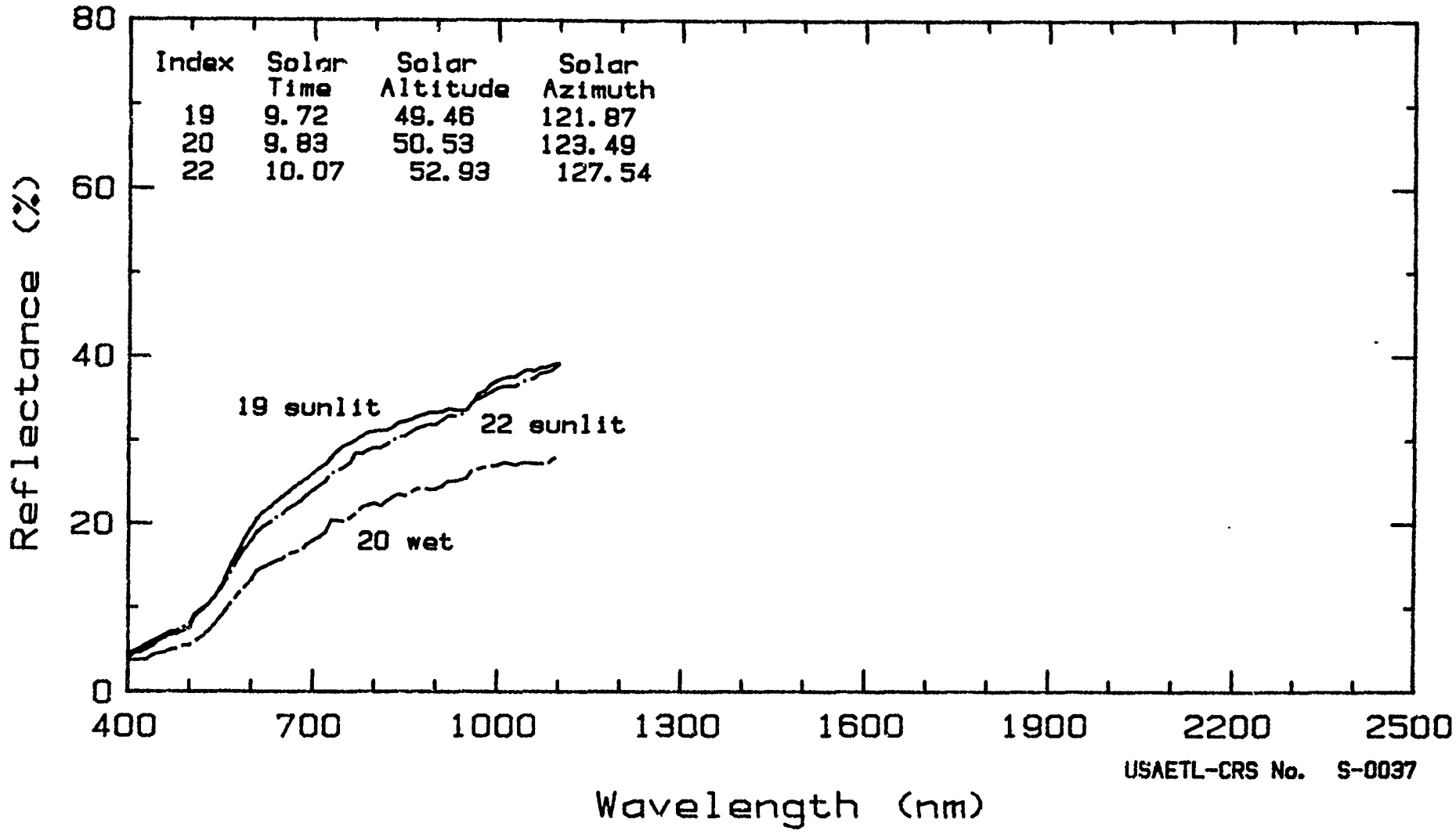
Composition: 76.7 % Sand, 10.0 % Silt, 13.3 % Clay
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
19	7.4	14.1	23.7	31.7		
20	5.4	9.8	16.2	22.9		
22	7.7	13.6	21.7	30.0		

Compiled by: Melvin B. Satterwhite. Sheet No: S-0037.
USAETL-RI-RSD.



Reflectance Spectra of Sandy Loam Soil.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand — Date Collected: 29 Aug 1987
Taxonomy: Typic Paleorthid — Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: 87LCS.03, .04, .05, .11, .12, .13.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA
32.6 deg. N. Latitude; 106.7 deg. W. Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: A light-toned sand (3, 4, 5) and a dark-toned sand (11, 12, 13) were measured. The spectra were taken of the sunlit, air-dry, undisturbed surfaces (3, 11). The shaded soil surfaces were the air-dry surfaces with a shadow cast on them (4, 12). The spectra of the sunlit, moist soils were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (5, 13). Textural analysis was by hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 90.0 % Sand, 2.0 % Silt, 8.0 % Clay
Moisture Content: air dry

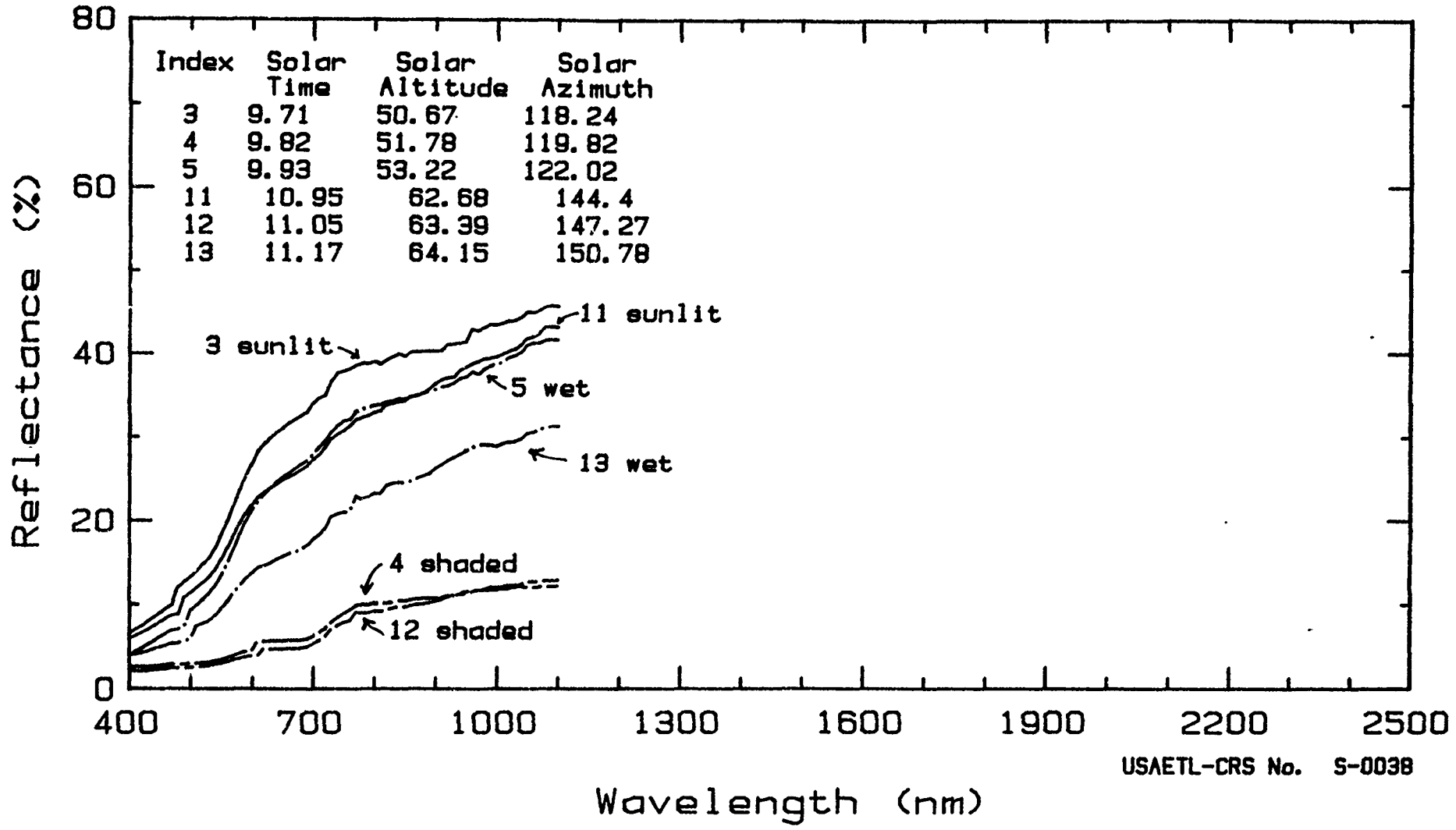
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
3	11.9	20.2	31.6	39.5		
4	2.9	3.7	5.8	10.3		
5	7.9	15.3	25.6	34.3		
11	10.1	16.9	25.2	33.9		
12	2.4	3.2	4.8	9.5		
13	5.9	10.5	16.0	24.1		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0038.



Reflectance Spectra of Sand Soils.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand
Date Collected: 29 Aug 1987
Taxonomy: Typic Paleorthid
Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: LJOR.12, .13, .14.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The sunlit, air-dry, undisturbed soil surface was measured (12). Shaded soil surface was the air-dry surface with a shadow cast on it (13). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (14). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

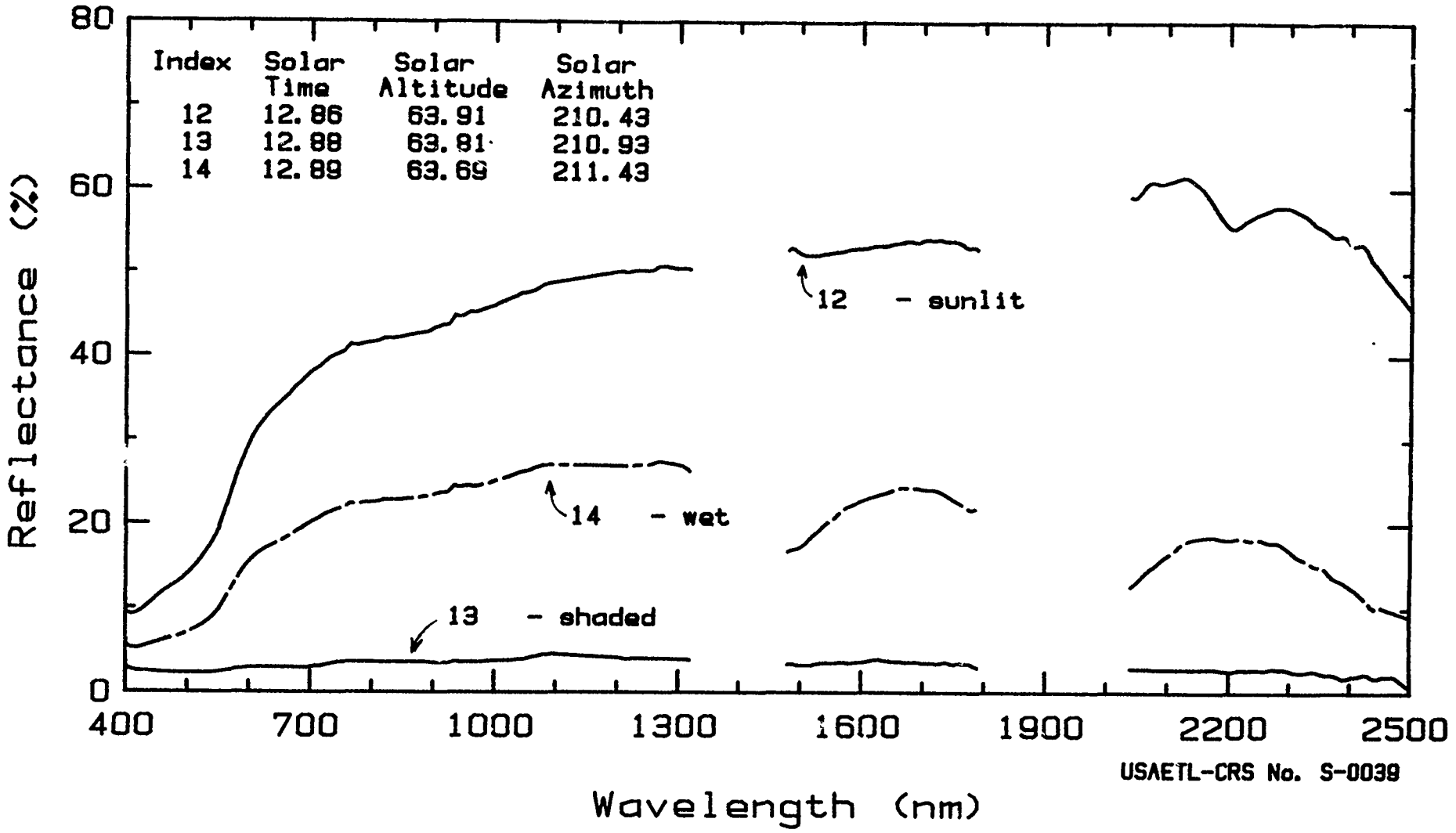
Composition: 90.0 % Sand, 2.0 % Silt, 8.0 % Clay
Moisture Content air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
12	13.2	21.7	35.0	42.0	53.4	58.2
13	2.2	2.5	2.8	3.5	3.6	2.7
14	6.6	11.1	18.3	22.8	23.3	17.4

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.
Sheet No.: S-0039.



Reflectance Spectra of Sand Soil

Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Gravel (caliche) Date Collected: 30 Aug 1987
Taxonomy: Typic Paleorthid
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: LJOR.24.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry, gravel-size particles of the exposed indurated subsurface horizon (petrocalic or caliche horizon). These gravels were soil particles that had been cemented together by calcium carbonate.

Physical & Chemical Properties of Composite Sample.

Composition: > 90.0 % gravel size particles.
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
24	35.6	47.7	61.1	67.7	68.1	62.0

Compiled by: Melvin B. Satterwhite. Sheet No.: S-0040.
USAETL-RI-RSD.

Field Reflectance Spectra of Soil

Soil Texture: Gravel (caliche) Date Collected: 30 Aug 1987
Taxonomy: Typic Paleorthid
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: LJOR.24.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.5 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry, gravel-size particles of the exposed indurated subsurface horizon (petrocalic or caliche horizon). These gravels were soil particles that had been cemented together by calcium carbonate.

Physical & Chemical Properties of Composite Sample.

Composition: > 90.0 % gravel size particles.
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
24	35.6	47.7	61.1	67.7	68.1	62.0

Compiled by: Melvin B. Satterwhite. Sheet No.: S-0040.
USAETL-RI-RSD.

Field Reflectance Spectra of Soil

Soil Texture: Sandy Loam Date Collected: 7 Apr 1987
Taxonomy: Typic Paleorthid Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc 1/
Spectrum No.: 87LCA.35, .36, .37.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of a light-toned sand. This was a sunlit, air-dry, undisturbed soil surface (35, 36). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (37). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

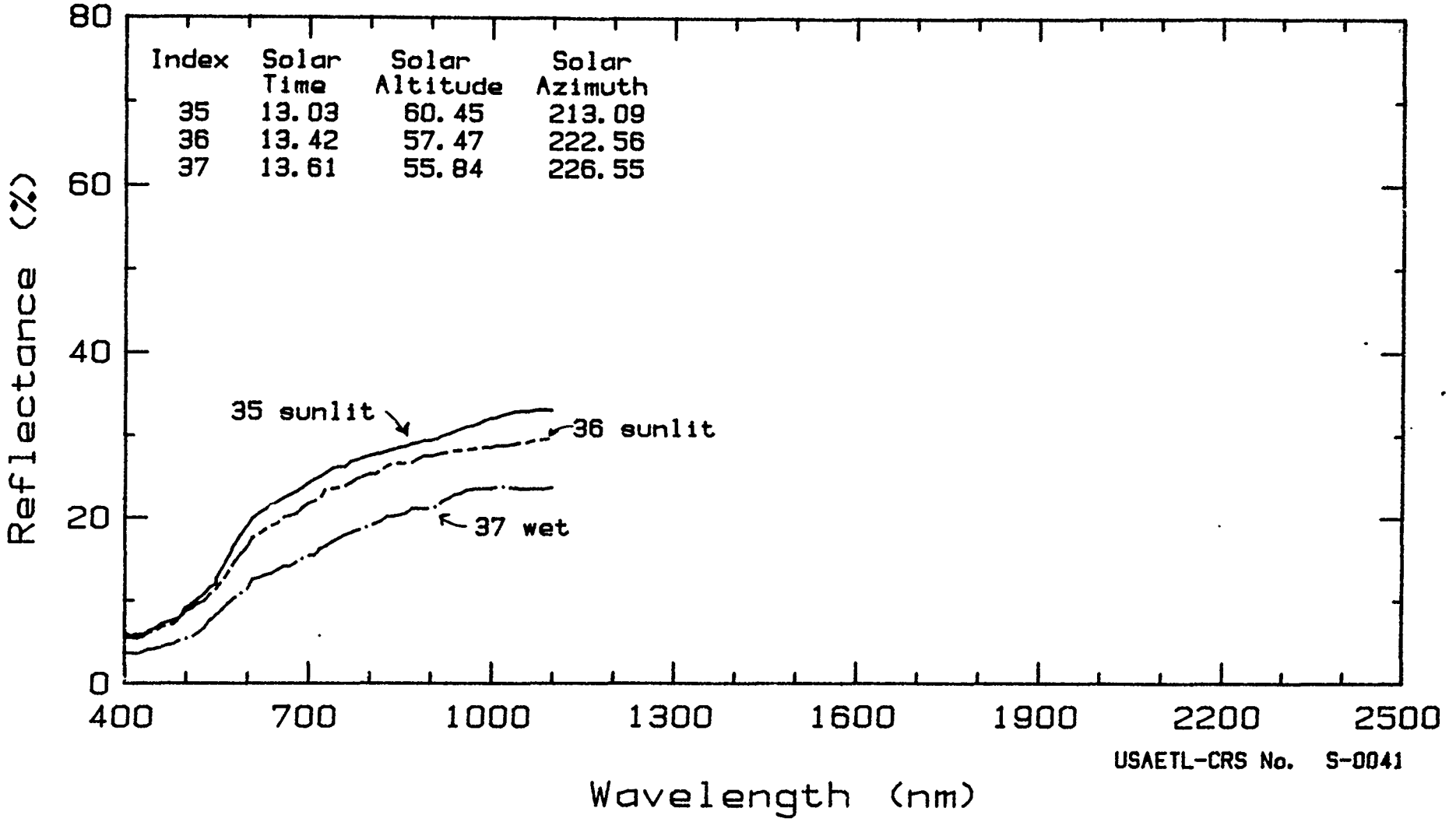
Composition: 73.4 % Sand, 12.0 % Silt, 14.6 % Clay
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
35	8.2	14.2	22.4	28.1		
36	7.8	12.7	19.7	26.0		
37	5.0	8.8	13.9	19.7		

Compiled by: Melvin B. Satterwhite. Sheet No: S-0041.
USAETL-RI-RSD.



Reflectance Spectra of Sandy Loam Soil.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loamy Sand — Date Collected: 31 Aug 1987
Taxonomy: Typic Paleorthid — Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: 87LCS.44, .45, .46

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry, undisturbed surface (44). The shaded soil surface was the air-dry surface with a shadow cast on it (45). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (46). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 86.2 % Sand, 6.2 % Silt, 7.6 % Clay
Moisture Content: air dry

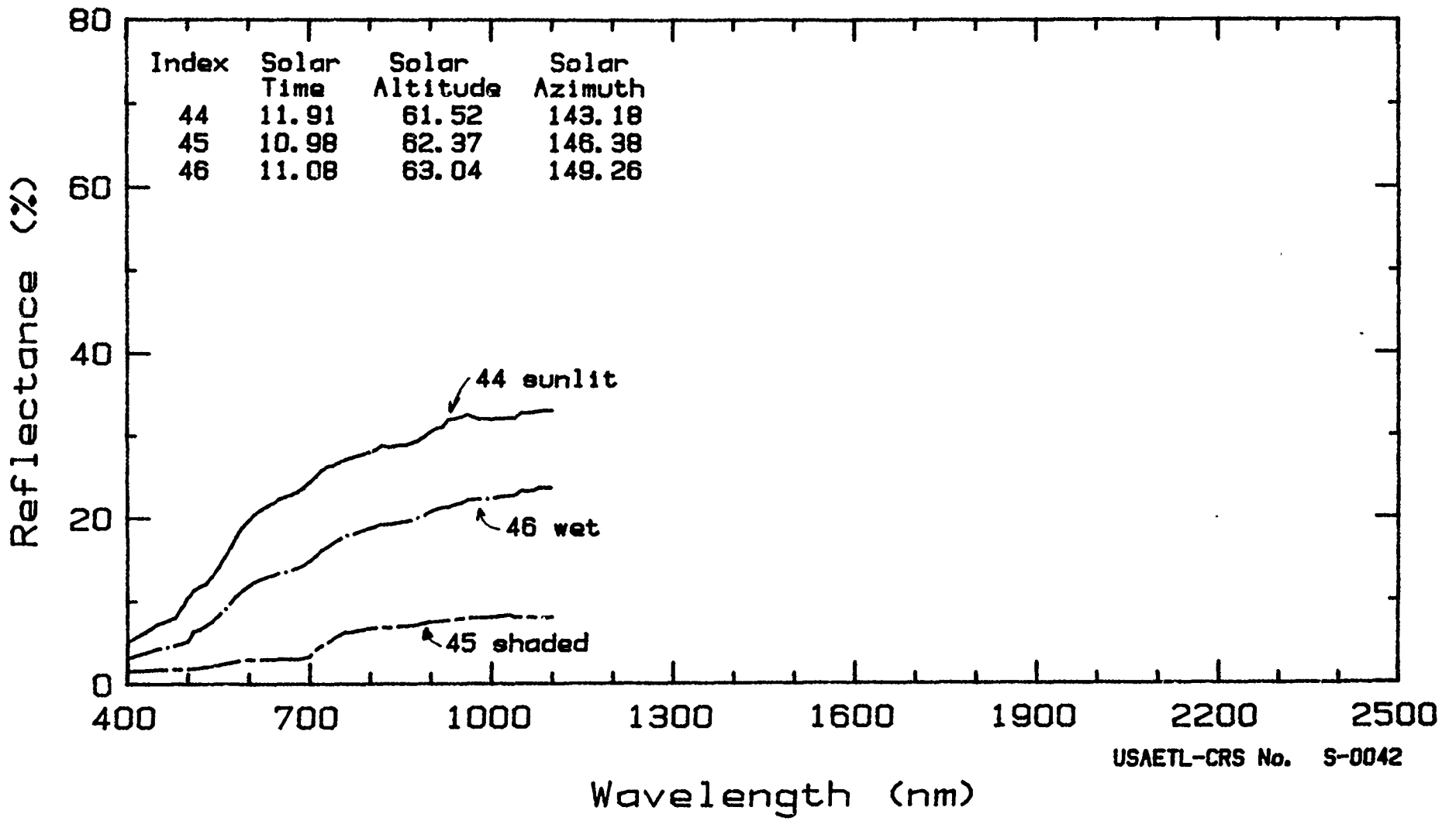
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
44	9.1	15.4	22.6	28.6		
45	1.8	2.5	3.1	6.8		
46	5.1	9.1	13.6	19.3		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0042.



Reflectance Spectra of Sandy Loam Soil.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loamy Sand Date Collected: 31 Aug 1987
Taxonomy: Typic Paleorthid Unified System: SM
Mapping Unit: Simona-Harrisburg Assoc. 1/
Spectrum No.: LJOR.54, .55, .56, .60, .62, .63.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The sunlit, air-dry, undisturbed soil surface was measured (54, 60). Shaded soil surface was the air-dry surface with a shadow cast on it (55). The spectra of the sunlit, moist soil were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (56, 63). The moist soil was then shaded and its spectrum taken (62). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

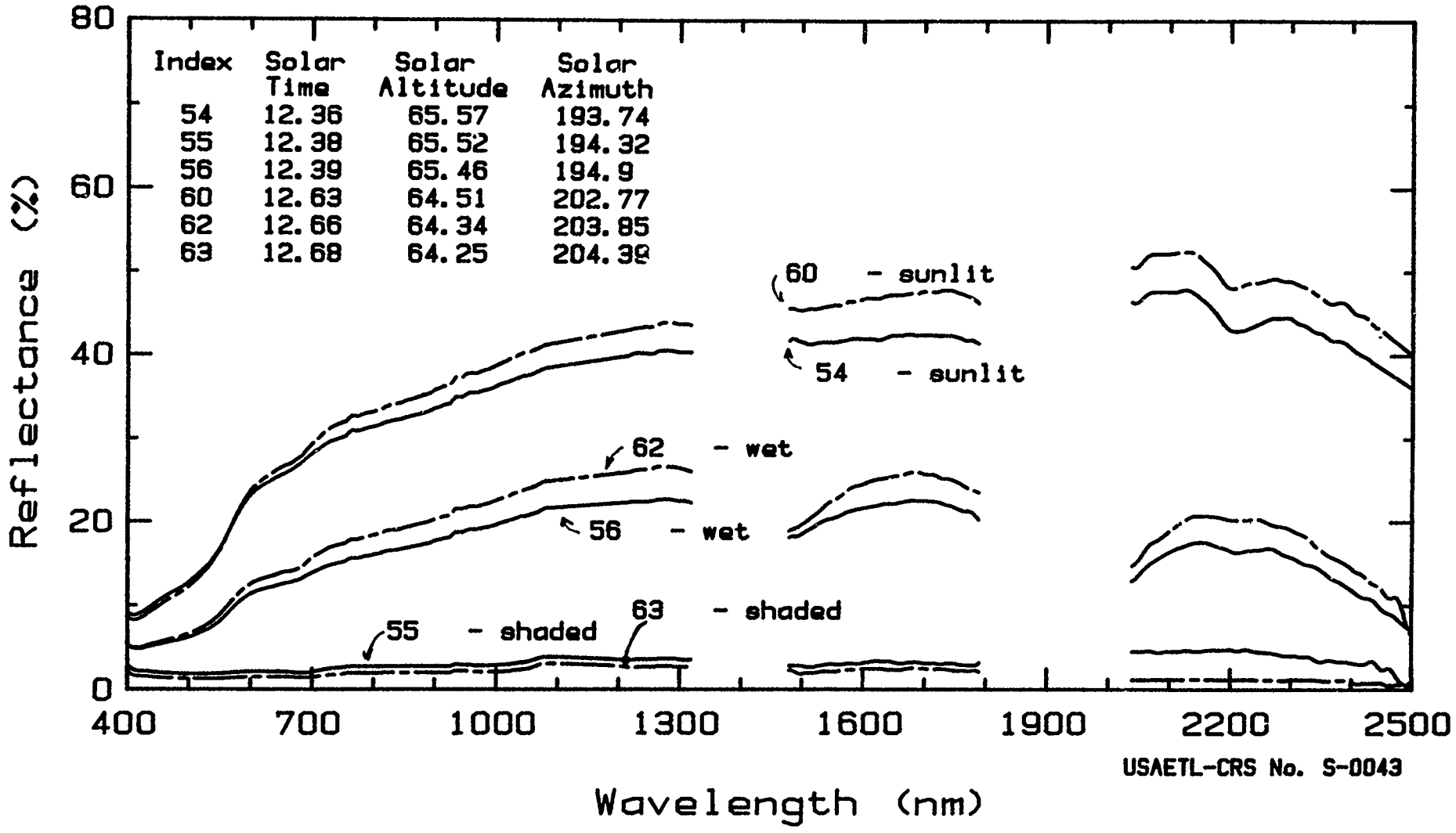
Composition: 90.0 % Sand, 2.0 % Silt, 8.0 % Clay
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
54	12.1	18.3	26.0	32.1	42.2	45.0
55	1.8	2.0	2.0	2.7	3.2	4.4
56	5.9	8.9	12.7	16.5	21.9	16.4
60	11.5	18.2	26.8	34.0	47.1	49.8
62	6.3	9.7	14.0	18.9	25.0	19.6
63	1.3	1.4	1.4	2.0	2.4	1.2

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.
Sheet No.: S-0043.



Reflectance Spectra of Loamy Sand Soil.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamment
Mapping Unit: Onite-Pintura Assoc. 1/
Spectrum No.: 87LCS.23, .27.

Date Collected: 30 Aug 1987
Unified System: SP-SM

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra were taken of two sand soil surfaces at the same sample location, with one surface (#27) being the darker toned soil. Both were sunlit, air-dry, undisturbed soil surfaces (23, 27). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 90.0 % Sand, 2.0 % Silt, 8.0 % Clay
Moisture Content: air dry

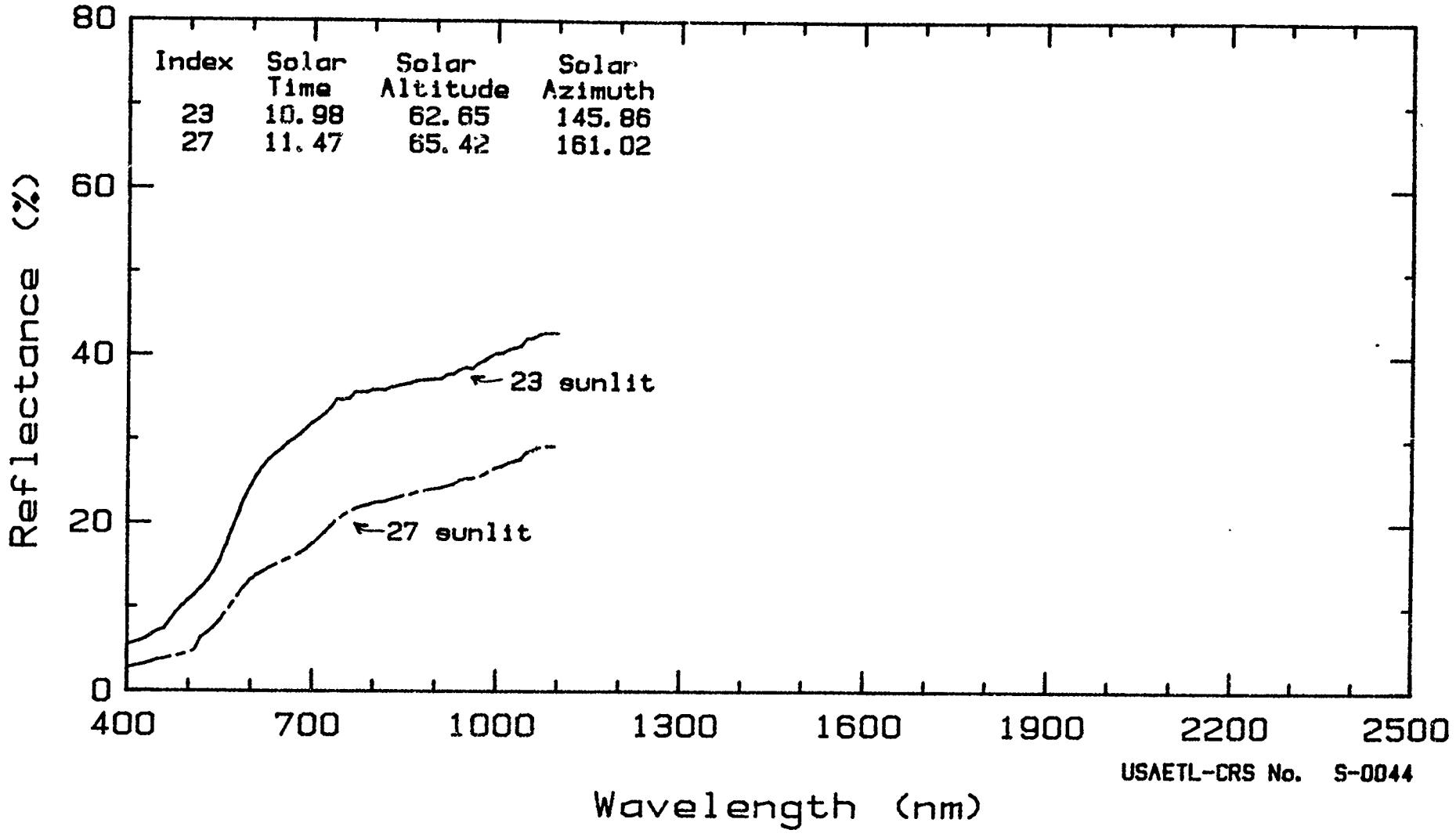
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
23	9.4	17.6	29.4	36.2		
27	4.4	9.5	15.7	22.8		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0044.



Reflectance Spectra of Sand Soils.
Jornada Expermental Range, Dona Ana Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamment
Mapping Unit: Onite-Pintura Assoc. 1/
Spectrum No.: LJOR.48, .49, .51.

Date Collected: 30 Aug 1987
Unified System: SP-SM

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra of the sunlit, air-dry, disturbed light-toned sand surface (48) and the disturbed surface of a darker-toned sand (51) were taken. Spectrum #49 was of an undisturbed, sandy surface. Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 90.0 % Sand, 2.0 % Silt, 8.0 % Clay
Moisture Content: air dry

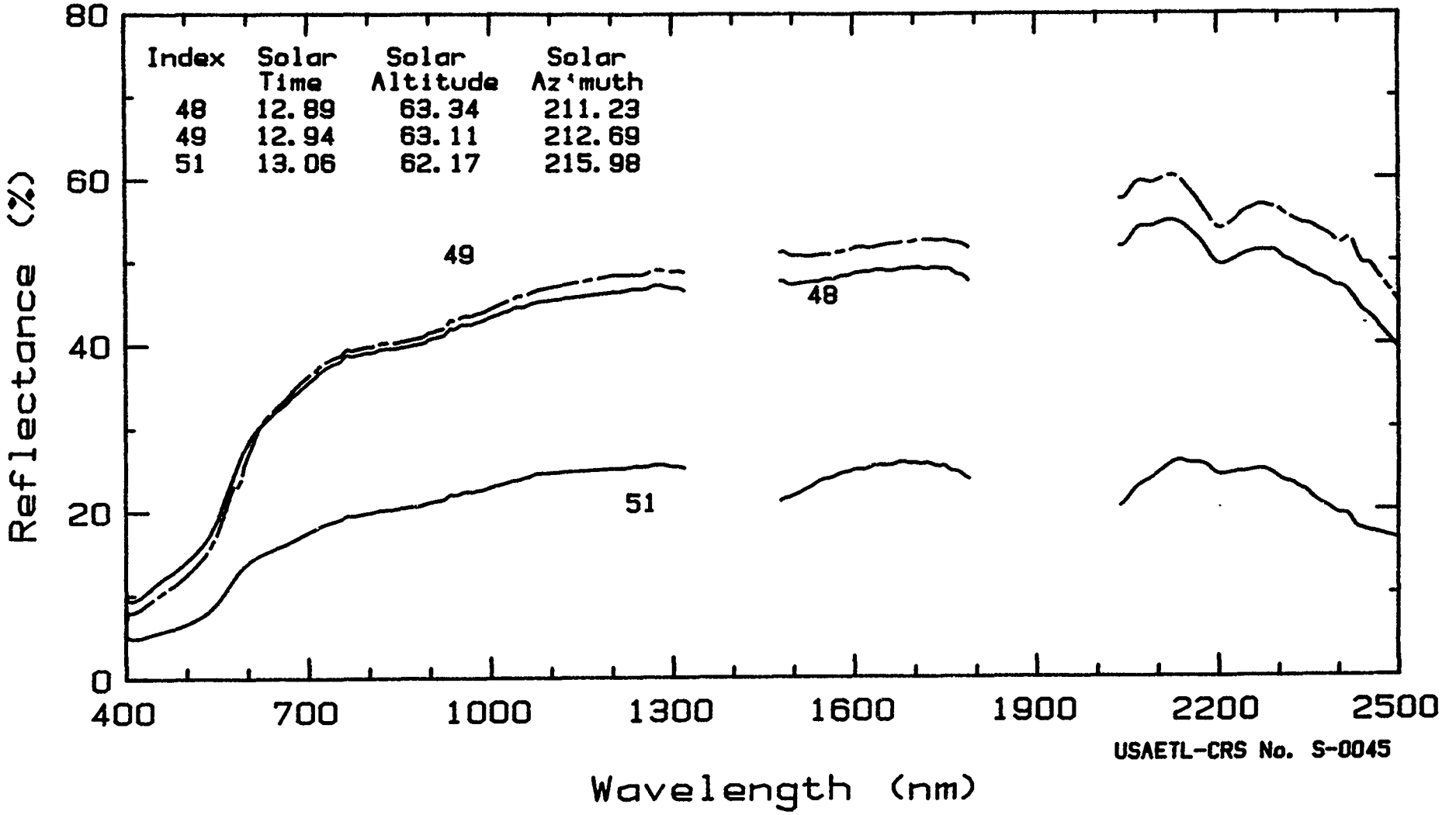
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
48	13.2	21.1	32.8	39.6	48.8	51.7
49	11.6	19.5	33.3	40.2	51.9	56.8
51	6.2	10.2	16.1	20.2	25.2	24.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0045.



Reflectance Spectra of Sand Soil.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loamy Sand
Taxonomy: Typic Torripsamment
Mapping Unit: Onite-Pintura Assoc. 1/
Spectrum No.: 87LCA.43, .44, .45, .48, .49, .50.

Date Collected: 8 Apr 1987
Unified System: SM

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.6 deg. N Latitude; 106.7 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Spectra were taken of a sunlit, air-dry soil and a undisturbed soil surface (43, 48). The spectrum of the shaded surfaces was of the air-dry surface with a shadow cast on it (44). The spectra of the sunlit, moist surface were taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (45, 50). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: 78.2 % Sand, 8.5 % Silt, 13.1 % Clay
Moisture Content: air dry

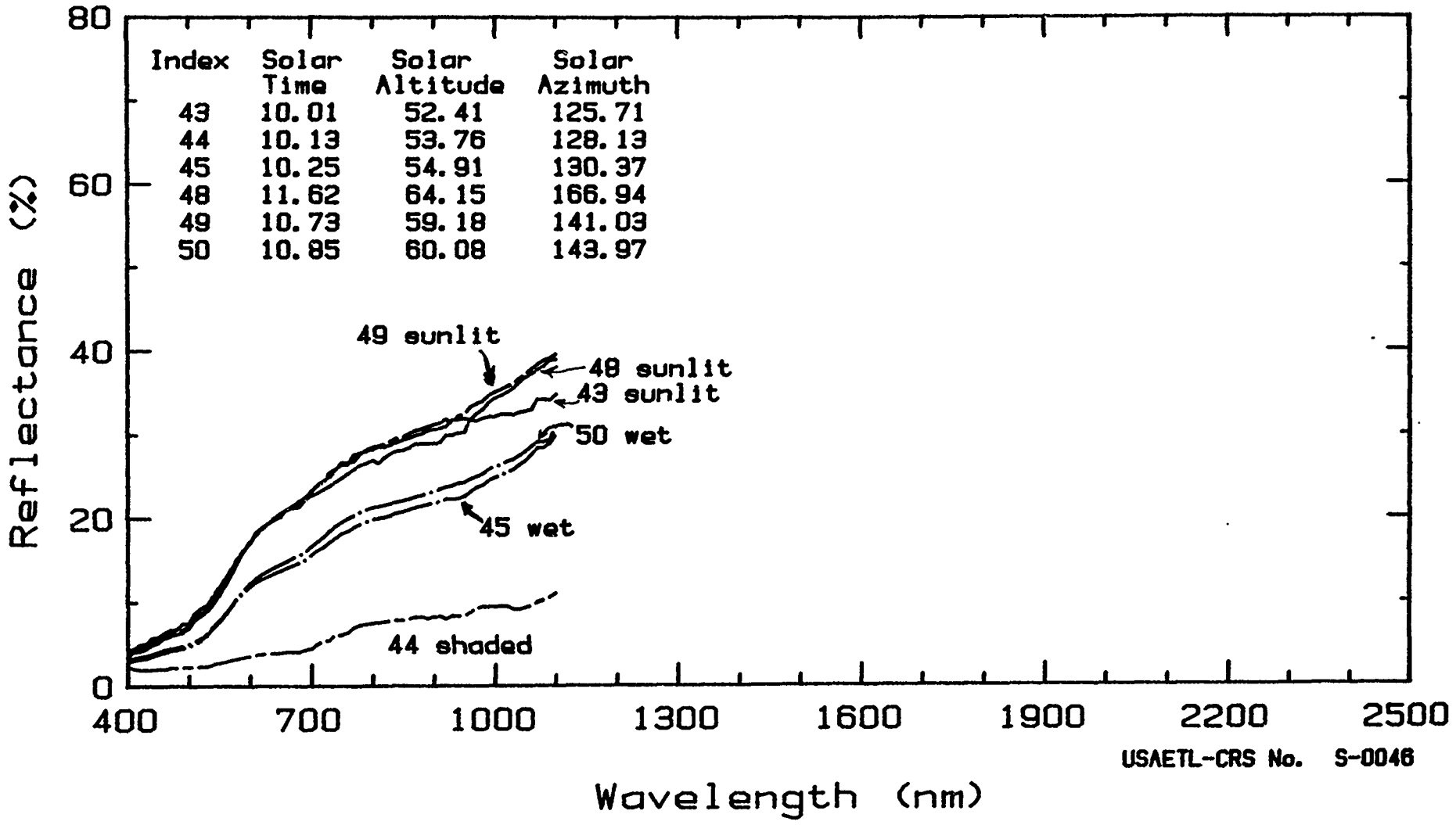
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
43	7.4	13.0	20.8	27.6		
44	2.3	3.0	4.1	7.7		
45	4.8	8.7	14.1	20.4		
48	6.6	12.4	21.1	29.9		
49	6.9	12.6	21.0	29.3		
50	4.6	8.7	14.9	21.8		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0046.



Reflectance Spectra of Sandy Loam Soil.
Jornada Experimental Range, Dona Ana Co., NM; Apr. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Mapping Unit: Lake Bed (ephemeral). 1/
Spectrum No.: LJOR.89, .91.

Date Collected: 29 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum of the sunlit, air-dry undisturbed surface (89) was taken. The spectrum was also taken of the sunlit, moist soil surface after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (91). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: <1.0 % Sand, 52.0 % Silt, 47.6 % Clay
Moisture Content: air dry

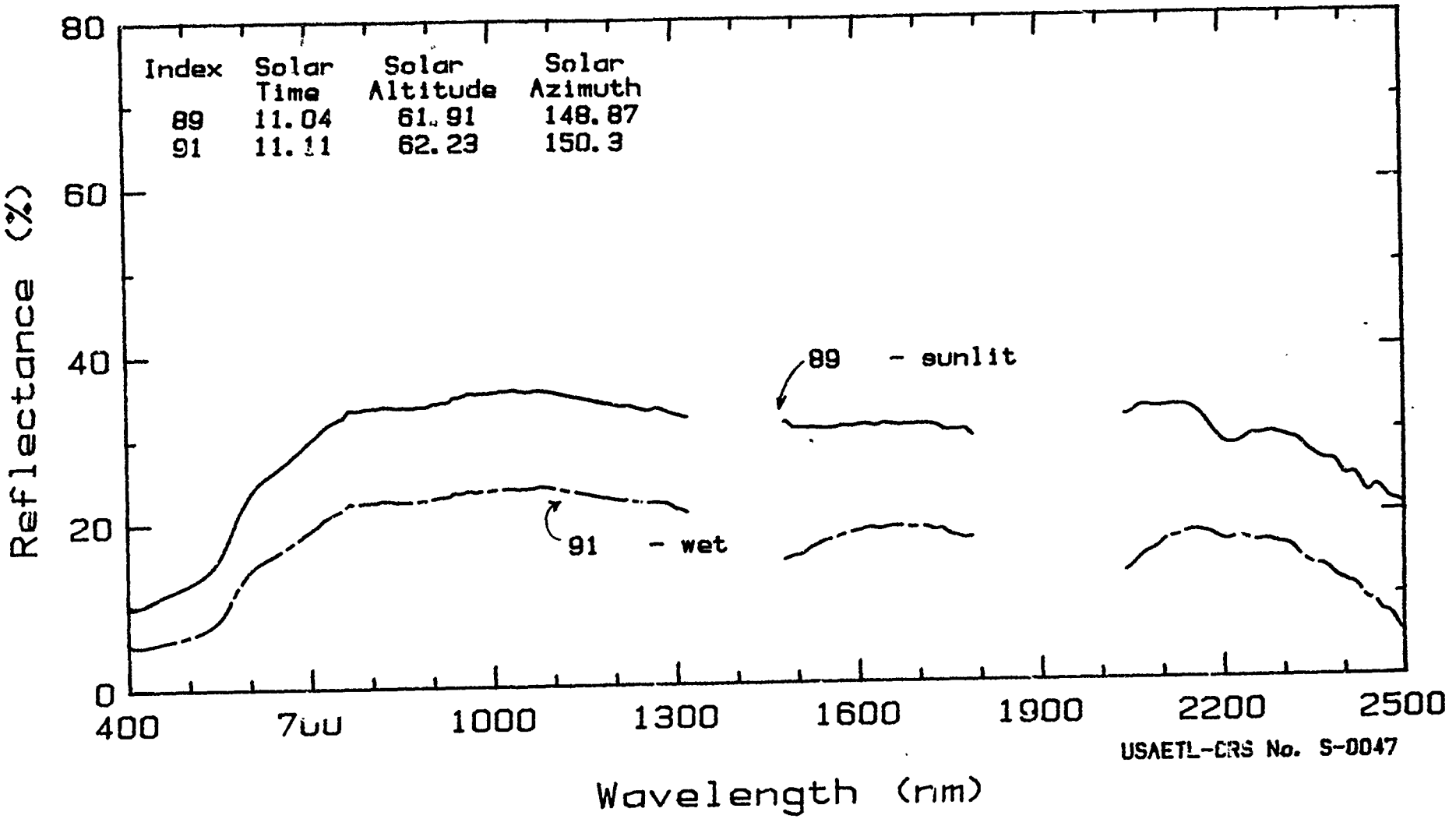
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
89	12.3	17.8	27.4	33.8	31.0	30.3
91	6.2	10.0	17.1	22.5	18.4	16.5

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0047.



Reflectance Spectra of Silty Clay Soil.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Mapping Unit: Lake Bed (ephemeral). 1/
Spectrum No.: LJOR.92, .94, .95.

Date Collected: 29 Aug 1987
Unified System: CL

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Spectra were taken of the sunlit, air-dry soil horizon at the 5 cm depth (92, 95) were taken. The spectrum was also taken of the moist soil after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (94). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

Composition: <1.0 % Sand, 52.0 % Silt, 47.6 % Clay
Moisture Content air dry

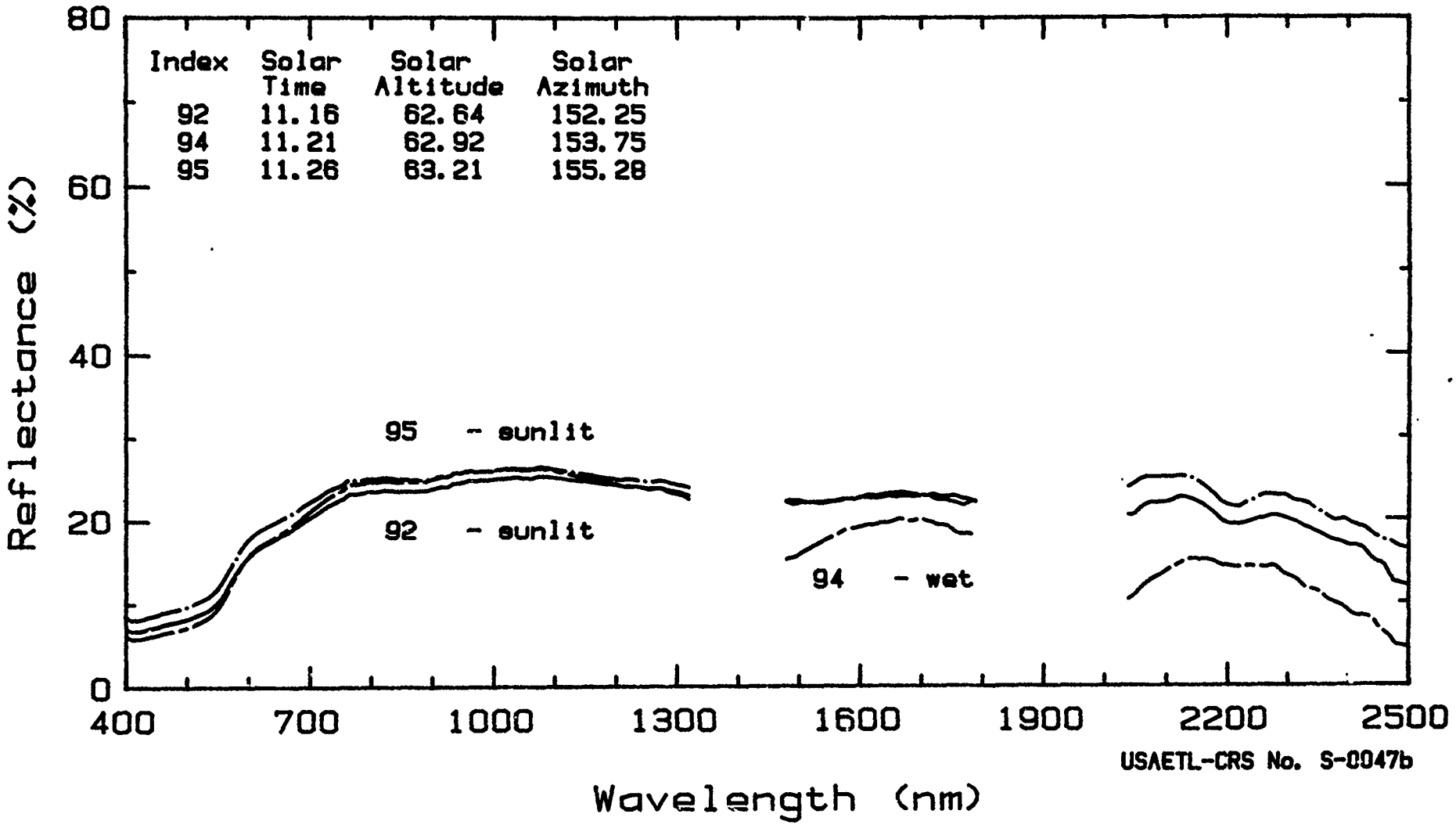
Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
92	8.0	11.7	18.5	23.6	22.8	20.6
94	7.0	11.2	18.9	24.7	19.4	14.0
95	9.5	13.5	20.5	25.1	22.8	23.2

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0047b.



Reflectance Spectra of Silty Clay Soil.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: 29 Aug 1987
Taxonomy: Typic Camborthid Unified System: CL
Mapping Unit: Mimbres. 1/
Spectrum No.: LJOR.105, .106, .107.

Site Location: Jornada Experimental Range, Dona Ana Co., NM, USA.
32.8 deg. N Latitude; 107.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry, undisturbed soil surface (105). Shaded soil surface was the air-dry surface with a shadow cast on it (106). The spectrum of the moist soil surface was taken after applied water had infiltrated and moistened the upper 2 cm to 5 cm of the soil profile (107). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

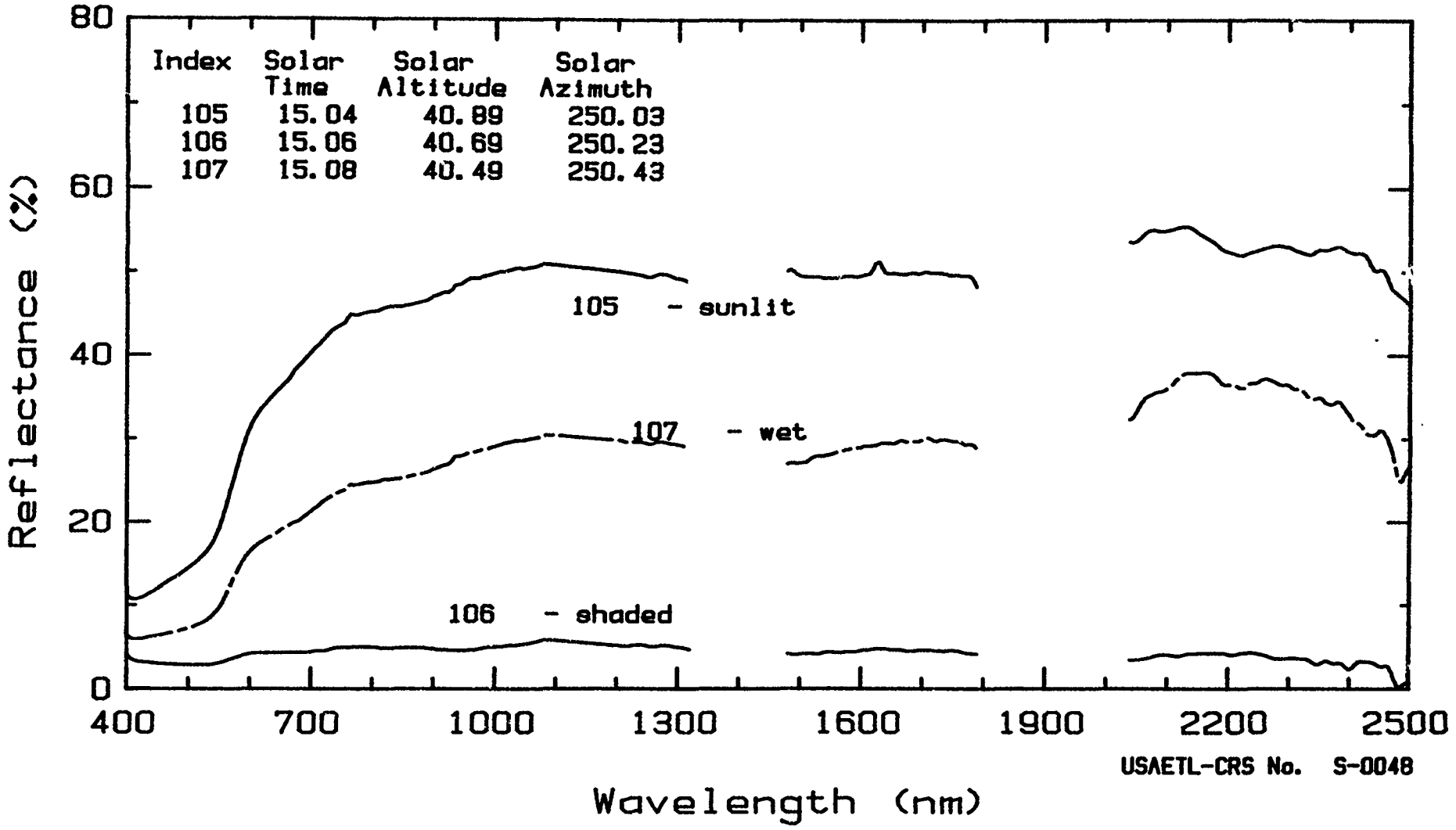
Composition: <1.0 % Sand, 64.4 % Silt, 35.6 % Clay
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
105	13.7	22.2	36.9	45.7	49.9	53.4
106	2.9	3.4	4.3	4.9	4.6	3.9
107	6.9	11.4	19.3	25.2	29.4	36.6

Compiled by: Melvin B. Satterwhite. Sheet No.: S-0048.
USAETL-RI-RSD.



Reflectance Spectra of Silty Clay Loam.
Jornada Experimental Range, Dona Ana Co., NM; Aug, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand (gypsum) Date Collected: 1 Sep 1987
Taxonomy: Aridisol Unified System: SP-SM
Mapping Unit: Active Dune Land-Gypsum. 1/
Spectrum No.: 87LCS.62, .63.

Site Location: White Sands Nat'l. Monument, Otero Co., NM, USA.
32.8 deg. N Latitude; 106.2 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry soil surface, both as undisturbed, rough (62) and the manually smoothed surface (63). Textural analysis was by dry sieving.

Physical & Chemical Properties of Composite Sample.

Composition: 100.0 % Sand, <1 % Fines (Silt + Clay)
Moisture Content: air dry (approximately 24% water)

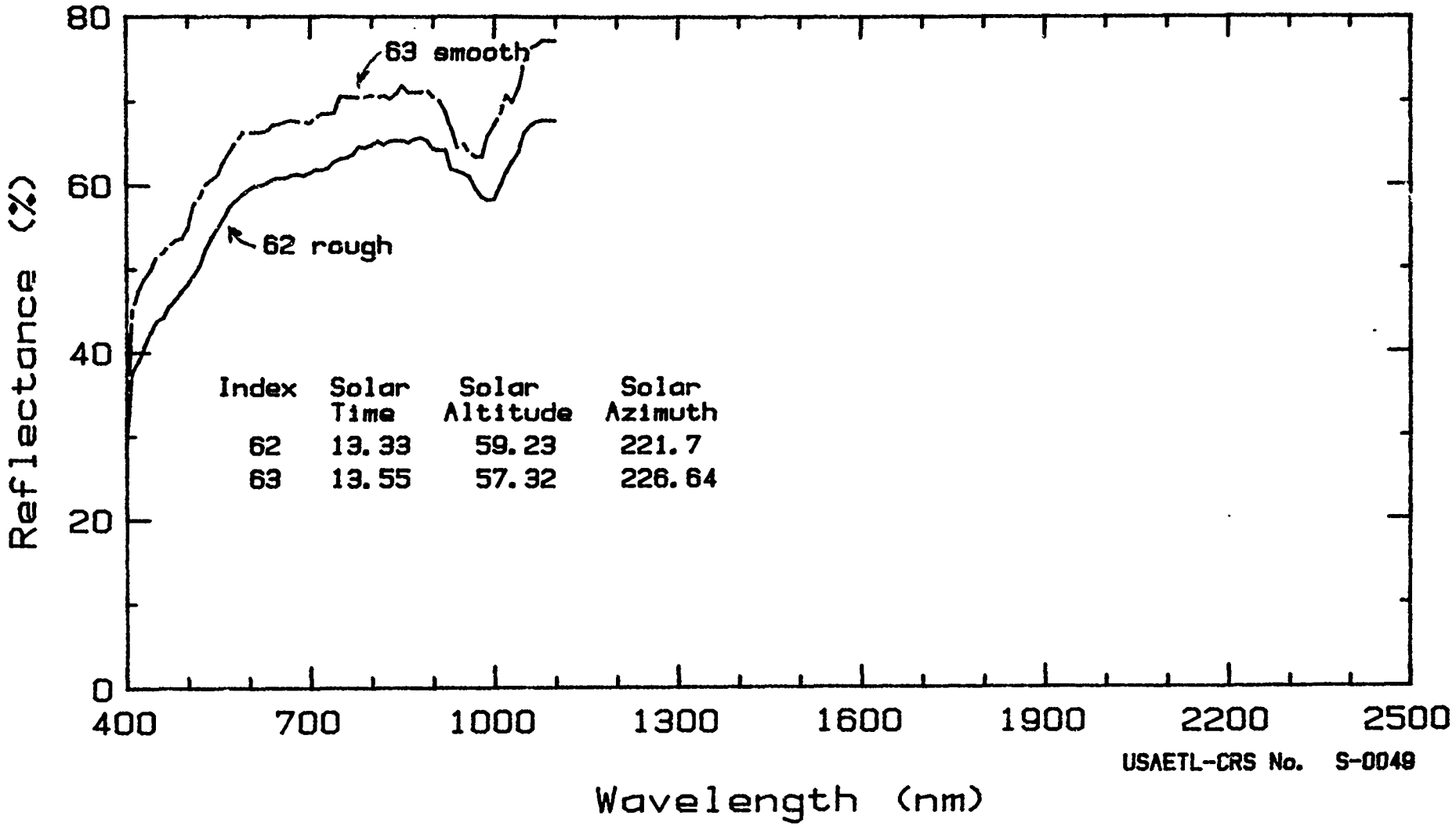
Ref: 1/. SCS-USDA, 1976, Soil Survey of White Sands Missile Range, New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
62	46.9	55.8	60.9	64.9		
63	54.4	62.9	67.4	70.9		

Compiled by: Melvin B. Satterwhite. USAETL-RI-RSD.

Sheet No: S-0049.



Reflectance Spectra of Gypsum Sand Soil.
White Sands Nat. Mon., Otero Co., NM; Sep. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand (gypsum) Date Collected: 1 Sep 1987
Taxonomy: Aridisol Unified System: SP-SM
Mapping Unit: Active Dune Land - Gypsum. 1/
Spectrum No.: LJOR.83, .84, .85, .86.

Site Location: White Sands Nat'l. Monument, Otero Co., NM, USA.
32.8 deg. N Latitude; 106.2 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Sunlit, air-dry soil spectra were taken of the undisturbed surface (83, 86), the smoothed surface (84) and the naturally moist subsurface (85) at the 10 cm depth. Textural analysis was by dry sieving.

Physical & Chemical Properties of Composite Sample.

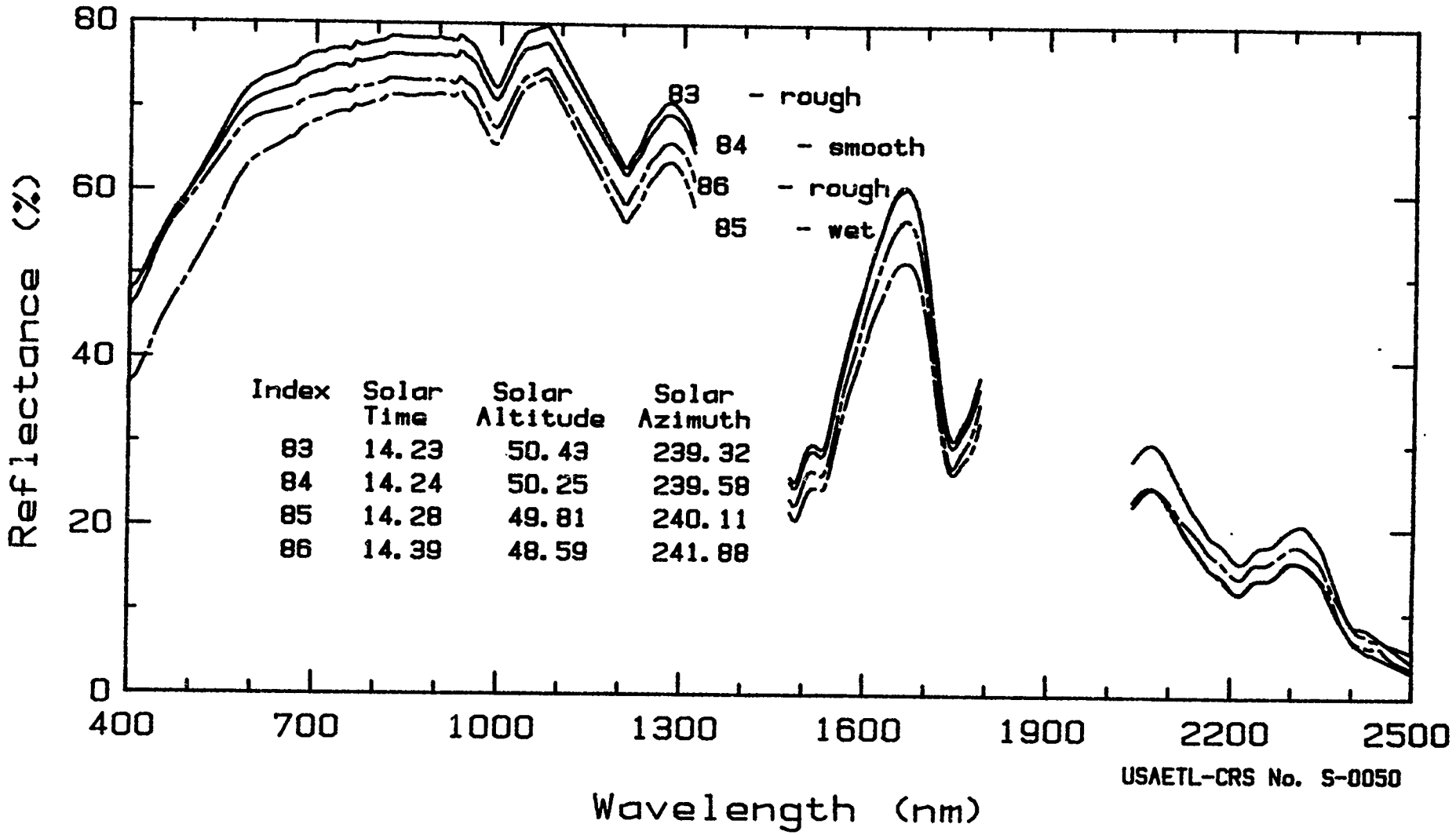
Composition: 100 % Sand, <1.0 % Fines (Silt + Clay).
Moisture Content air dry (approximately 24% water)

Ref: 1/. SCS-USDA, 1976, Soil Survey of White Sands Missile Range, New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
83	58.5	68.3	74.8	78.0	47.7	16.2
84	58.7	67.1	72.6	76.0	48.1	20.3
85	48.6	58.8	66.3	71.0	41.2	17.8
86	57.7	65.2	70.0	73.0	44.3	16.2

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.
Sheet No.: S-0050.



Reflectance Spectra of Gypsum Sand.
White Sands National Monument, Otero Co., NM; Sep, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loam (gypsiferous) Date Collected: 28 Aug 1987
Taxonomy: Aridisol Unified System: SP
Mapping Unit: Dona Ana-Reagan Assoc. 1/
Spectrum No.: LJOR.96, .97, .98.

Site Location: Jornada Experiment Range, Dona Ana Co., NM, USA.
32.7 deg. N Latitude; 106.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was taken of the sunlit, air-dry, undisturbed soil surface (96). The shaded surface was the air-dry surfaces with a shadow cast on it (97), and the wet surface had water applied, which wetted the upper 2 to 5 cm of soil profile. (98). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

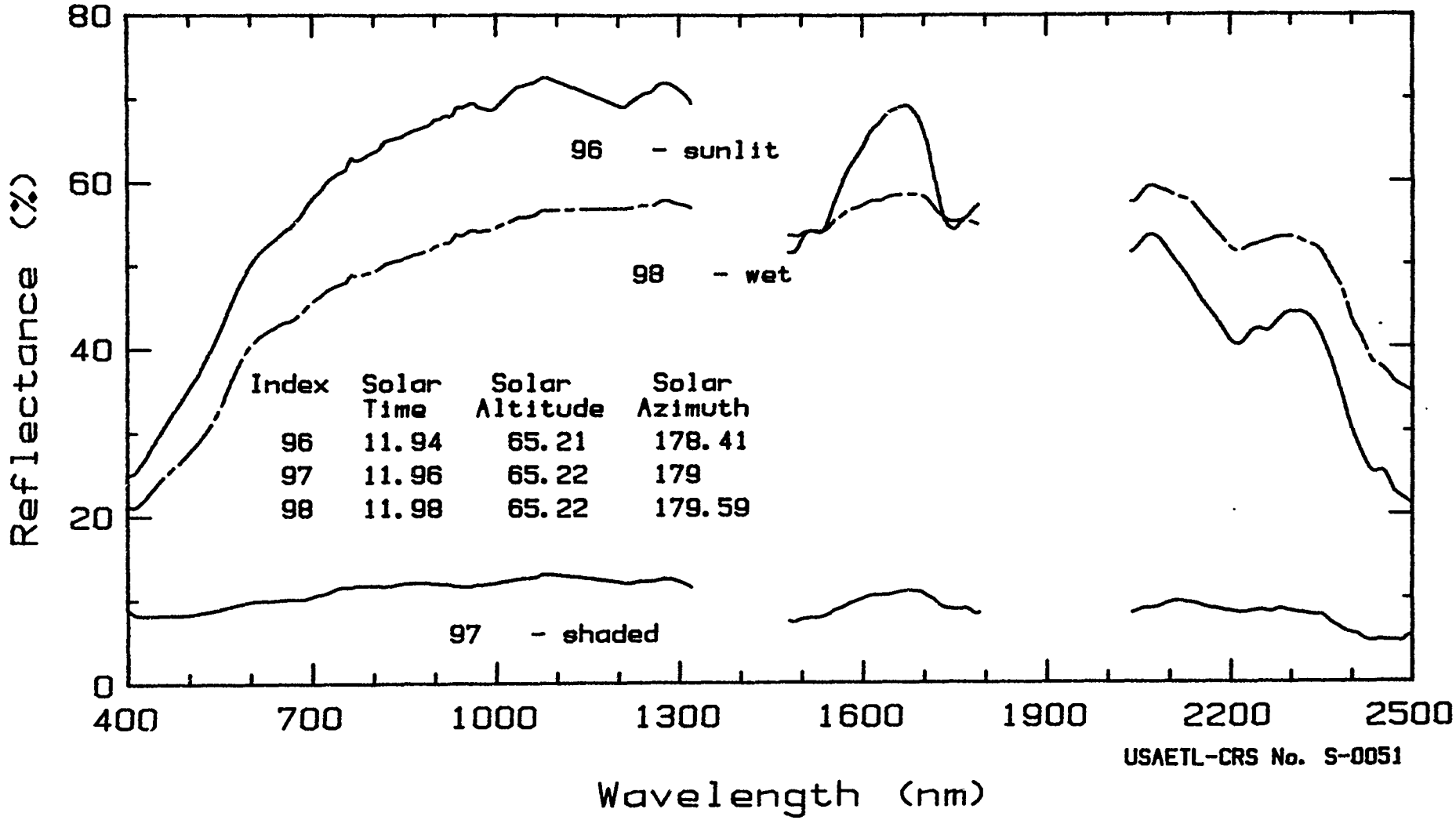
Composition: 40.4 % Sand, 44.0 Silt, 15.6 Clay.
Moisture Content: air dry

Ref: 1/. SCS-USDA, 1980, Soil Survey of Dona Ana Co., New Mexico.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
96	33.5	43.8	54.4	64.8	63.5	44.7
97	8.3	9.1	10.1	11.8	10.0	8.7
98	26.5	34.7	43.3	50.3	57.2	54.2

Compiled by: Melvin B. Satterwhite. Sheet No.: S-0051.
USAETL-RI-RSD.



Reflectance Spectra of Gypsiferous Loam.
Jornada Experimental Range, Dona Ana Co., NM; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Gravel
Taxonomy: Aridisol
Spectrum No.: LYUM.42, .44, .45.

Date Collected: 25 Aug 1987

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra were taken of quartz and calcite gravel-size particles that lie on the soil surface in small deposits up to 2 cm thick. These are well-rounded particles 2 to 5 mm in diameter. The spectra were taken of the sunlit, air-dry gravel surface (42), the shaded gravels (44) and the moistened gravels (45).

Physical & Chemical Properties of Composite Sample.

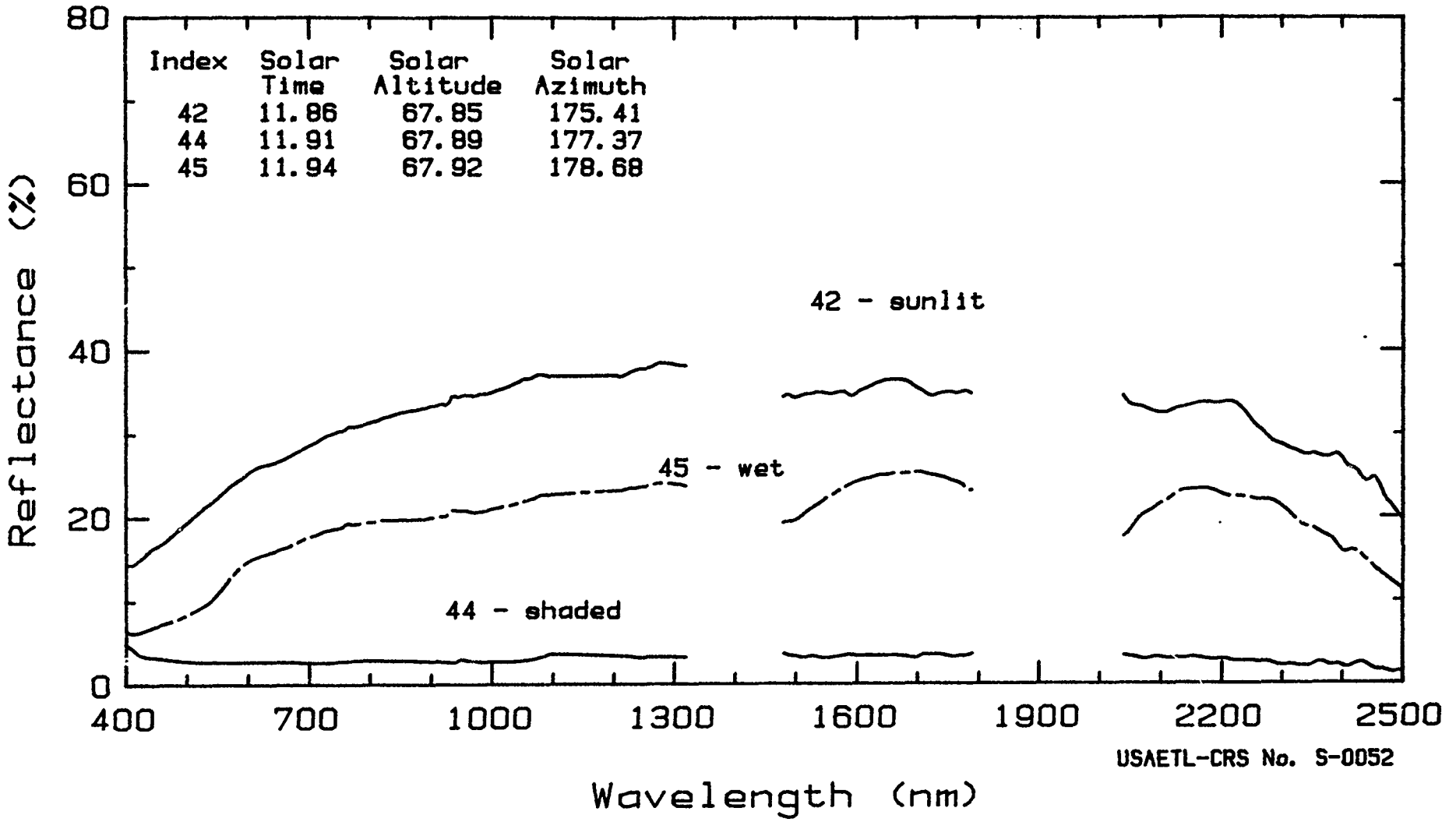
Composition: 100 % gravel size particles.
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
42	18.4	23.0	27.2	32.1	35.4	31.5
44	2.9	2.7	2.7	2.8	3.3	2.7
45	8.0	11.8	16.4	19.6	24.6	21.8

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0052.



Reflectance Spectra of Lag Gravels.
Marine Air Station, Yuma Co., AZ; Aug, 1987.

Field Reflectance Spectra of Soil

Soil Texture: Gravel
Taxonomy: Aridisol
Spectrum No.: 87YAA.23, .24, .25.

Date Collected: 25 Aug 1987

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Spectra were taken of a small localized gravel deposit, about 2 cm thick, under three conditions: sunlit, air-dry surface (23), shaded surface (24) and moistened surface (25).

Physical & Chemical Properties of Composite Sample.

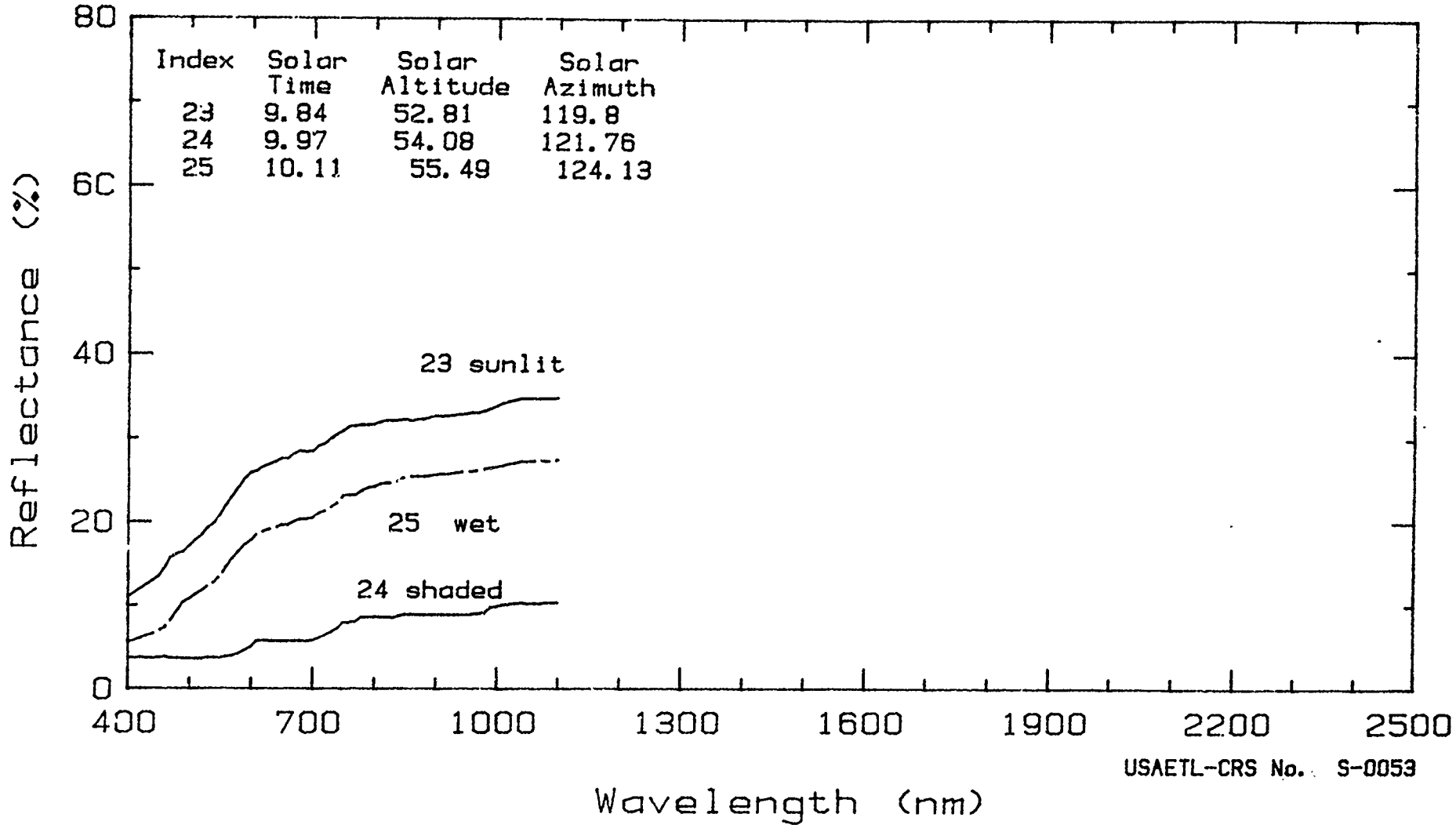
Composition: 100.0% gravel size particles
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
23	16.2	22.1	27.8	32.0		
24	3.6	4.0	5.7	8.7		
25	9.1	14.7	19.8	24.8		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0053.



Reflectance Spectra of Gravel.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Torripsamment
Spectrum No.: LYUM.31, .32.

Date Collected: 25 Aug 1987
Unified System: SM

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.3 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Sunlit, air-dry soil spectrum was of the undisturbed surface (31). Shaded soil surface was the air-dry surface with a shadow cast on it (32). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

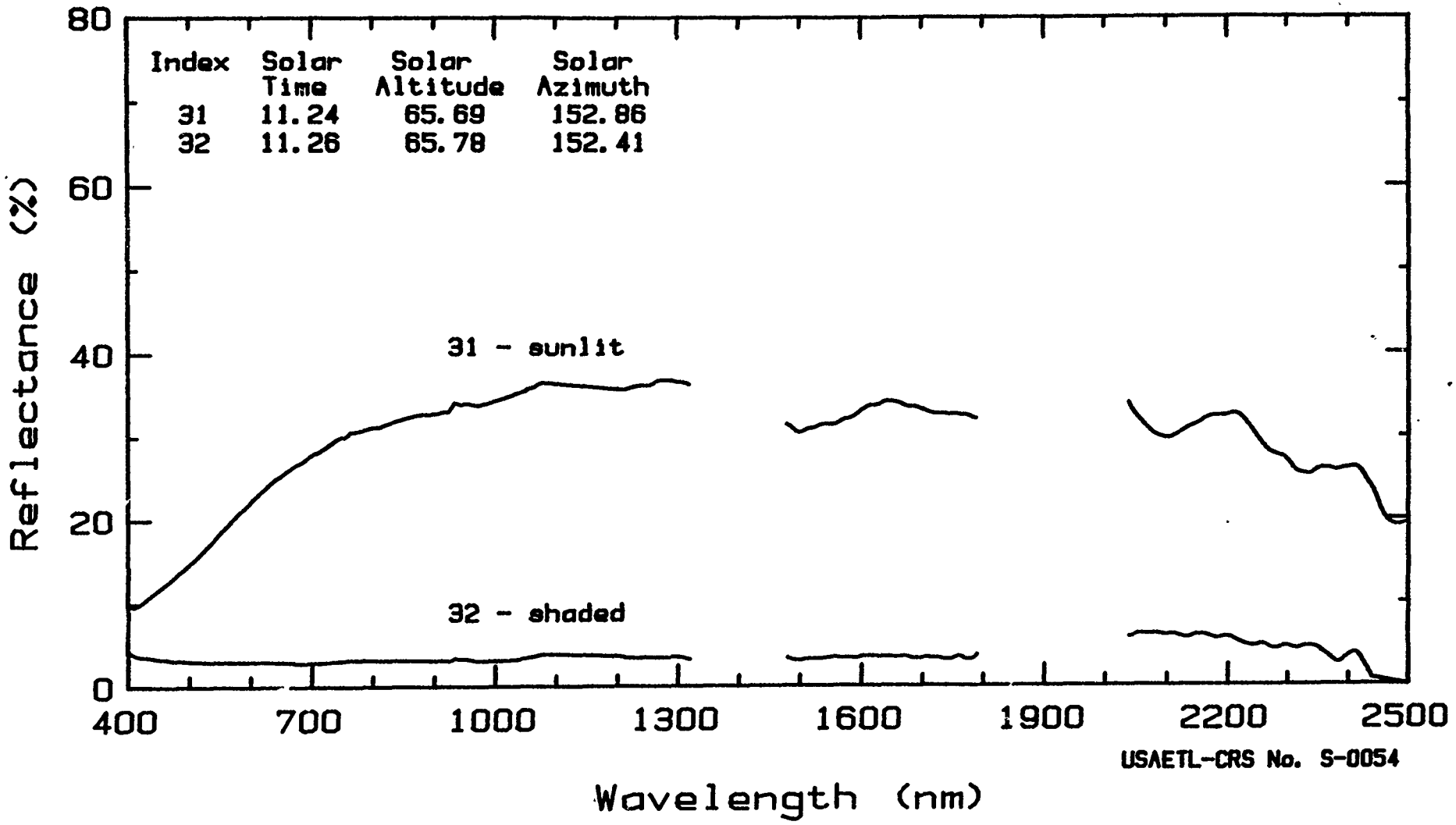
Composition: 89.2 % Sand, 3.2 % Silt, 7.6 % Clay
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
31	13.8	19.1	25.9	31.8	33.2	29.8
32	3.2	3.0	2.9	3.2	3.4	5.3

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0054.



Reflectance Spectra of Sand Soil.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sandy Loam Date Collected: 13 Apr 1988
Taxonomy: Mine spoil pile Unified System: SM
Spectrum No.: MOJ23.01, .10, .15, .20.

Site Location: Fortuna Mine, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 5 cm horizon of a mine-processing spoil pile. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

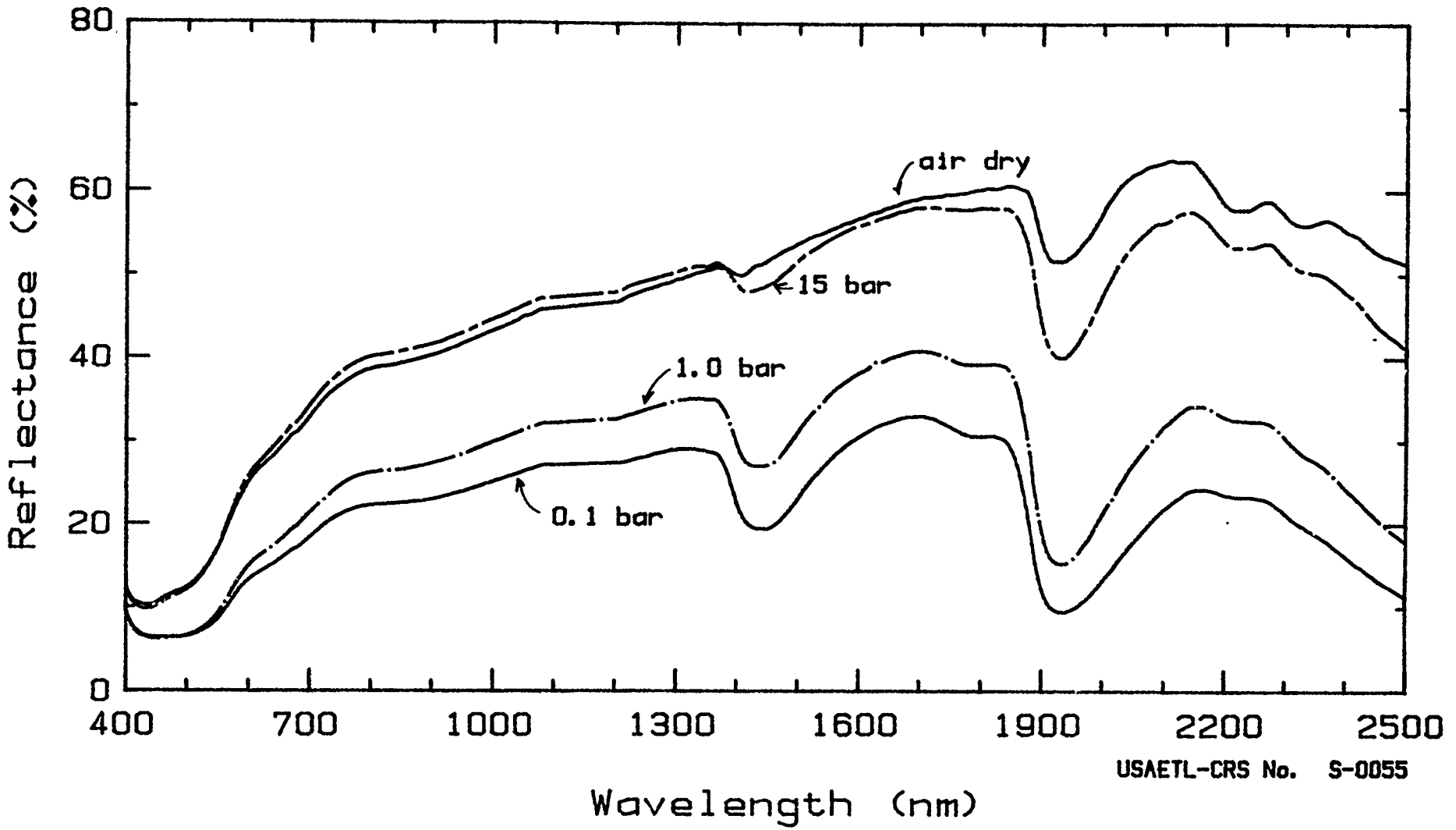
Composition: 60.0 % Sand, 32.0 % Silt, 8.0 % Clay
Moisture Content: 0.1 bar = 29.9 %; 1.0 bar = 18.9 %;
15 bar = 7.1 %; air dry = 1.9 %.
Electrical Conductivity = 18.0 * 1000 mmhos / cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	6.5	9.8	16.2	22.5	31.5	22.4
1.0	6.5	10.6	18.6	26.4	39.3	31.9
15	11.6	19.2	30.8	40.5	56.9	54.2
A.D.	11.9	19.0	29.7	39.0	58.0	59.7

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0055.



Moisture Effects on the Spectra of a Sandy Loam Soil.
Fortuna Mine, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Date Collected: 14 Apr 1988
Taxonomy: Torripsamment
Unified System: SM
Geomorphic Unit: Sand Sheet, coppice dunes
Spectrum No.: MOJ09.01, .10, .15, .20.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.5 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

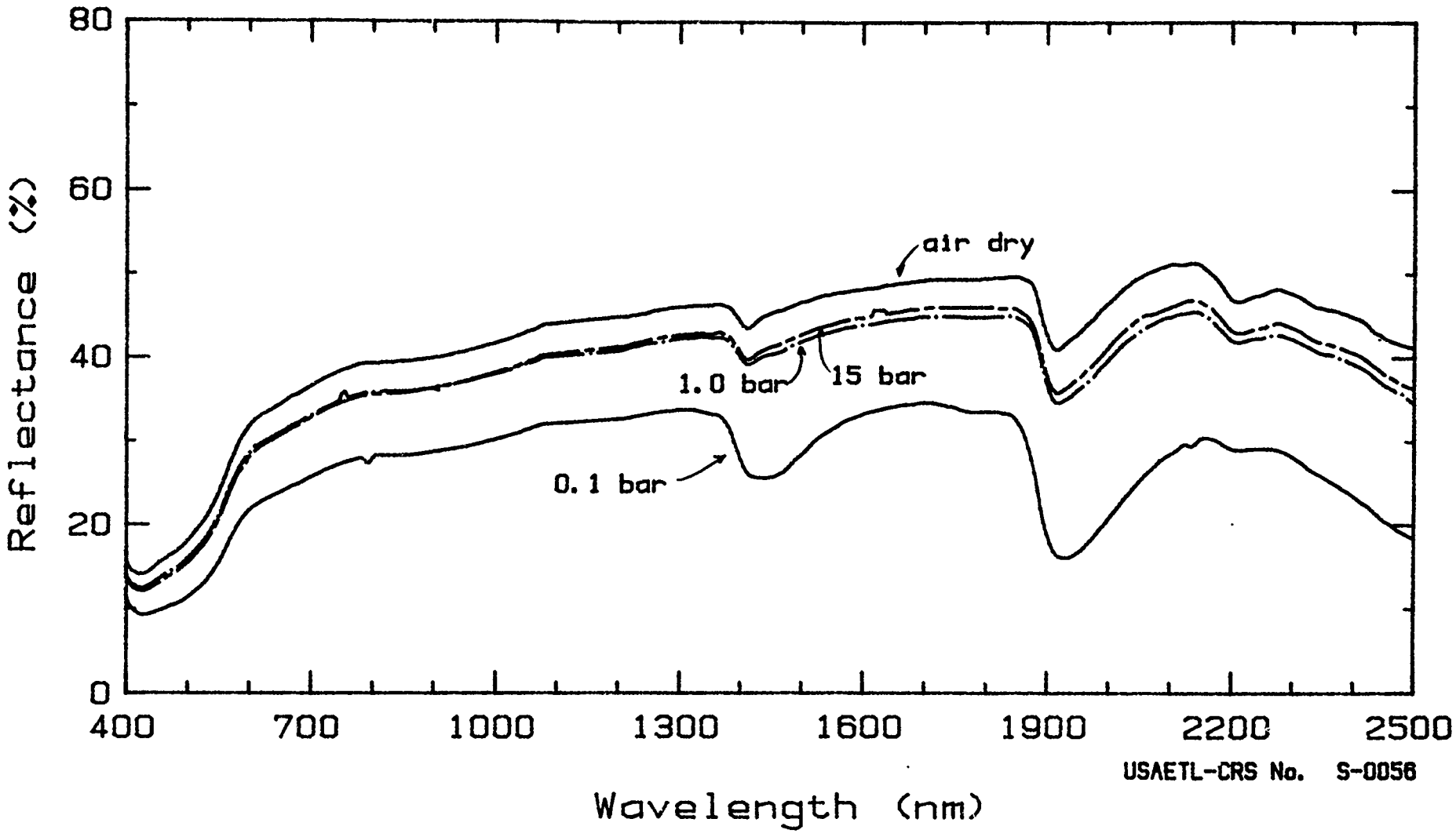
Sample: A sample was taken from the 0 to 10 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0 and 15 bar potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.
Composition: 99.4 % Sand, 0.6 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 5.4 %; 1.0 bar = 2.1 %;
15 bar = 1.3 %; air dry = 0.4 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.9	17.0	24.2	28.2	33.7	28.7
1.0	15.2	22.9	31.4	35.9	44.4	43.1
15	14.7	22.4	31.1	35.7	45.4	44.4
A.D.	17.2	25.6	34.8	39.5	48.8	48.6

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.
Sheet No: S-0056.



Moisture Effects on the Spectra of a Sand Soil.
Marine Air Station, Yuma Co., AZ; Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand Date Collected: 14 Apr 1988
Taxonomy: Torripsamment Unified System: SM
Geomorphic Unit: Sand Sheet, coppice dunes
Spectrum No.: MOJ31.01, .10, .15, .20.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.5 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

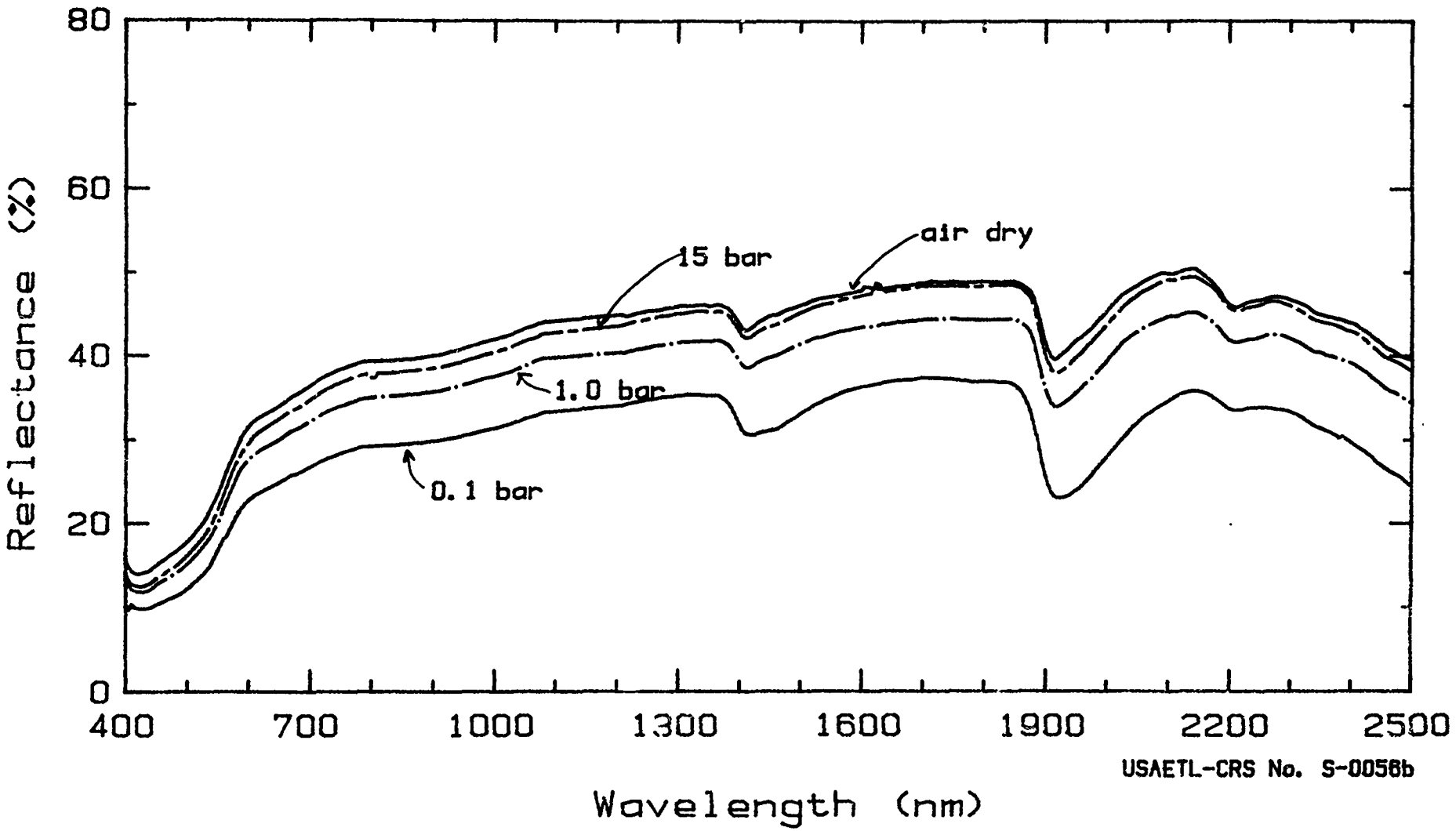
Sample: A sample was taken from the 10-20 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of these subsamples at the air-dry condition and the three pressured potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.
Composition: 100.0 % Sand, 0.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 3.9 %; 1.0 bar = 2.6 %;
15 bar = 1.7 %; air dry = 0.5 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	11.6	18.0	25.2	29.4	36.7	34.0
1.0	14.4	21.9	30.5	35.2	43.9	42.9
15	15.3	23.5	32.9	38.0	47.8	47.0
A.D.	17.0	25.3	34.5	39.5	48.3	47.7

Compiled by: Melvin B. Satterwhite, Sheet No: S-0056b.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Moisture Effects on the Spectra of a Sand Soil.
Marine Air Station, Yuma Co., AZ; Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Date Collected: 14 Apr 1988
Taxonomy: Torripsamment
Unified System: SM
Geomorphic Unit: Sand Sheet, coppice dunes
Spectrum No.: MOJ35.01, .10, .15, .20.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.5 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 20 to 30 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0 and 15 bar potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.
Composition: 100.0 % Sand, 0.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 3.8 %; 1.0 bar = 2.3 %;
15 bar = 1.8 %; air dry = 0.5 %.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	14.1	21.6	30.0	34.6	42.7	41.0
1.0	14.1	21.6	30.3	35.1	44.6	43.7
15	14.5	22.2	31.1	35.9	44.6	43.8
A.D.	17.3	26.0	35.5	40.7	50.5	49.5

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.
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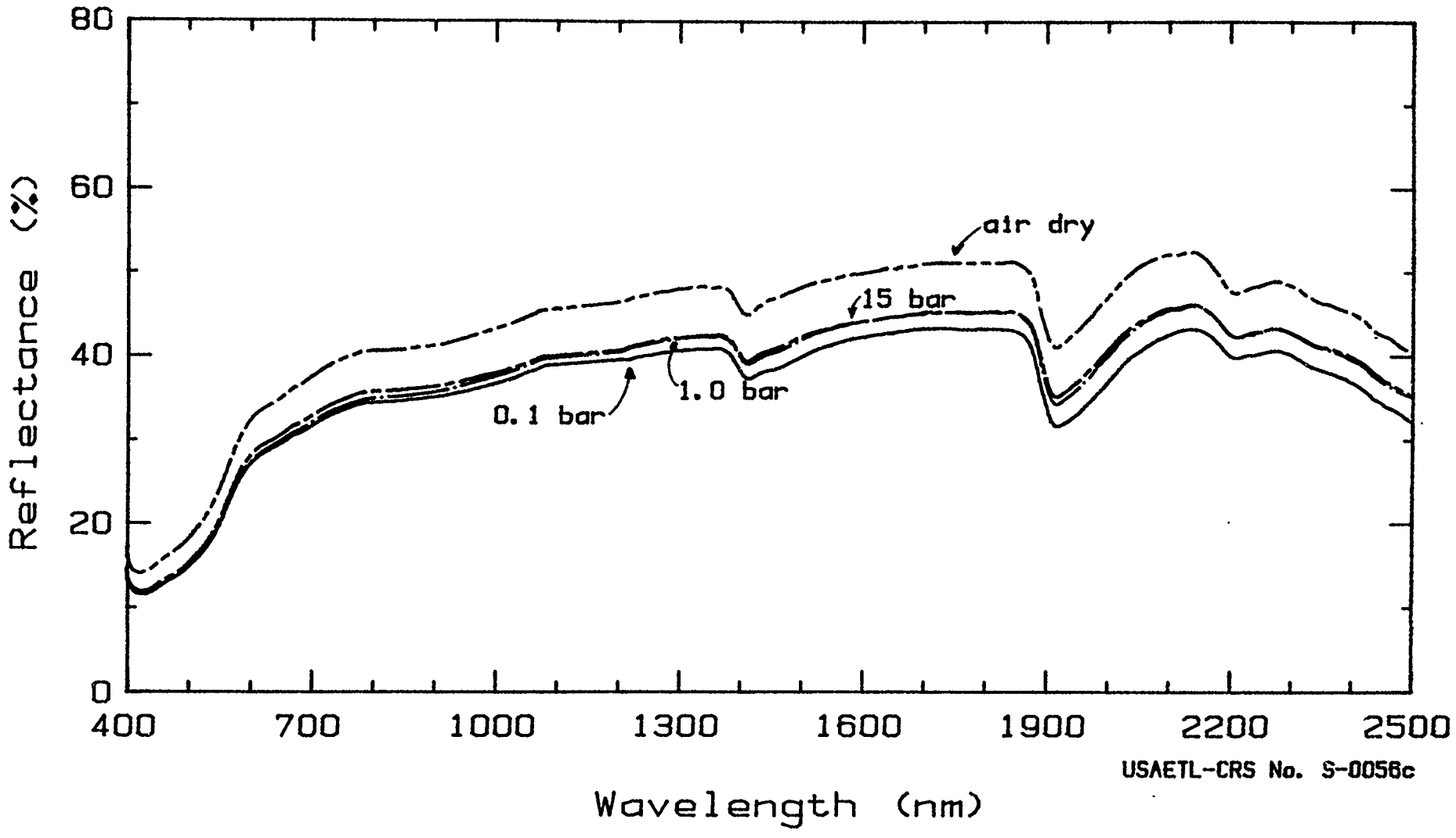


Moisture Effects on the Spectra of a Sand Soil.
Marine Air Station, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Date Collected: 14 Apr 1988
Taxonomy: Torripsamment
Unified System: SM
Geomorphic Unit: Sand Sheet, coppice dunes
Spectrum No.: MOJ42.10, .15.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.5 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 30 to 40 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 1.0 and 15 bar potential. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.

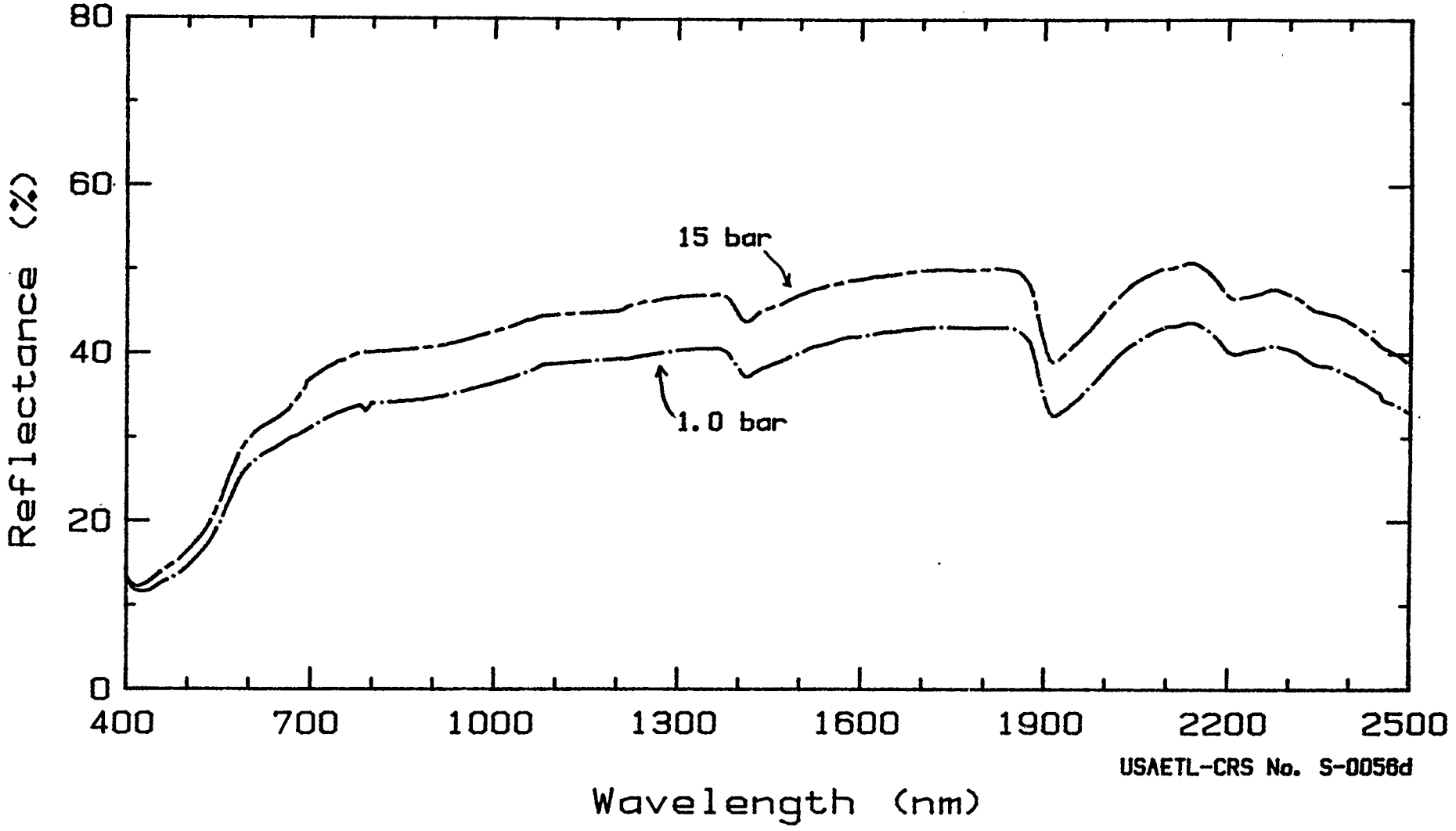
Composition: 100.0 % Sand, 0.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 5.5 %; 1.0 bar = 2.2 %;
15 bar = 1.7 %; air dry = 0.6 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1.0	13.9	21.1	29.5	34.1	42.6	41.4
15	15.6	23.8	33.3	40.3	49.4	48.1

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0056d.



Moisture Effects on the Spectra of a Sand Soil.
Marine Air Station, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Date Collected: 14 Apr 1988
Taxonomy: Torripsamment
Unified System: SM
Geomorphic Unit: Sand Sheet, coppice dunes
Spectrum No.: MOJ46.01, .10, .15.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.5 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 40 to 50 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1, 1.0 and 15 bar potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.

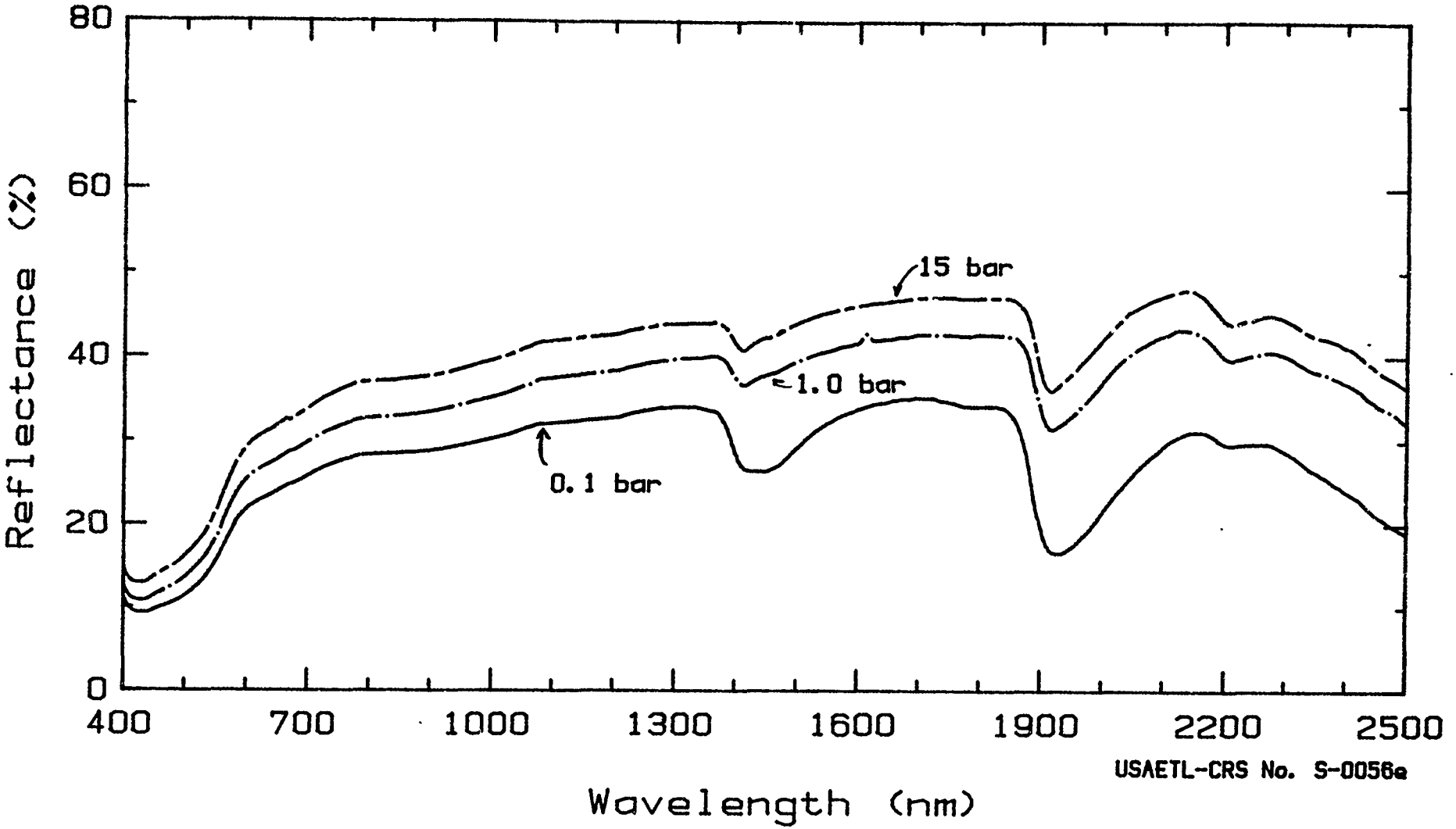
Composition: 100.0 % Sand, 0.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 5.9 %; 1.0 bar = 2.2 %;
15 bar = 1.6 %; air dry = 0.6 %.
Electrial Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.9	17.0	24.3	28.4	34.3	29.5
1.0	12.9	19.9	28.2	32.9	42.1	41.0
15	15.4	23.2	32.2	37.2	46.5	45.4

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0056e.



Moisture Effects on the Spectra of a Sand Soil.
Desert Well, Yuma Co., AZ; Apr, 1988.

Field Reflectance Spectra of Soil

Soil Texture: Gravelly Loamy Sand Date Collected: 27 Aug 1987
Taxonomy: Aridisol Unified System: GM
Spectrum No.: 87YAA.29, .30, .31.

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectrum was measured of the sunlit, air-dry undisturbed soil surface (29). The spectrum of the shaded surface was of the air-dry surface with a shadow cast on it (30). The spectrum of the sunlit, moistened soil was taken after applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (31). Textural analysis using the hydrometer technique was conducted on the <2000 um soil fraction.

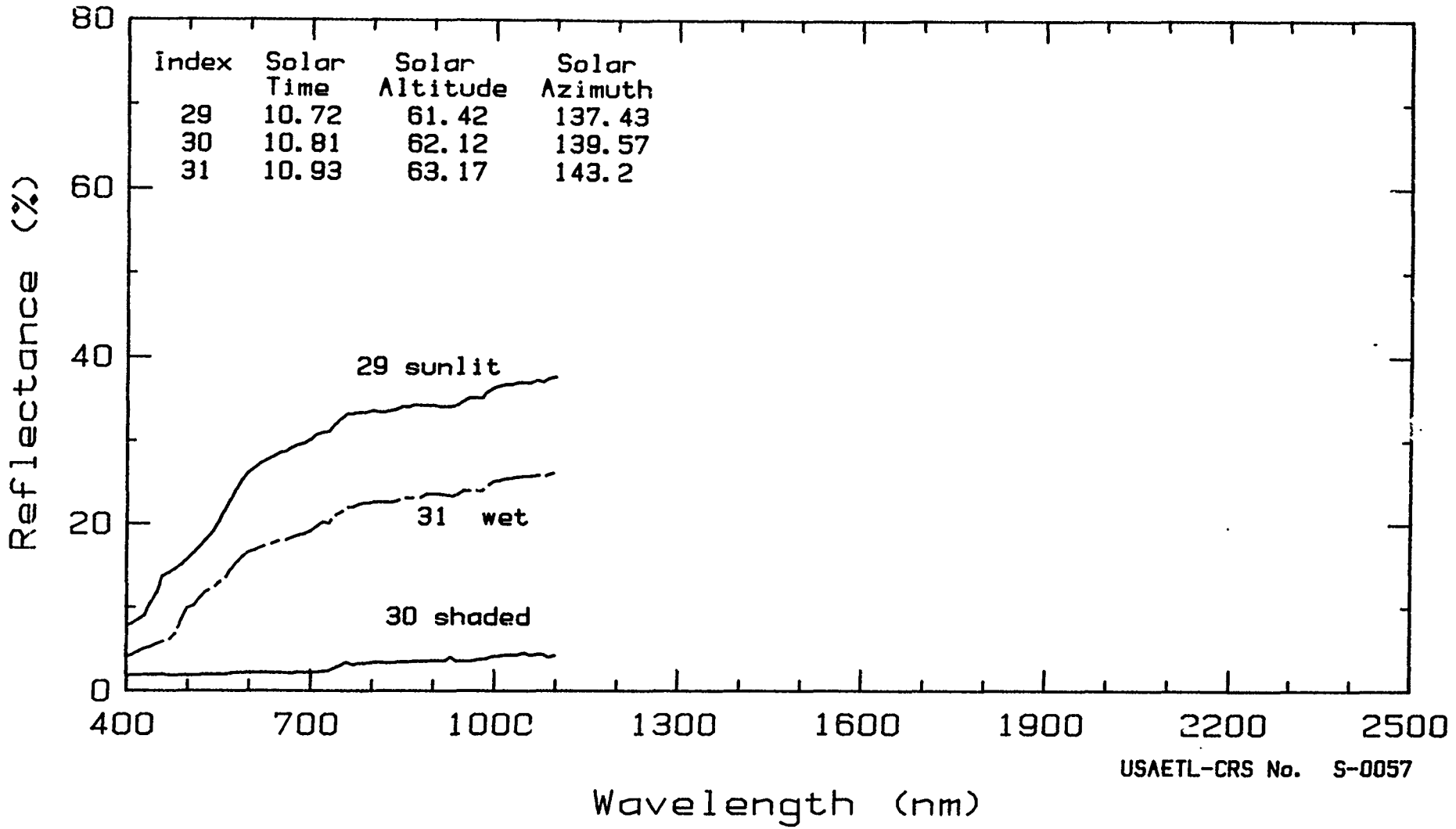
Physical & Chemical Properties of Composite Sample.

Composition: 82.2% Sand; 10.2 % Silt; 7.6 % Clay
18.7 % Gravel
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
29	14.3	21.5	28.8	33.8		
30	1.9	2.0	2.1	3.4		
31	8.1	13.8	18.2	22.9		

Compiled by: Melvin B. Satterwhite. Sheet No: S-0057.
USAETL-RI-RSD.



Reflectance Spectra of Gravelly Loamy Sand.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Torripsamment
Spectrum No.: 87YAA.06, .09, .10.

Date Collected: 25 Aug 1987
Unified System: SM

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 75 to 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: The spectra of two different surfaces of this sunlit, air-dry, undisturbed soil (6, 9) were taken. The spectrum of the shaded surface was the air-dry surface with a shadow cast on it (10). Textural analysis by the hydrometer technique used the <2000 um soil fraction.

Physical & Chemical Properties of Composite Sample.

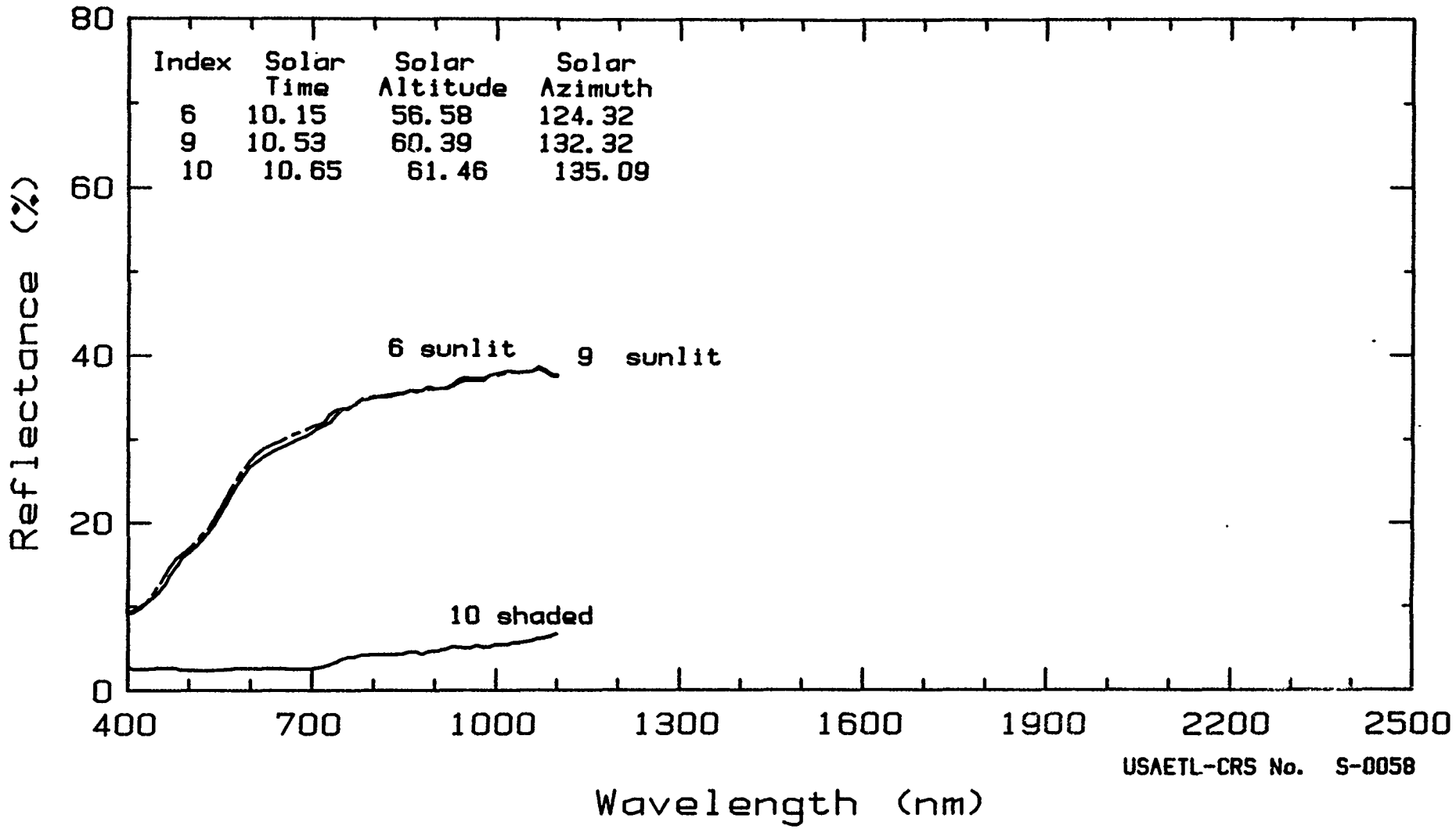
Composition: 89.2% Sand; 3.2 % Silt; 7.6 % Clay
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
6	15.0	22.2	29.4	35.2		
9	15.7	22.9	30.2	35.3		
10	2.5	2.5	2.5	4.3		

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No: S-0058.



Reflectance Spectra of Sand Soil.
Marine Air Station, Yuma Co., AZ; Aug. 1987.

Field Reflectance Spectra of Soil

Soil Texture: Loamy Sand
Taxonomy: Aridisol
Spectrum No.: LYUM.34, .35, .36.

Date Collected: 27 Aug 1987
Unified System: SM

Site Location: Marine Air Station, Yuma Co., AZ, USA.
32.5 deg. N Latitude; 114.3 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Sunlit, air-dry soil spectrum was of the undisturbed surface (34). Shaded soil surface was the air-dry surface with a shadow cast on it (35). The spectrum of the sunlit, moist soil was taken after the applied tap water had infiltrated and moistened the upper 2 cm to 5 cm of soil (36). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

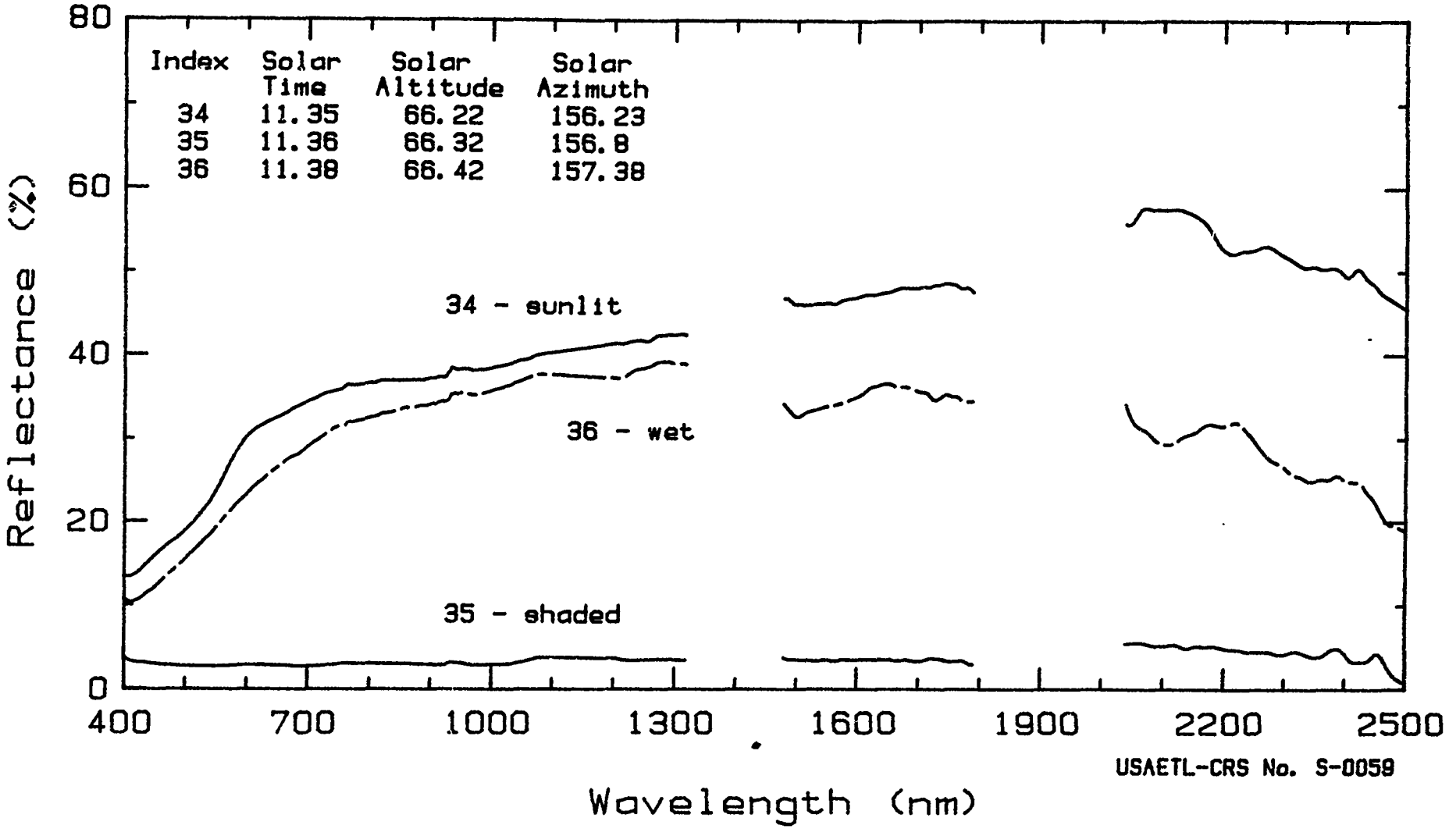
Composition: 87.2 % Sand, 5.2 % Silt, 7.6 % Clay
Moisture Content: air dry

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
34	18.0	25.1	32.9	36.8	47.5	54.0
35	2.7	2.7	2.7	2.9	3.4	4.7
36	14.4	20.0	26.9	33.0	35.4	29.2

Compiled by: Melvin B. Satterwhite.
USAETL-RI-RSD.

Sheet No.: S-0059.



Reflectance Spectra of Loamy Sand Soil.
Marine Air Station, Yuma Co., AZ; Aug, 1987.

Laboratory Reflectance Spectra of Soil

Soil Texture: Loamy Sand Date Collected: 12 Apr 1987
Taxonomy: Aridisol Unified System: SM
Geomorphic Unit: Lower alluvial fan.
Spectrum No.: MOJ57.01, .15, .20.

Site Location: Desert Wells, Yuma Co., AZ, USA.
33.7 deg. N Latitude; 113.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: The soil sample taken from the 0 to 2 cm horizon was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by the hydrometer procedure on the <2000 um soil fraction. Using the pressure plate apparatus, the moisture conditions equivalent to the 0.1 and 15 bar pressure potentials were created in 20 to 40 gram subsamples. Spectra were taken of these duplicates and an air dry subsample. The percent moisture in each subsample was determined gravimetrically (oven-dry weight basis).

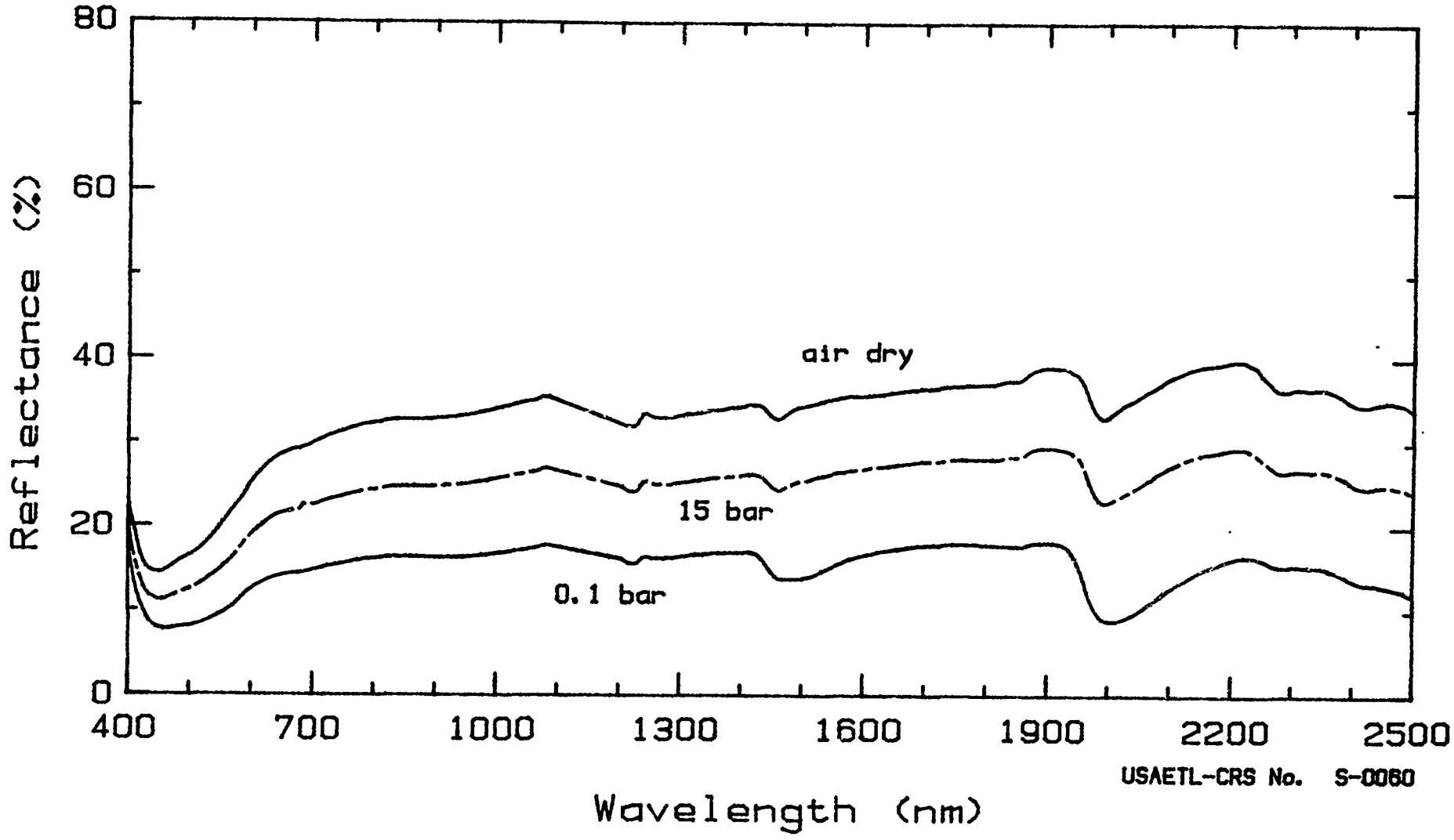
Physical & Chemical Properties of Composite Sample.

Composition: 86.4 % Sand, 8.0 % Silt, 5.6 % Clay
41.8 % Gravel
Moisture Content: 0.1 bar = 6.8 %; 1.0 bar = na %;
15 bar = 2.4 %; air dry = 0.5 %.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	8.0	10.1	14.2	16.2	17.1	15.1
15	12.0	15.7	21.7	24.6	27.3	27.8
A.D.	15.8	21.0	28.7	32.5	36.1	38.0

Compiled by: Melvin B. Satterwhite, Sheet No: S-0060.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Moisture Effects on the Spectra of a Loamy Sand Soil.
Desert Wells, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ44.01, .15.

Date Collected: 12 Apr 1988
Unified System: SM

Site Location: Desert Wells, Yuma Co., AZ, USA.
33.7 deg. N Latitude; 113.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by wet sieving on the <2000 um soil fraction. The moisture conditions equivalent to the 0.1 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1 and 15 bar potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.

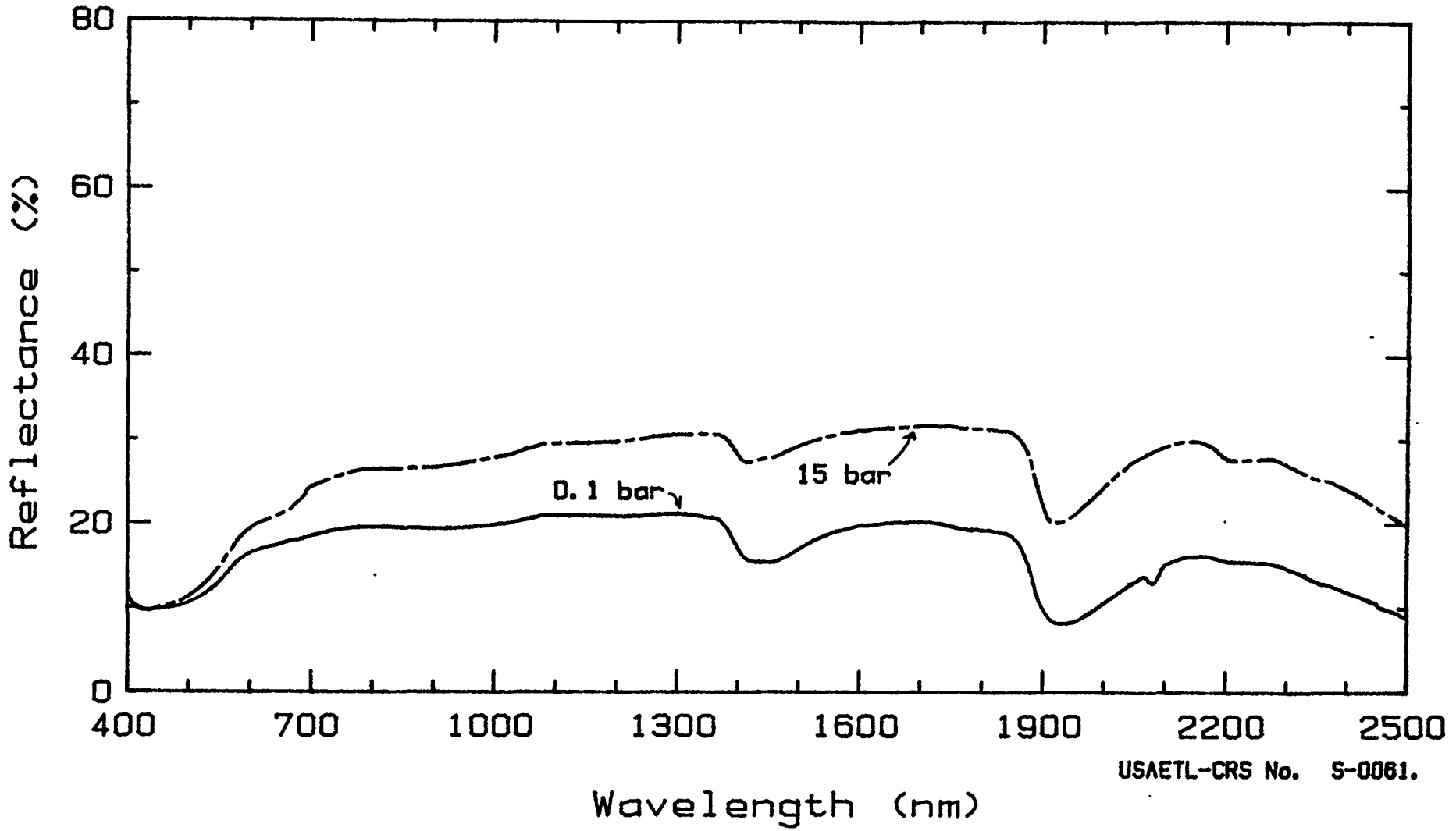
Composition: 56.0 % Sand, 34.0 % Silt 10.0% Clay
Moisture Content: 0.1 bar = 18.8 %; 1.0 bar = 12.2 %;
15 bar = 6.8 %; air dry = 1.8 %.
Electrical Conductivity = 0.73 * 1000 mmhos/cm at 25 degrees C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.3	13.8	17.7	19.5	19.8	15.1
15	10.9	15.8	21.6	26.5	31.4	28.1

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0061.



Moisture Effects on the Spectra of a Sandy Loam Soil.
Desert Wells, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ49.01, .10, .15, .20.

Date Collected: 12 Apr 1988
Unified System: SM

Site Location: Desert Wells, Yuma Co., AZ, USA.
33.7 deg. N Latitude; 113.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm soil horizon. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. Textural analysis was by hydrometer method on the <2000 um soil fraction. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and the 0.1, 1.0 and 15 bar potentials. The percent moisture was determined gravimetrically (oven-dry weight basis).

Physical & Chemical Properties of Composite Sample.

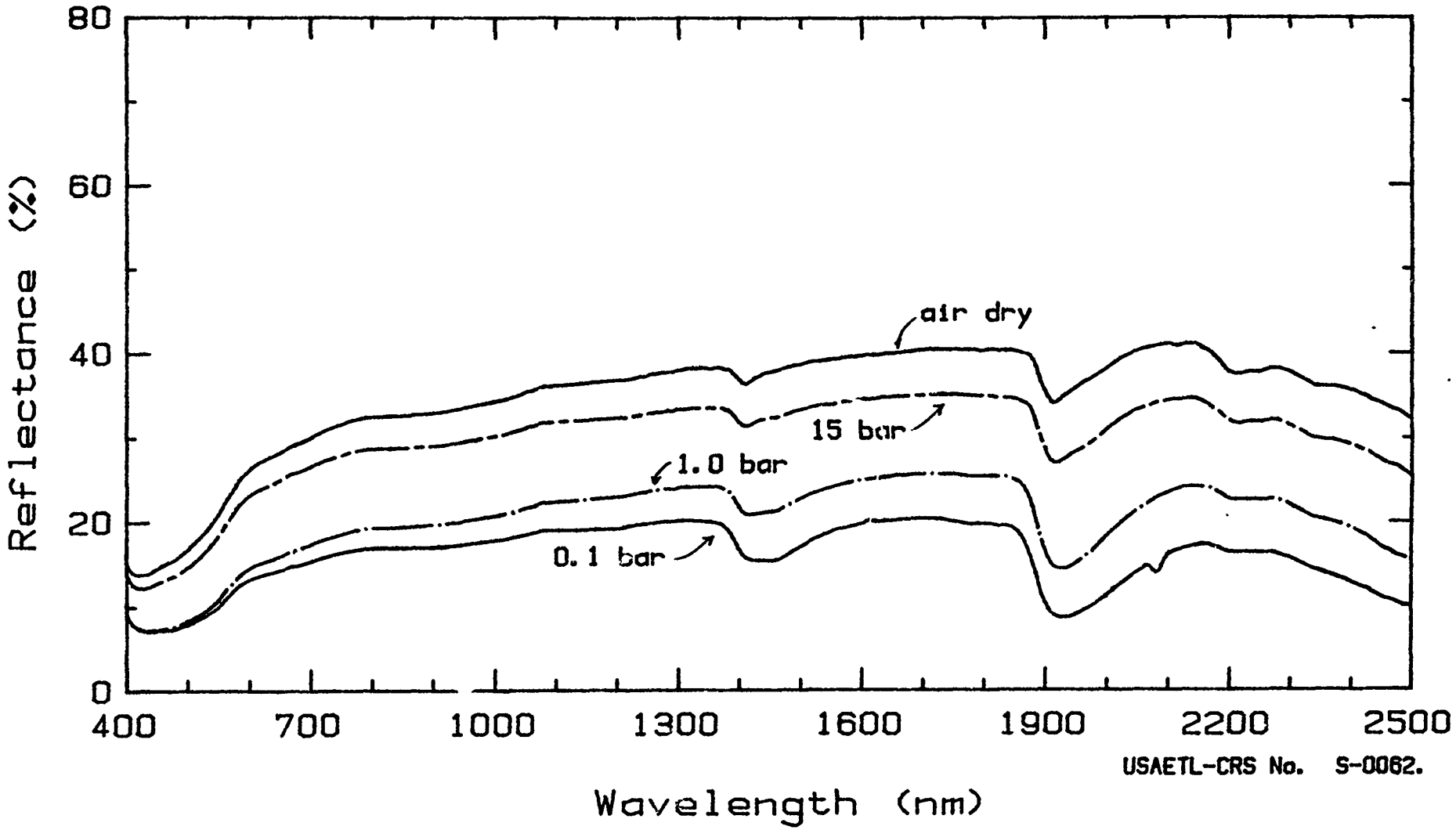
Composition: 76.0 % Sand, 16.0 % Silt, 8.0% Clay)
Moisture Content: 0.1 bar = 13.4 %; 1.0 bar = 7.0 %;
15 bar = 3.9 %; air dry = 0.9 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 degree C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.6	10.8	14.6	17.0	20.1	16.1
1.0	7.9	11.7	16.3	19.4	25.3	22.8
15	14.0	19.5	25.4	28.8	34.8	32.6
A.D.	16.0	22.2	28.7	32.6	40.1	38.8

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0062.



Moisture Effects on the Spectra of a Sandy Loam Soil.
Desert Wells, Yuma Co., AZ; Apr, 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: CH, CL
Geomorphic Unit: Playa
Spectrum No.: MOJ48.01, .10, .15, .20.

Site Location: Broadwell Lake, San Bernardino Co., CA., USA.
34.8 deg. N Latitude; 116.2 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

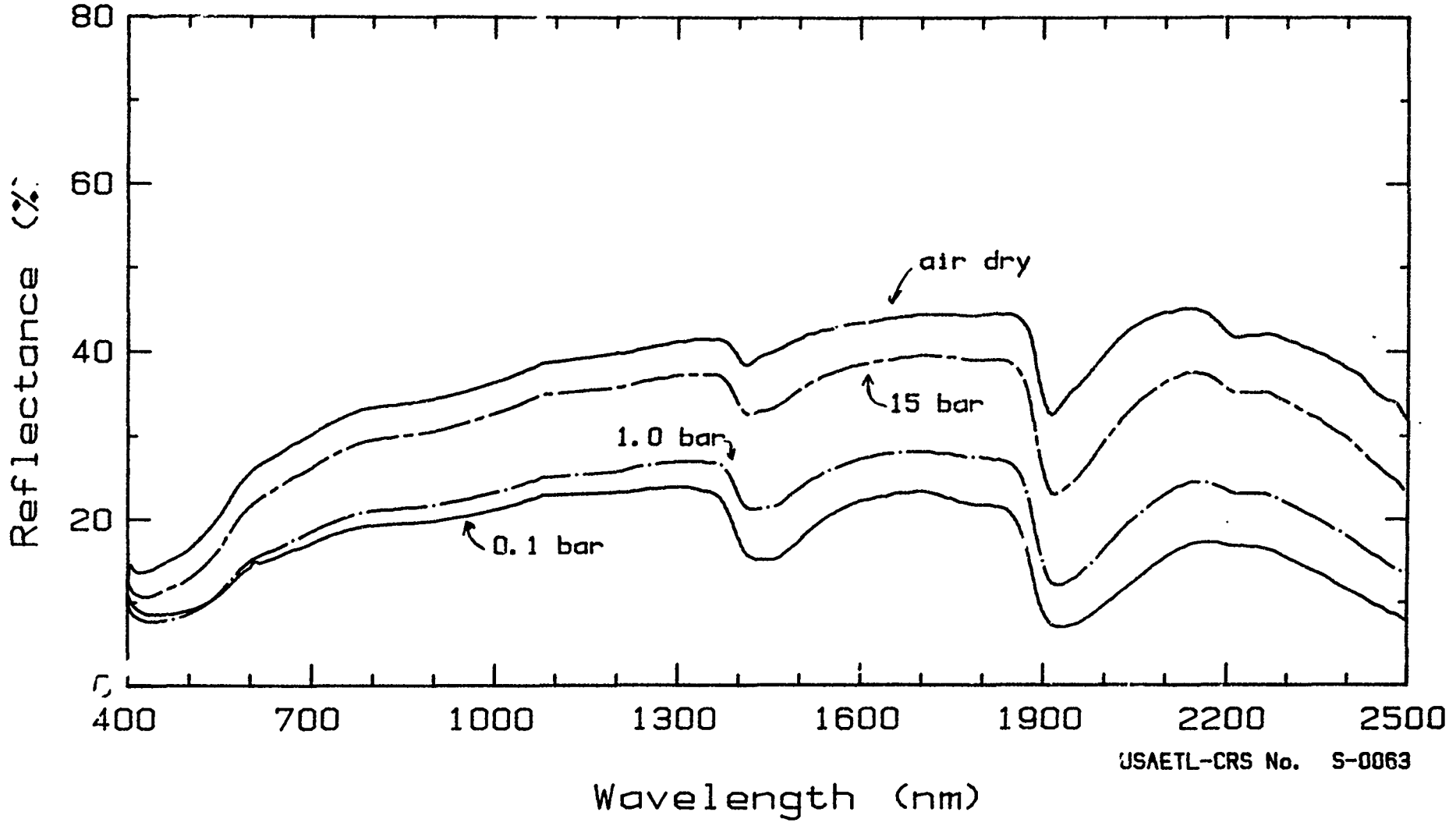
Sample: A sample was taken from the 0 to 2 cm surface horizon of the playa surface. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and the 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.
Composition: 0.0 % Sand, 63.0 % Silt, 37.0% Clay
Moisture Content: 0.1 bar = 49.4%; 1.0 bar = 28.6 %;
15 bar = 18.3 %; air dry = 7.9 %.
Electrical Conductivity = 0.83 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	8.9	11.7	16.0	19.5	22.6	16.1
1.0	8.4	12.0	17.1	21.3	27.6	22.9
15	12.4	17.7	24.6	29.8	38.9	35.4
A.D.	15.8	21.6	28.5	33.7	43.9	42.8

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.
Sheet No: S-0063.



Spectra of a Playa Soil at Four Moisture Levels.
Broadwell Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL
Geomorphic Unit: Playa
Spectrum No.: MOJ50.01, .10, .15, .20.

Site Location: Broadwell Lake, San Bernardino Co., CA, USA.
34.8 deg. N Latitude; 116.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm surface horizon of the lake bed. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition, and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

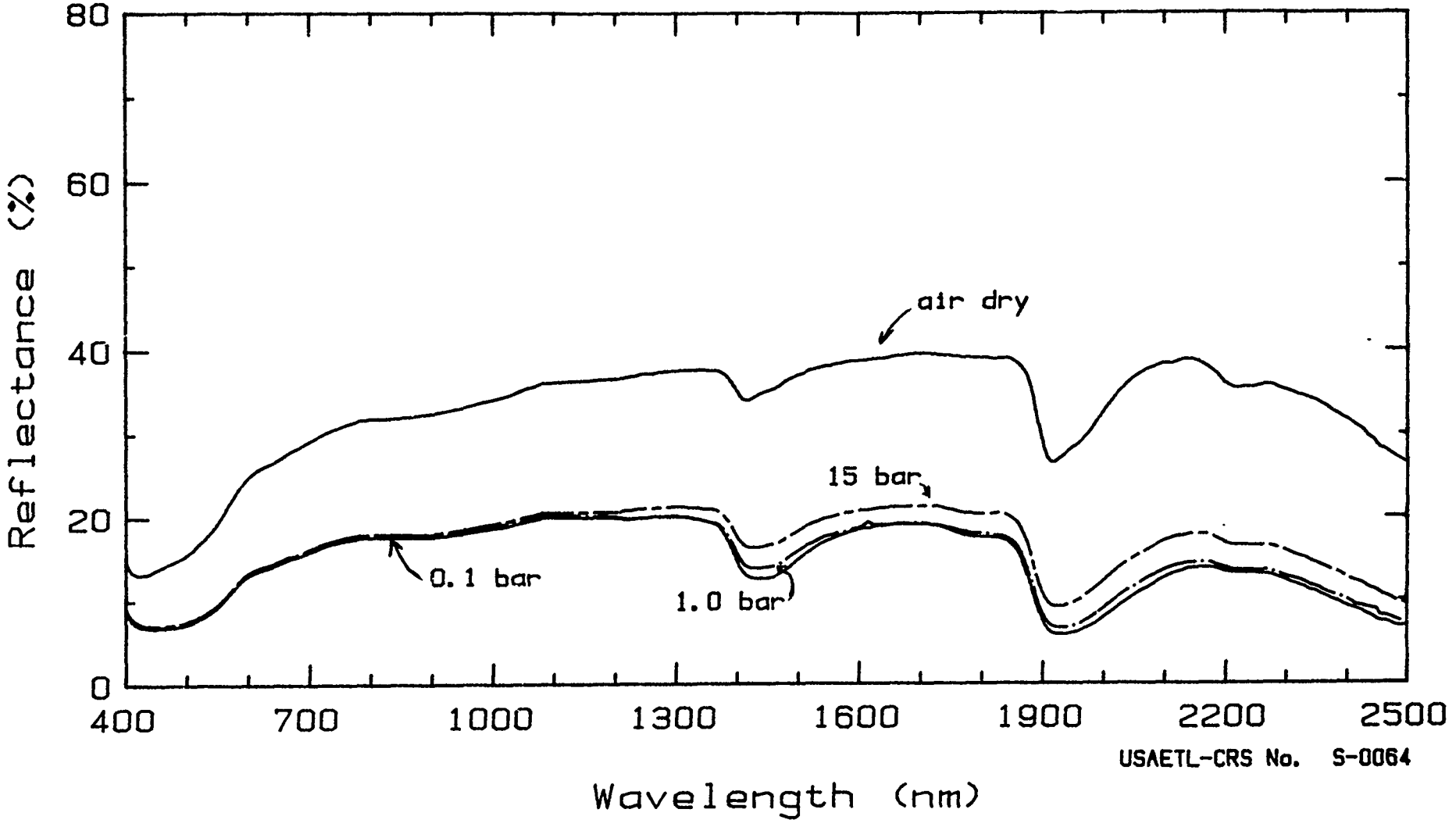
Composition: 18.0 % Sand, 54.0 % Silt, 28.0 % Clay.
Moisture Content: 0.1 bar = 41.6%; 1.0 bar = 29.1 %;
15 bar = 22.2 %; air dry = 9.7 %.
Electrical Conductivity = 28.0 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.2	10.3	14.8	17.7	18.7	12.9
1.0	7.3	10.4	15.2	18.0	18.9	13.5
15	7.5	10.5	15.1	18.0	21.0	16.6
A.D.	15.2	20.7	27.6	32.0	39.2	36.5

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0064.



Spectra of a Playa Soil at Four Moisture Levels.
Broadwell Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridis[illegible] Unified System: CL
Geomorphic Unit: Playa
Spectrum No.: MOJ20.01, .10.

Site Location: Cadiz Lake, San Bernardino Co., CA, USA.
34.4 deg. N Latitude; 115.3 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm surface horizon of the lake bed. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, and 1.0 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

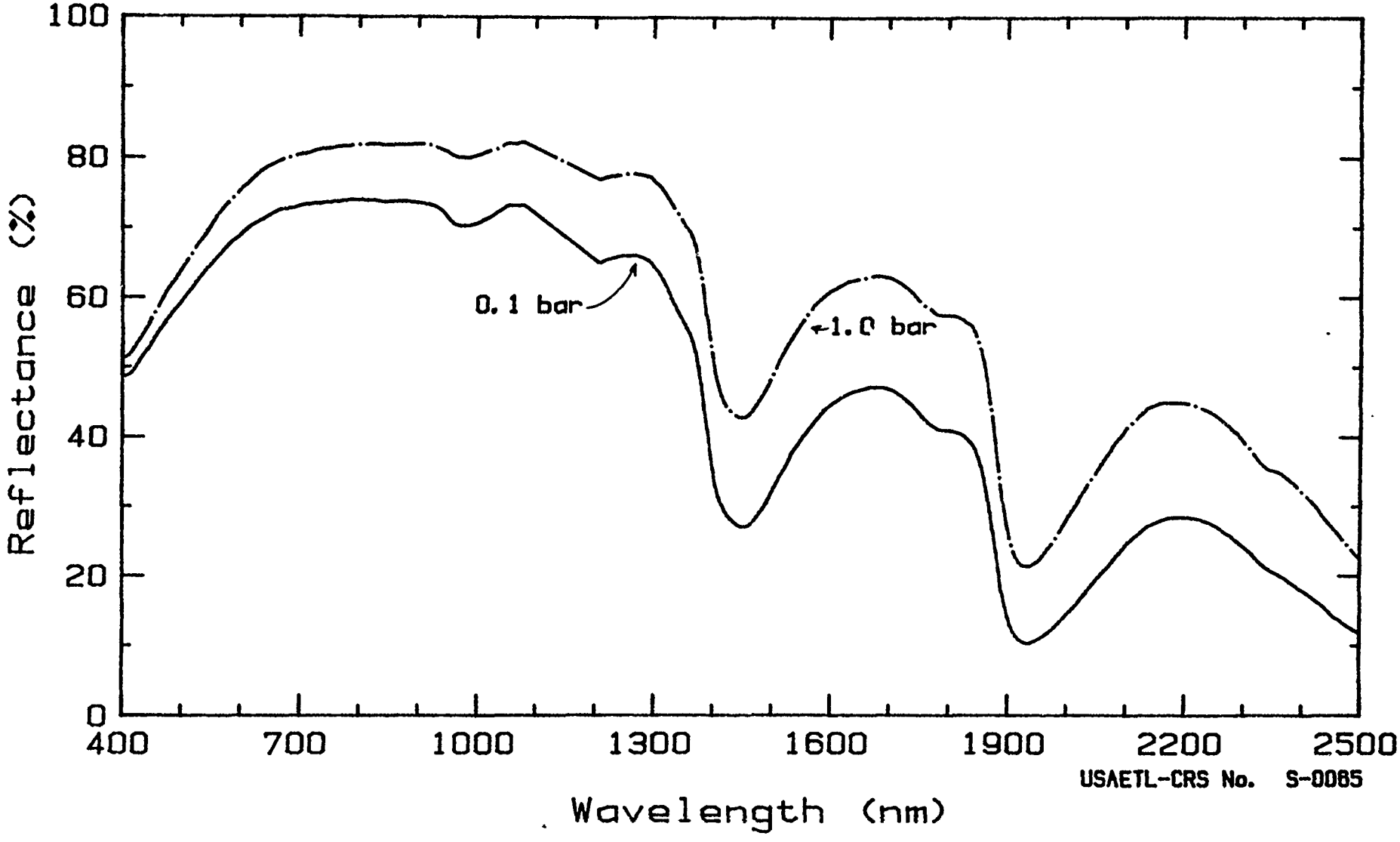
Physical & Chemical Properties of Composite Sample.

Composition: 18.0 % Sand, 54.0 % Silt, 28.0 % Clay.
Moisture Content: 0.1 bar = 41.6%; 1.0 bar = 29.1 %;
15 bar = 22.2 %; air dry = 9.7 %.
Electrical Conductivity = 28.0 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	57.7	65.6	72.1	73.8	45.1	25.8
1.0	61.9	71.3	79.2	81.9	61.3	41.8

Compiled by: Melvin B. Satterwhite, Sheet No: S-0065.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Spectra of Playa Soil at Two Moisture Levels.
Cadiz Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ01.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Coyote Lake, San Bernardino Co., CA, USA.
34.4 deg. N Latitude; 115.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 1 to 5 cm horizon of the playa lake bed, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition, and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

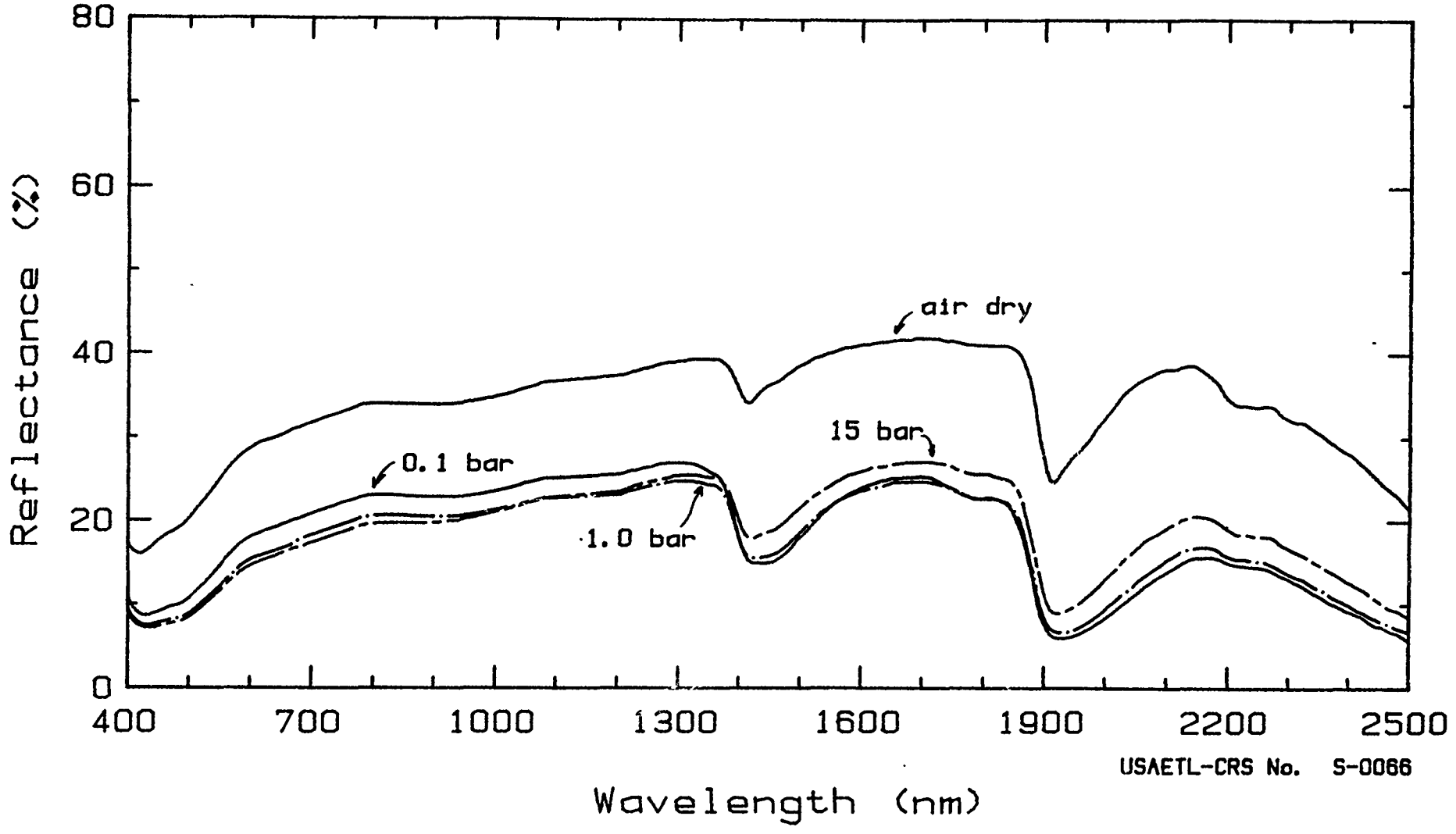
Composition: 24.0 % Sand, 44.0 % Silt, 32.0 % Clay
Moisture Content: 0.1 bar = 42.7 %; 1.0 bar = 28.7 %;
15 bar = 18.5 %; air dry = 7.4 %.
Electrical Conductivity = 1.22 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.3	15.3	19.8	23.0	24.4	14.1
1.0	8.6	12.8	17.0	20.5	24.0	15.0
15	8.2	12.2	16.3	19.6	26.4	18.4
A.D.	19.5	25.7	30.6	34.0	41.4	35.1

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0066.



Spectra of a Playa Soil at Four Moisture Levels.
Coyote Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ08.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Coyote Lake, San Bernardino Co., CA, USA.
34.1 deg. N Latitude; 116.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1.0 cm horizon of the playa lake bed. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

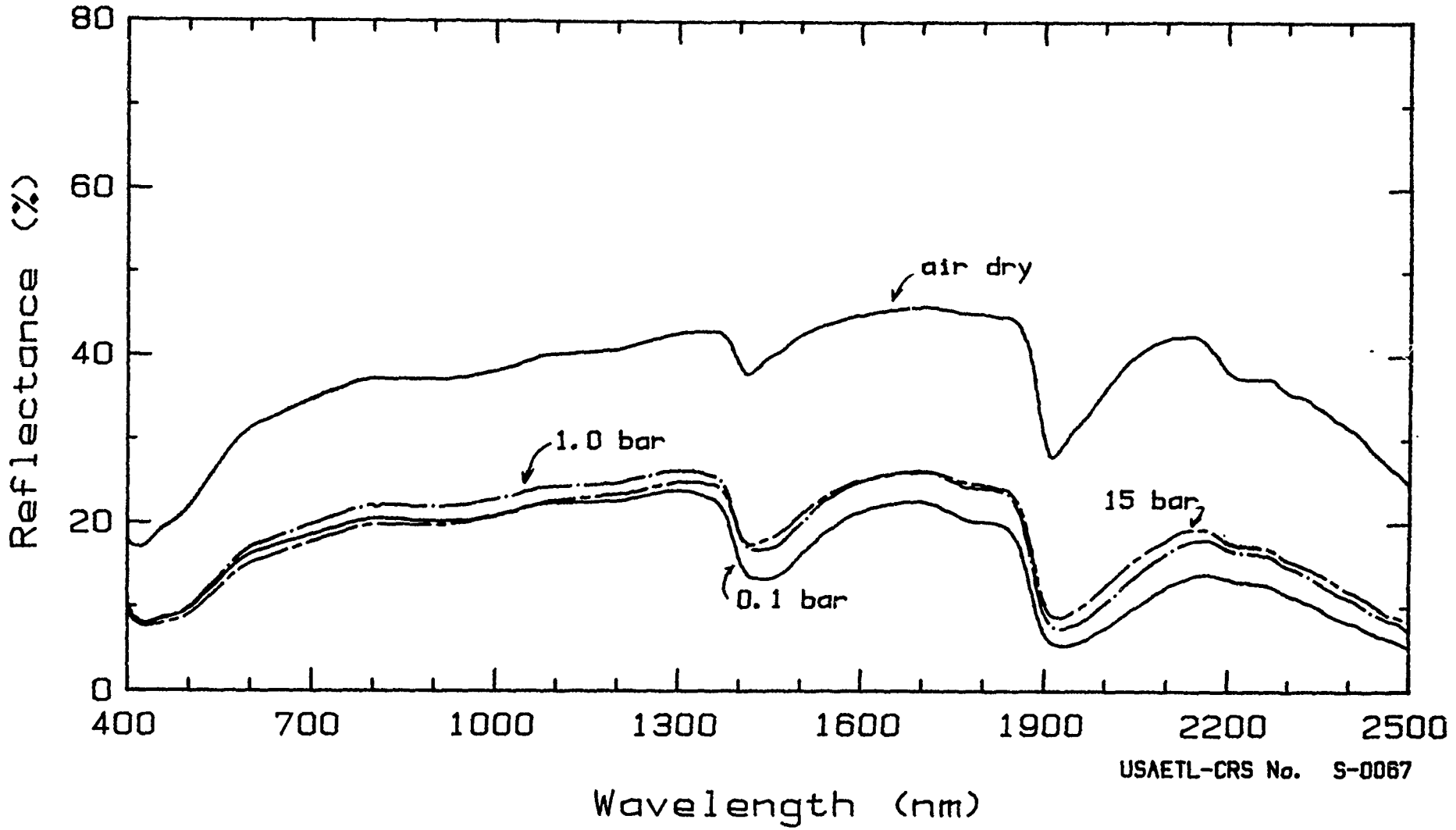
Composition: 30.0 % Sand, 42.0 % Silt, 28.0 % Clay)
Moisture Content: 0.1 bar = 39.4 %; 1.0 bar = 27.3 %;
15 bar = 18.0 %; air dry = 6.7 %.
Electrical Conductivity = 0.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.3	13.8	17.7	20.4	21.7	12.5
1.0	9.5	14.3	18.7	22.0	25.4	16.2
15	8.7	12.8	16.7	19.7	25.4	17.2
A.D.	21.0	27.9	33.4	37.1	45.3	38.6

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0067.



Spectra of a Playa Soil at Four Moisture Levels.
Coyote Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ14.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Coyote Lake, San Bernardino Co., CA, USA.
35.1 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm horizon of the hard playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

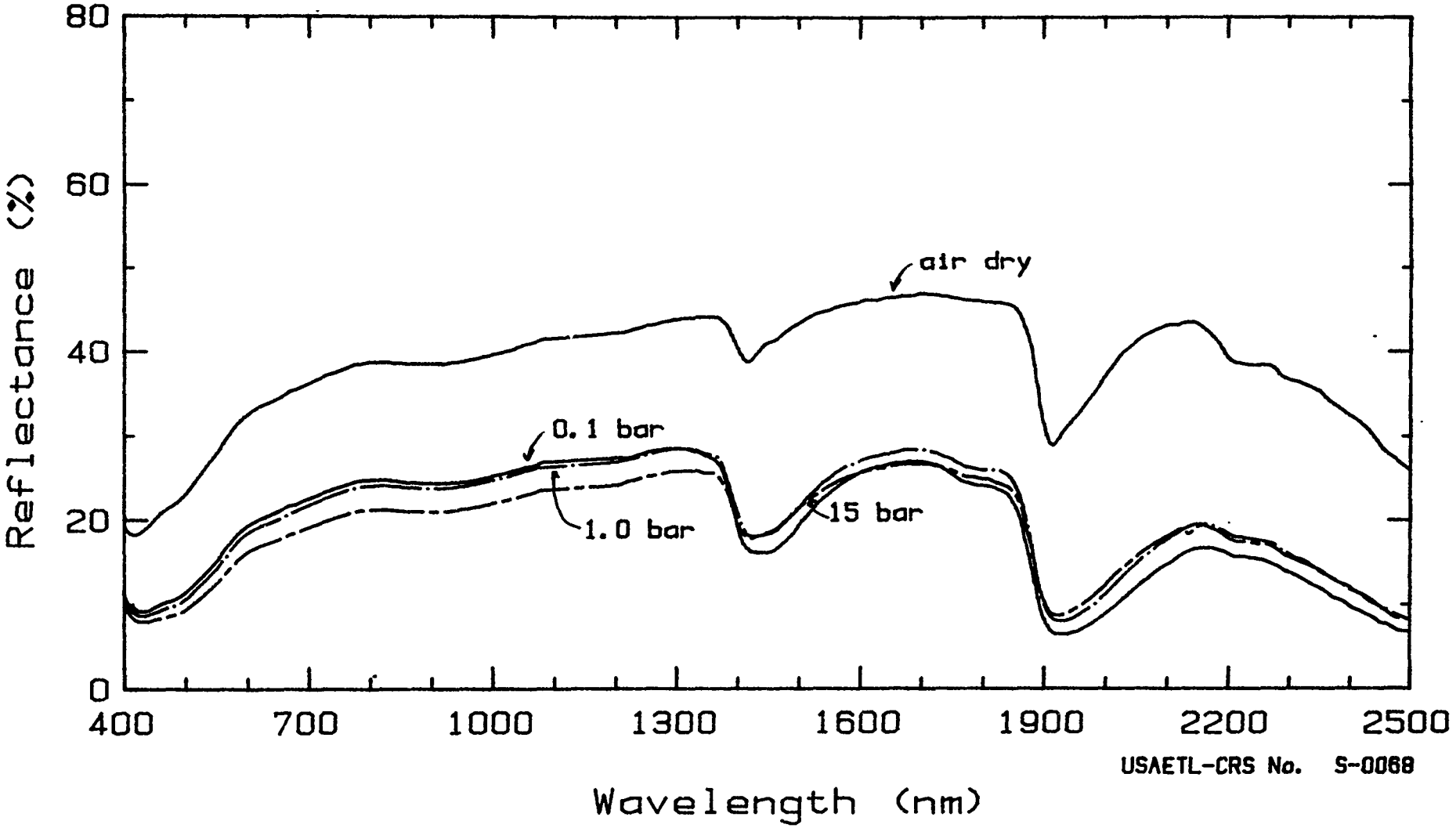
Composition: 44.4 % Sand, 28.0 % Silt, 27.6 % Clay
Moisture Content: 0.1 bar = 37.0 %; 1.0 bar = 24.9 %;
15 bar = 17.5 %; air dry = 6.5 %.
Electrical Conductivity = 0.98 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	11.0	16.1	21.4	24.6	26.0	15.0
1.0	10.3	15.3	20.5	24.0	27.5	17.5
15	9.1	13.4	18.2	21.1	26.0	17.2
A.D.	22.3	29.0	34.9	38.6	46.4	39.8

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0068.



Spectra of a Playa Soil at Four Moisture Levels.
Coyote Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ17.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CH, CL

Site Location: Coyote Lake, San Bernardino Co., CA, USA.
35.1 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 0 to 2 cm horizon of dry playa lake bed, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

Composition: 8.0 % Sand, 48.0 % Silt, 44.0 % Clay
Moisture Content: 0.1 bar = 47.0 %; 1.0 bar = 35.2 %;
15 bar = 25.2 %; air dry = 11.1 %.
Electrical Conductivity = 0.43 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.3	9.9	12.7	16.0	20.6	13.0
1.0	7.1	9.7	12.4	15.6	21.0	14.0
15	8.1	11.2	14.5	18.4	25.8	19.2
A.D.	16.6	22.1	27.0	31.7	41.7	36.3

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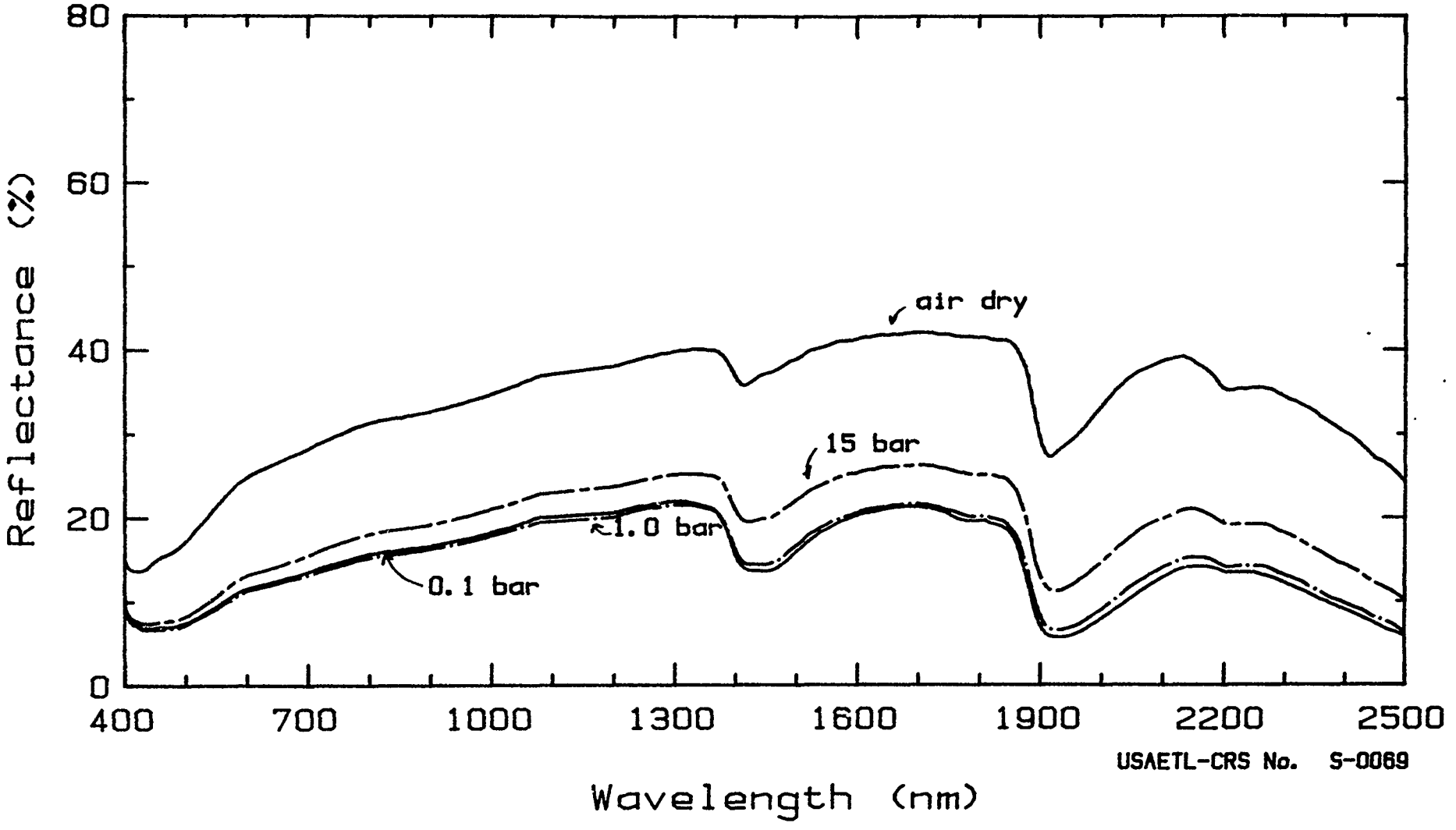
USAETL-RI-RSD.

Sheet No: S-0069.



Spectra of a Playa Soil at Four Moisture Levels.
Coyote Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ39.01, .10, .15.

Date Collected: May 1988
Unified System: CL

Site Location: Coyote Lake, San Bernardino Co., CA, USA.
35.1 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0-4 cm horizon in depression (sink hole) of the playa surface. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

Composition: 1.0 % Sand, 16.0 % Silt, 83.0% Clay
Moisture Content: 0.1 bar = 56.3%; 1.0 bar = 40.2 %;
15 bar = 30.2 %; air dry = 11.3 %.
Electrical Conductivity = 0.9 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	11.7	17.4	23.7	26.5	24.8	13.6
1.0	10.4	15.4	20.6	24.0	24.7	14.0
15	10.0	14.7	19.6	22.5	23.1	13.2

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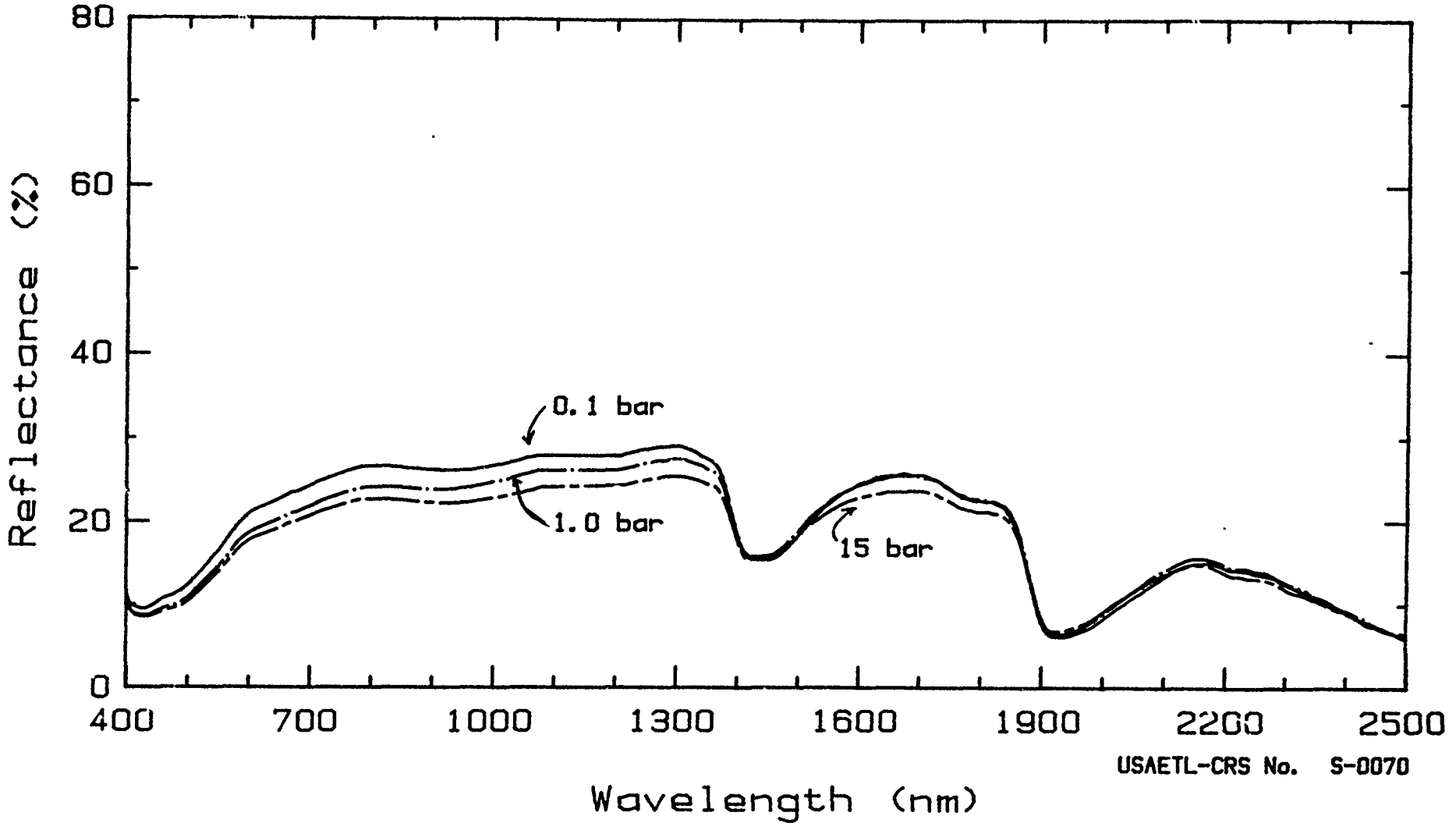
USAETL-RI-RSD.

Sheet No: S-0070.



Spectra of a Playa Soil at Three Moisture Levels.
Coyote Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ02.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 0 to 1 cm horizon of the playa surface, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

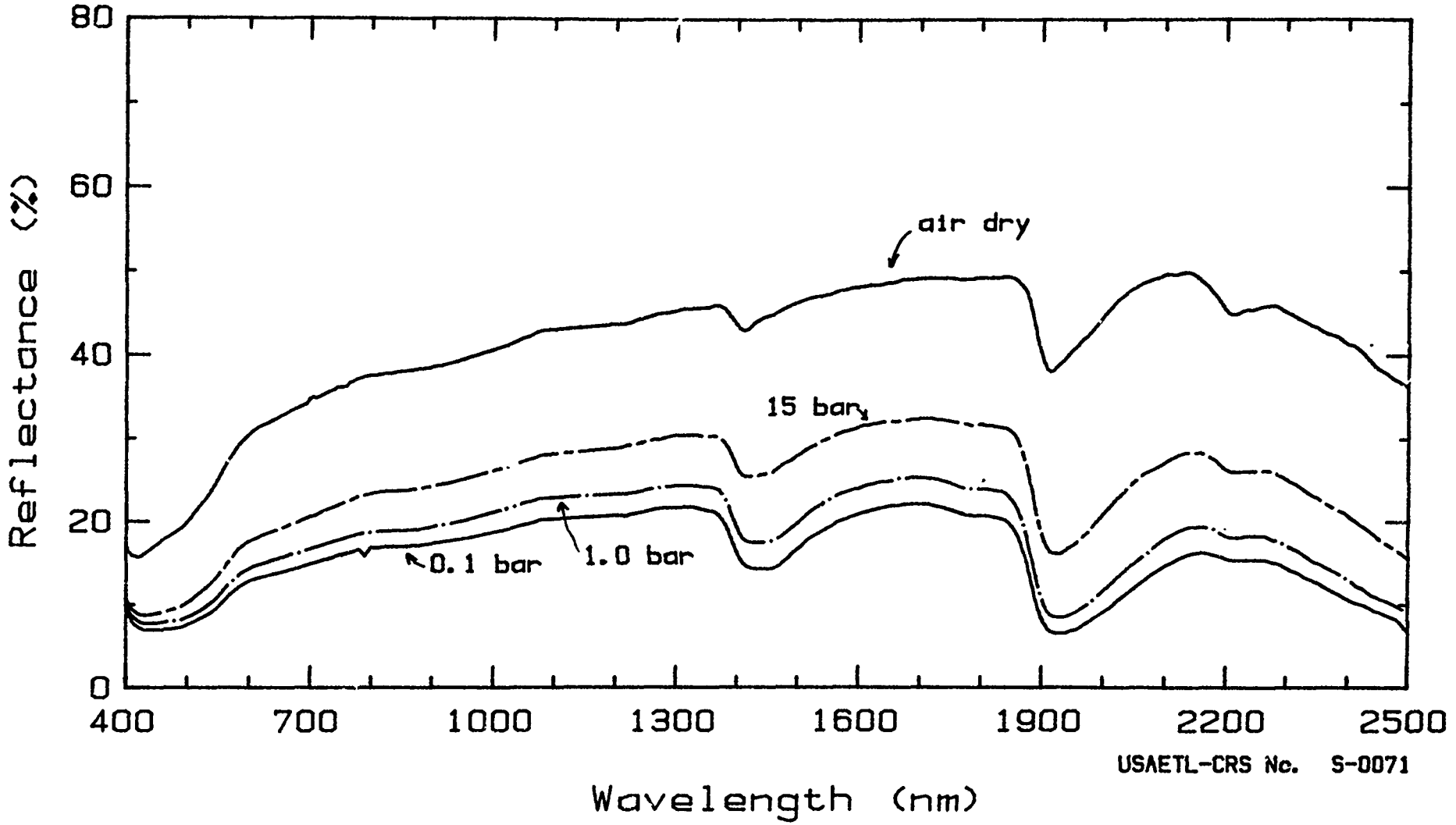
Composition: 28.0 % Sand, 42.0 % Silt, 30.0 % Clay
Moisture Content: 0.1 bar = 39.2 %; 1.0 bar = 30.1 %;
15 bar = 17.4 %; air dry = 5.8 %.
Electrical Conductivity = 0.7 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.3	10.5	14.1	16.8	21.4	15.0
1.0	8.3	11.8	15.8	18.9	24.6	17.9
15	9.8	14.4	19.4	23.6	31.8	26.3
A.D.	19.2	26.2	33.0	37.8	48.7	46.7

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0071.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ07.01, .15.

Date Collected: May 1988
Unified System: SM

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontallv using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample taken from the 0 to 2.0 cm horizon of the playa lake bed was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1 and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by wet sieving.

Physical & Chemical Properties of Composite Sample.

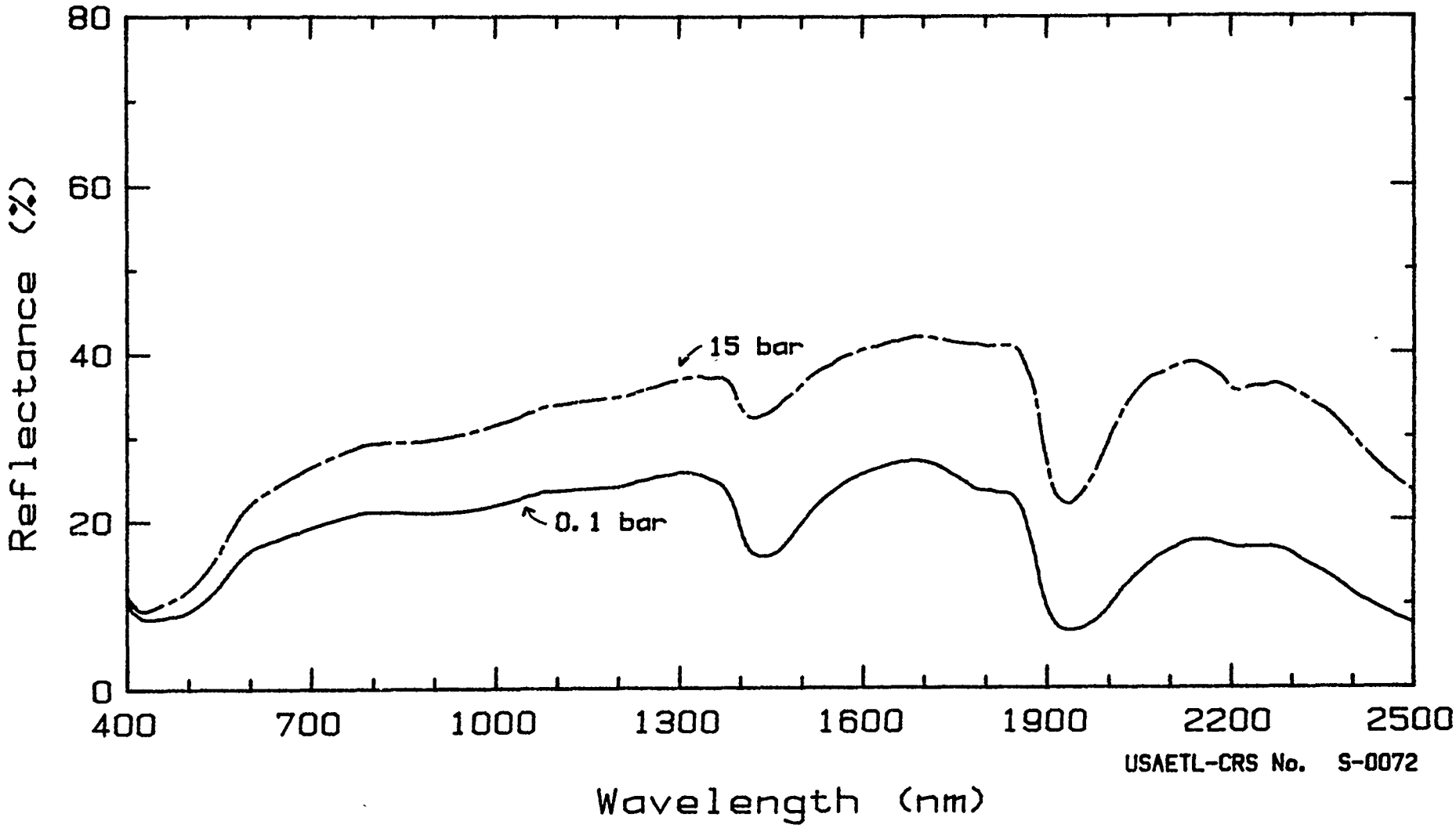
Composition: 59.1 % Sand, 40.9 % Fines (silt + clay)
Moisture Content: 0.1 bar = 16.1 %; 15.0 bar = 4.7 %;
air dry = 1.6 %.
Electrical Conductivity = 130 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.1	13.3	18.3	21.0	26.0	16.5
15	11.3	17.7	24.9	29.4	41.0	36.5

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0072.



Spectra of a Playa Soil at Two Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ04.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 0 to 0.5 cm horizon of the playa surface, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

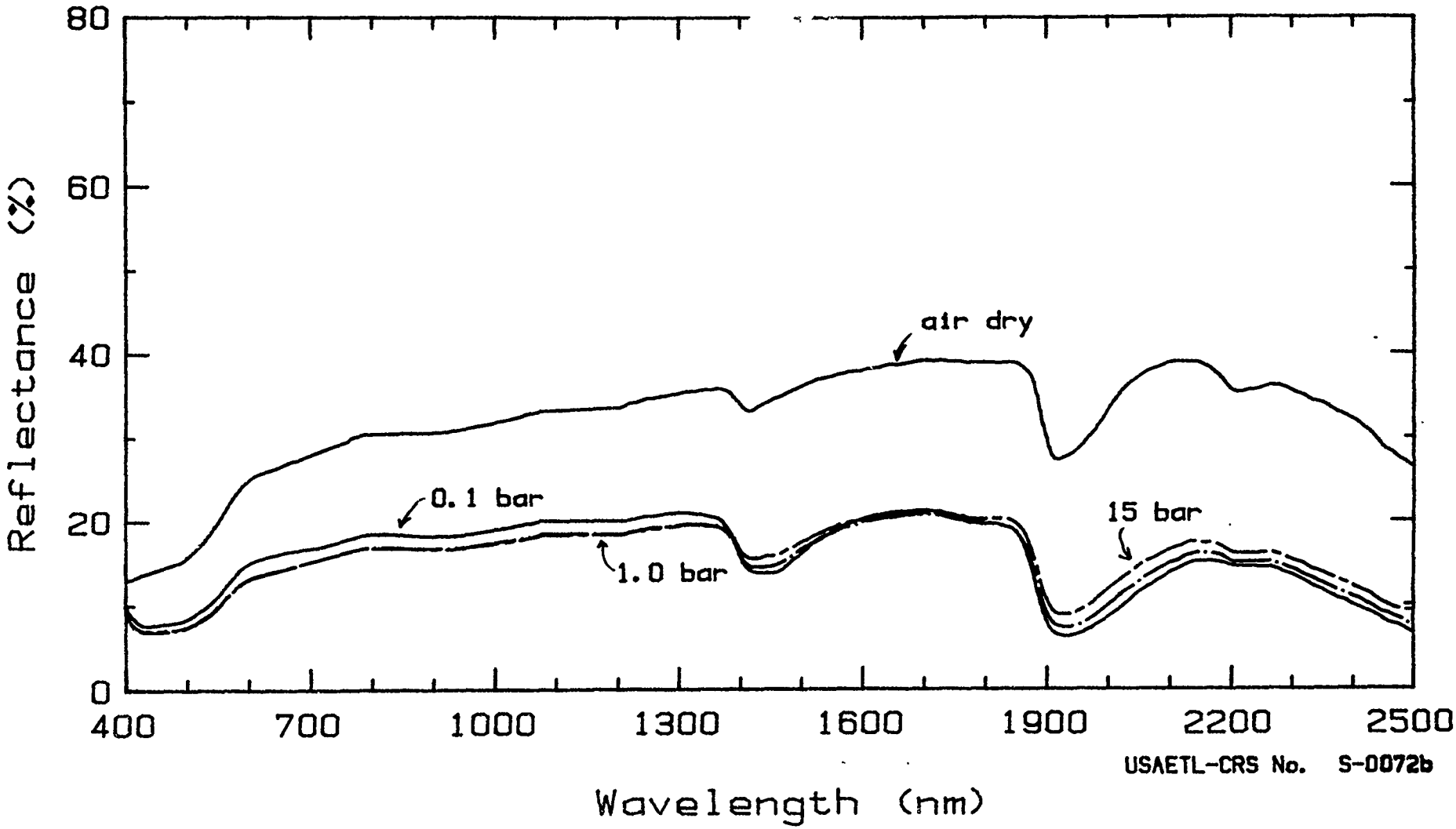
Composition: 28.4 % Sand, 16.0 % Silt, 55.6 % Clay
Moisture Content: 0.1 bar = 38.1 %; 1.0 bar = 25.2 %;
15 bar = 18.2 %; air dry = 7.2 %.
Electrical Conductivity = 13.6 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	8.3	12.1	16.3	18.4	20.6	14.1
1.0	7.3	10.6	14.4	16.8	20.2	14.9
15	7.4	10.7	14.5	16.8	20.5	16.1
A.D.	15.4	21.1	26.9	30.5	38.6	36.7

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0072b.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silt Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ03.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Danby Lake, San Bernardio Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 6 to 12 cm horizon of the playa surface, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

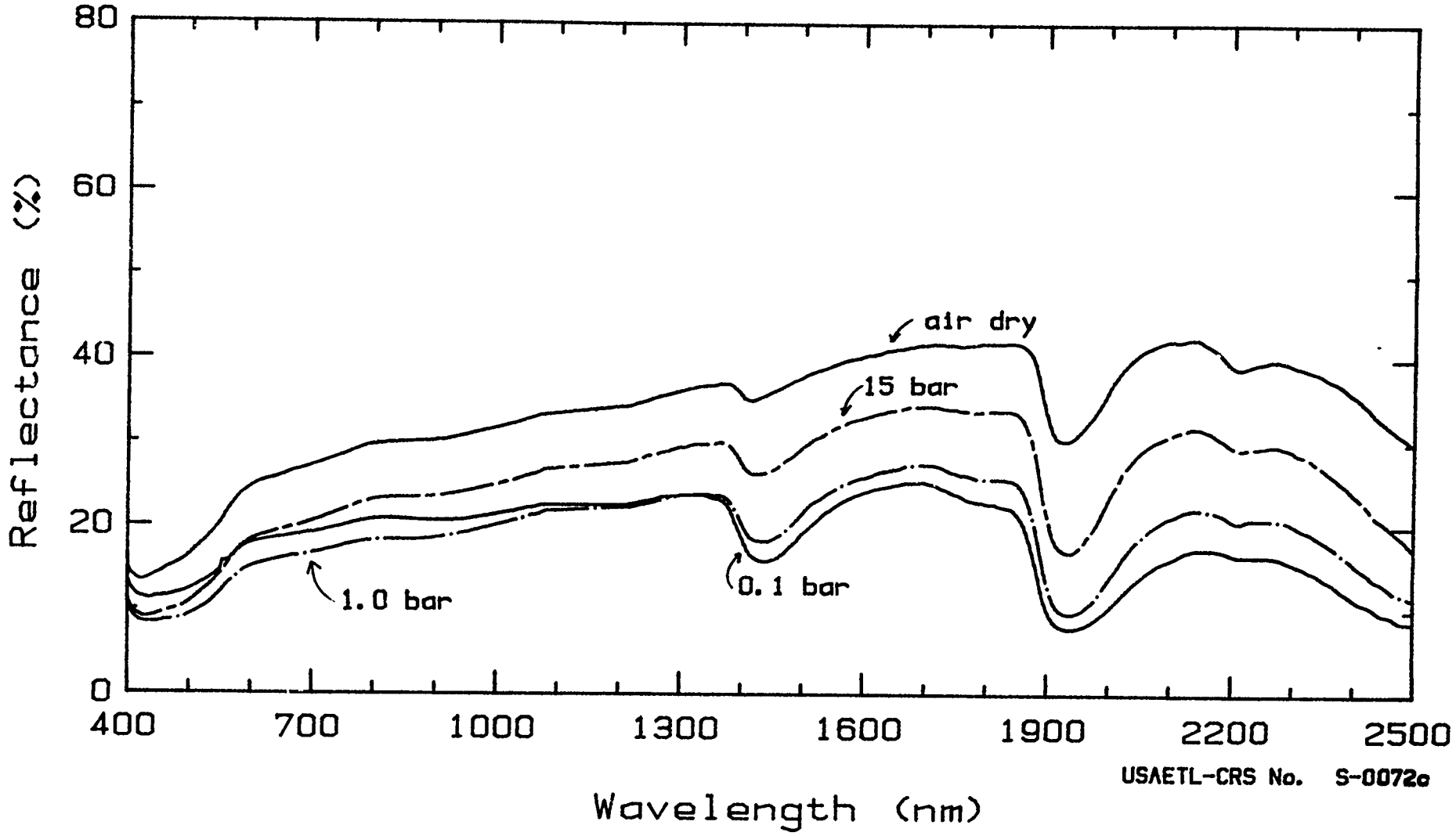
Composition: 22.3 % Sand, 77.6 % Fines (silt + clay)
Moisture Content: 0.1 bar = 27.9 %; 1.0 bar = 19.1 %;
15 bar = 11.1 %; air dry = 4.5 %.
Electrical Conductivity = 80.0 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	12.0	15.5	18.7	20.7	24.4	16.3
1.0	9.0	12.6	16.1	18.2	26.5	20.8
15	10.4	15.1	19.7	23.1	33.6	29.9
A.D.	15.8	21.2	26.2	29.8	40.9	40.3

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0072c.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ12.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SC, CL

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 0.5 cm horizon of the playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. A spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

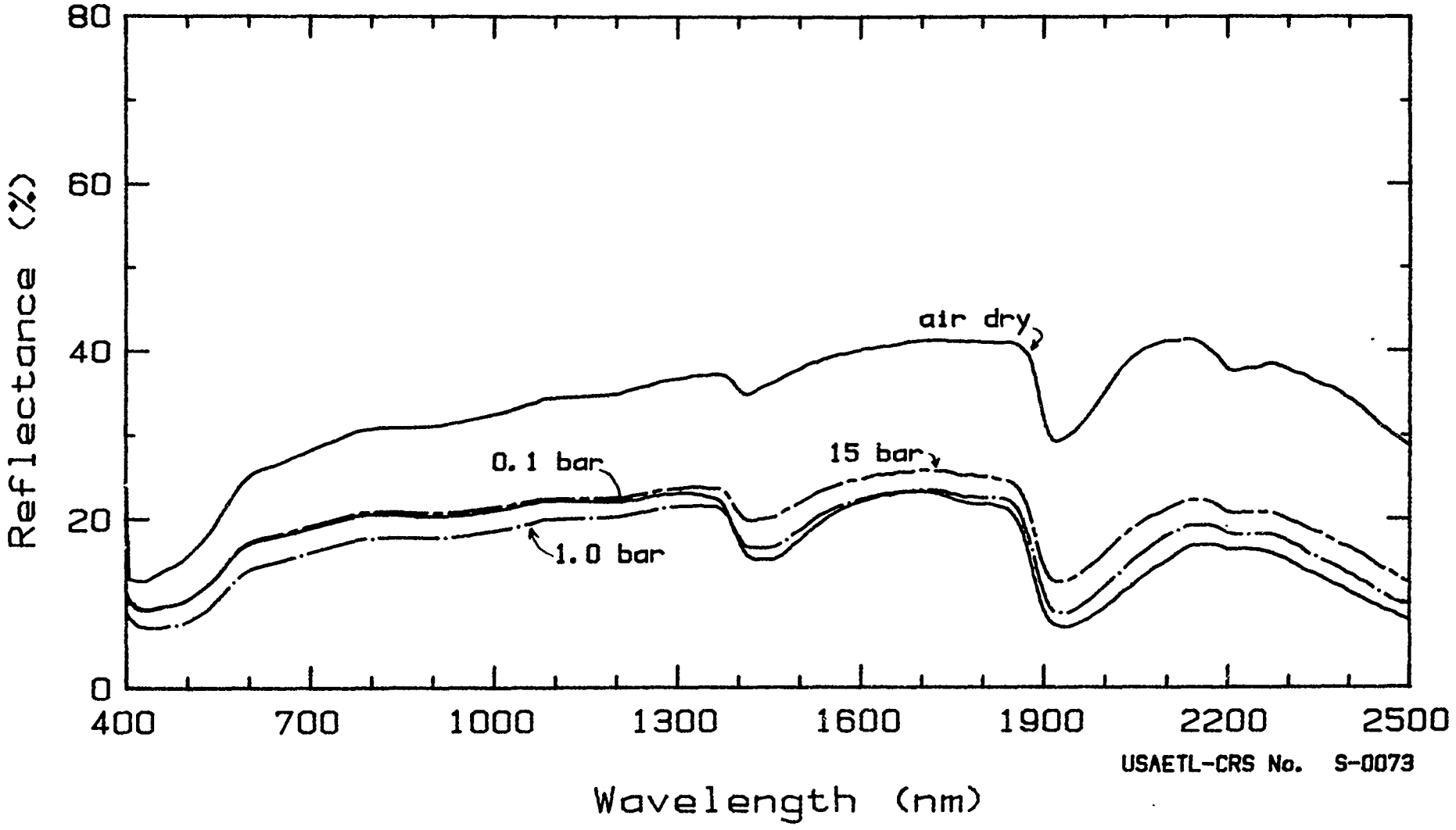
Composition: 39.0 % Sand, 27.0 % Silt, 34.0 % Clay
Moisture Content: 0.1 bar = 26.9 %; 1.0 bar = 17.4 %;
15 bar = 10.5 %; air dry = 5.0%.
Electrical Conductivity = 5.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.2	14.3	18.3	20.5	22.5	15.7
1.0	7.7	10.3	15.2	17.8	22.8	18.0
15	10.2	14.4	18.5	20.8	25.2	2082
A.D.	15.0	21.1	27.0	30.8	40.6	39.0

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0073.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silt Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ18.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 2-4 cm horizon of the gypsiferous surface of the playa surface, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

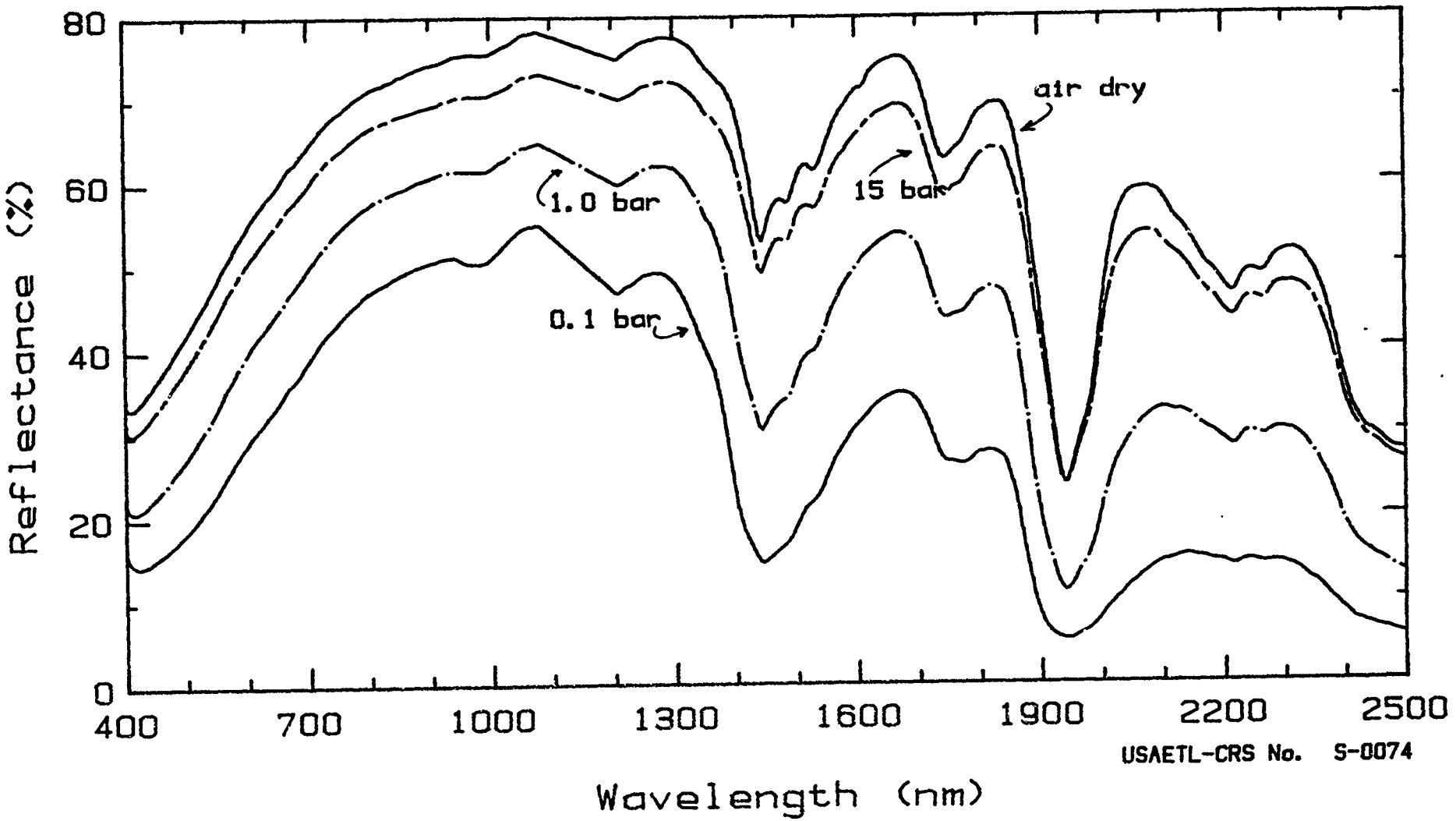
Composition: 24.0 % Sand, 76.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 61.0 %; 1.0 bar = 31.1 %;
15 bar = 23.3 %; air dry = 20.0 %.
Electrical Conductivity = 5.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	17.6	24.5	34.8	48.1	31.2	14.2
1.0	26.0	34.6	45.8	58.4	49.8	30.3
15	36.7	45.6	56.2	67.4	65.3	57.8
A.D.	40.3	49.7	60.8	72.1	70.6	51.5

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0074.



Spectra of a Gypsiferous Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ15.10, .15.

Date Collected: May 1988
Unified System: CL

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample taken from the 0 to 1 cm horizon of the reddish crust of the playa surface was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1 and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

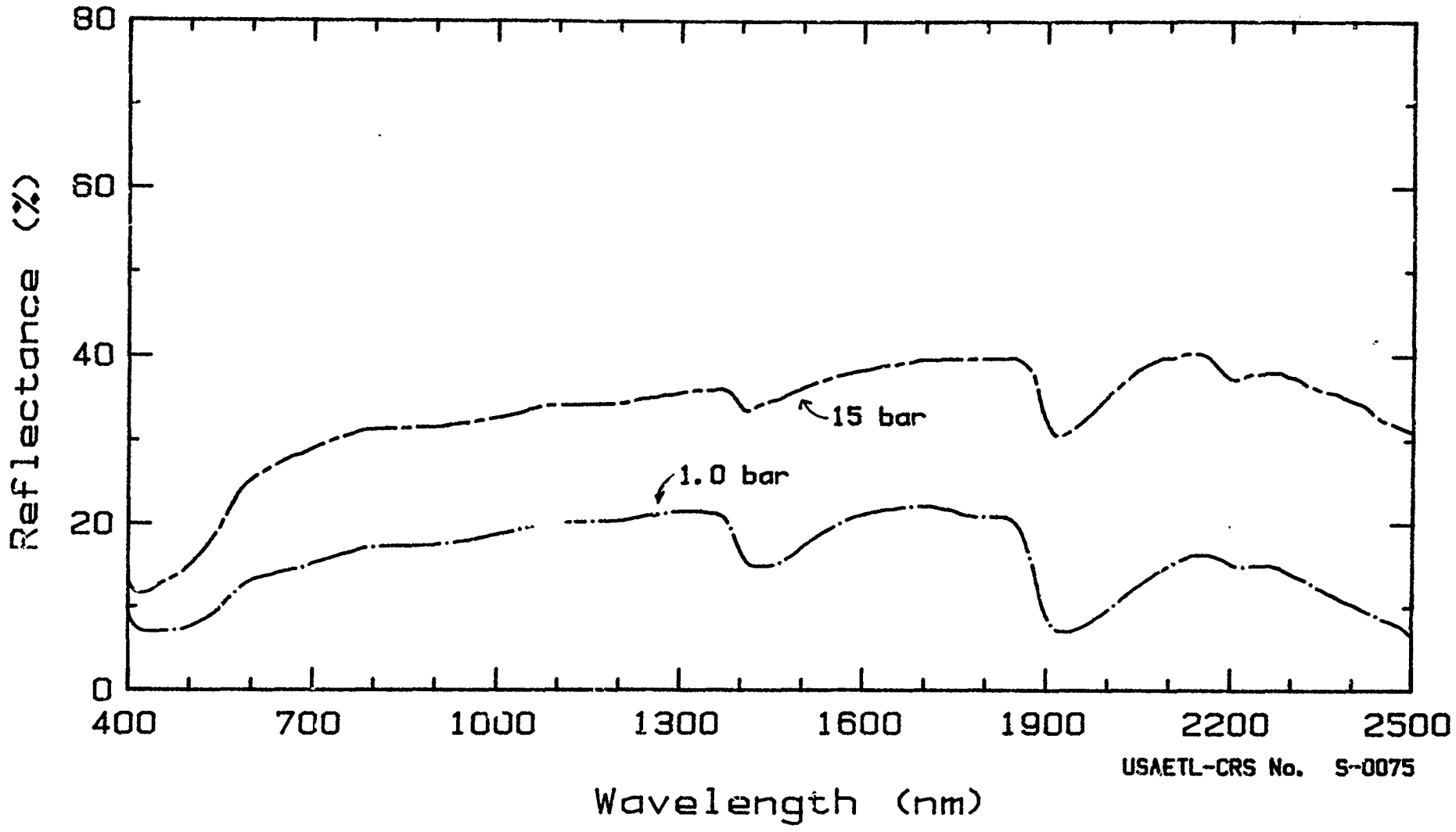
Composition: 0.0 % Sand, 33.0 % Silt, 67.0 % Clay
Moisture Content: 0.1 bar = 45.4 %; 1.0 bar = 35.0 %;
15 bar = 28.1 %; air dry = 8.8 %.
Electrical Conductivity = 3.45 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1.0	7.4	10.7	14.4	17.3	21.5	14.8
15	7.7	11.1	15.0	18.1	23.2	16.8

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD

Sheet No: S-0075.



Spectra of a Playa Soil at Two Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay loam (est.) Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL (est.)
Geomorphic Unit: Playa
Spectrum No.: MOJ13.01, .10, .15, .20.

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample, taken from the 0 to 12 cm horizon of the puffy saline surface, was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by wet sieving.

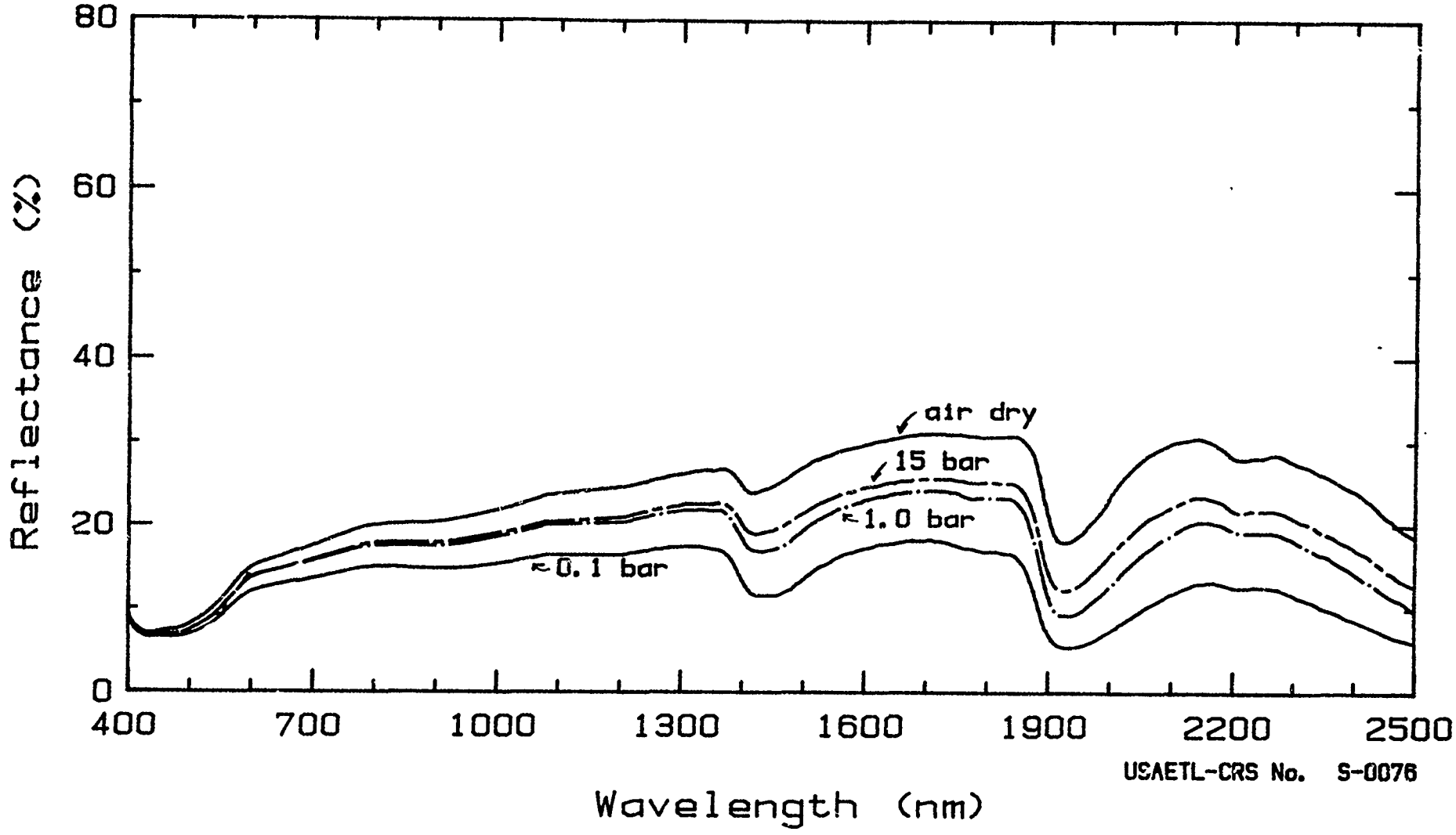
Physical & Chemical Properties of Composite Sample.

Composition: 40.9 % Sand, 59.1 % Fines (silt + clay)
Moisture Content: 0.1 bar = 27.2 %; 1.0 bar = 16.3 %;
15 bar = 10.8 %; air dry = 7.8%.
Electrical Conductivity = 40.0 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	6.8	9.7	13.1	14.9	17.6	12.2
1.0	7.3	10.7	14.9	17.5	23.5	19.0
15	7.2	10.9	15.0	17.8	25.0	21.8
A.D.	7.8	11.9	16.6	20.1	30.4	26.7

Compiled by: Melvin B. Satterwhite, Sheet No: S-0076.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ11.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Danby Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2.0 cm horizon of a small gypsum "butte" that was in the playa. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. Spectra were taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

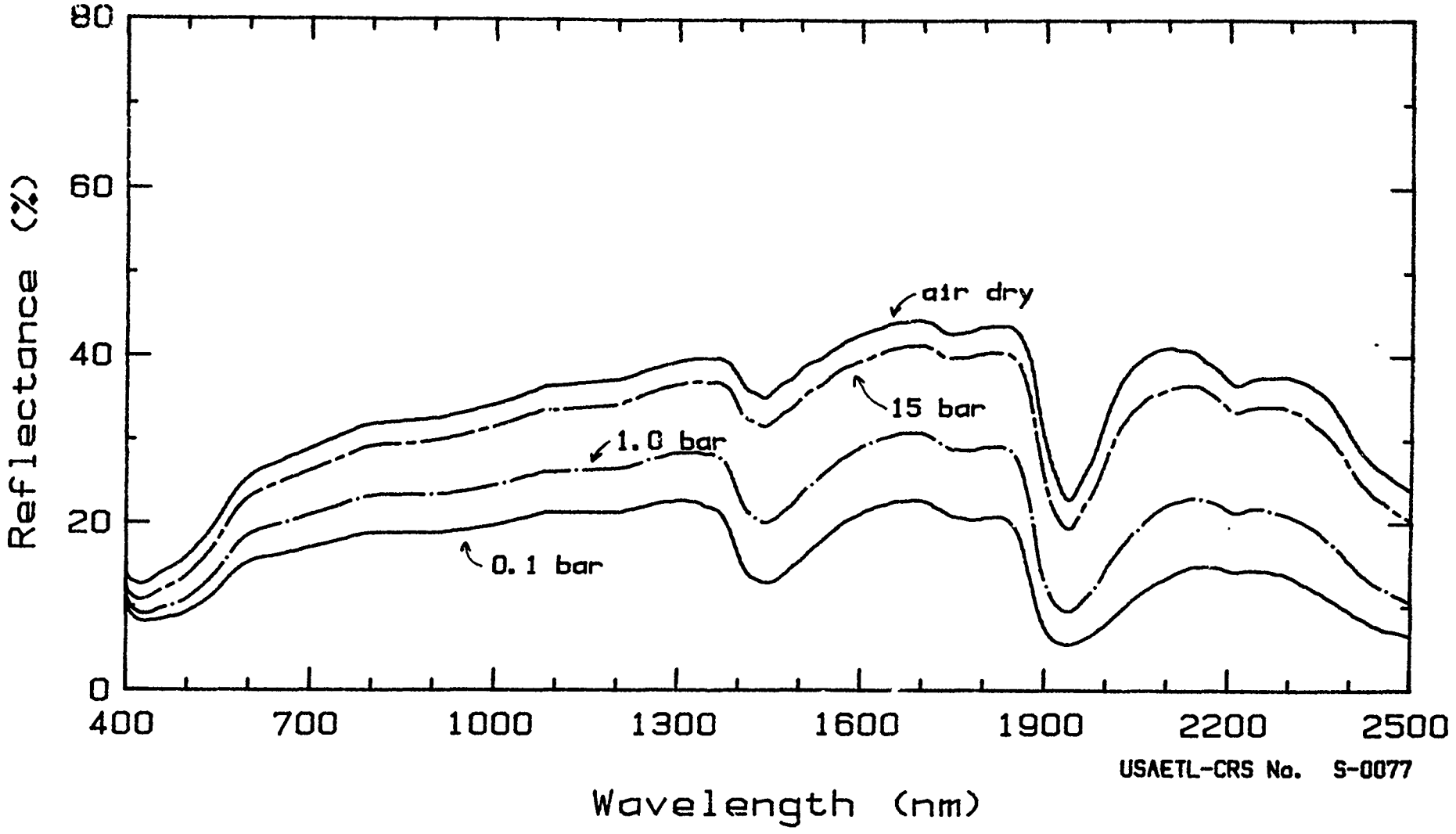
Physical & Chemical Properties of Composite Sample.
Composition: 50.0 % Sand, 41.0 % Silt, 9.0 % Clay
Moisture Content: 0.1 bar = 28.7 %; 1.0 bar = 17.9 %;
15 bar = 10.1 %; air dry = na.
Electrical Conductivity = 6.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.0	12.7	16.4	18.8	21.6	13.9
1.0	10.5	15.3	20.1	23.3	29.6	21.6
15	13.1	19.2	25.2	29.4	40.2	34.5
A.D.	15.3	21.6	27.7	32.0	43.2	38.3

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0077.



Spectra of a Playa Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Torripsamment
Geomorphic Unit: Sand Dune
Spectrum No.: MOJ16.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Danby Lake, San Bernardino Co., CA, USA, 34.2 deg. N Latitude; 115.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 4 cm horizon of the small dunes at the southeast end of the playa. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. A spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

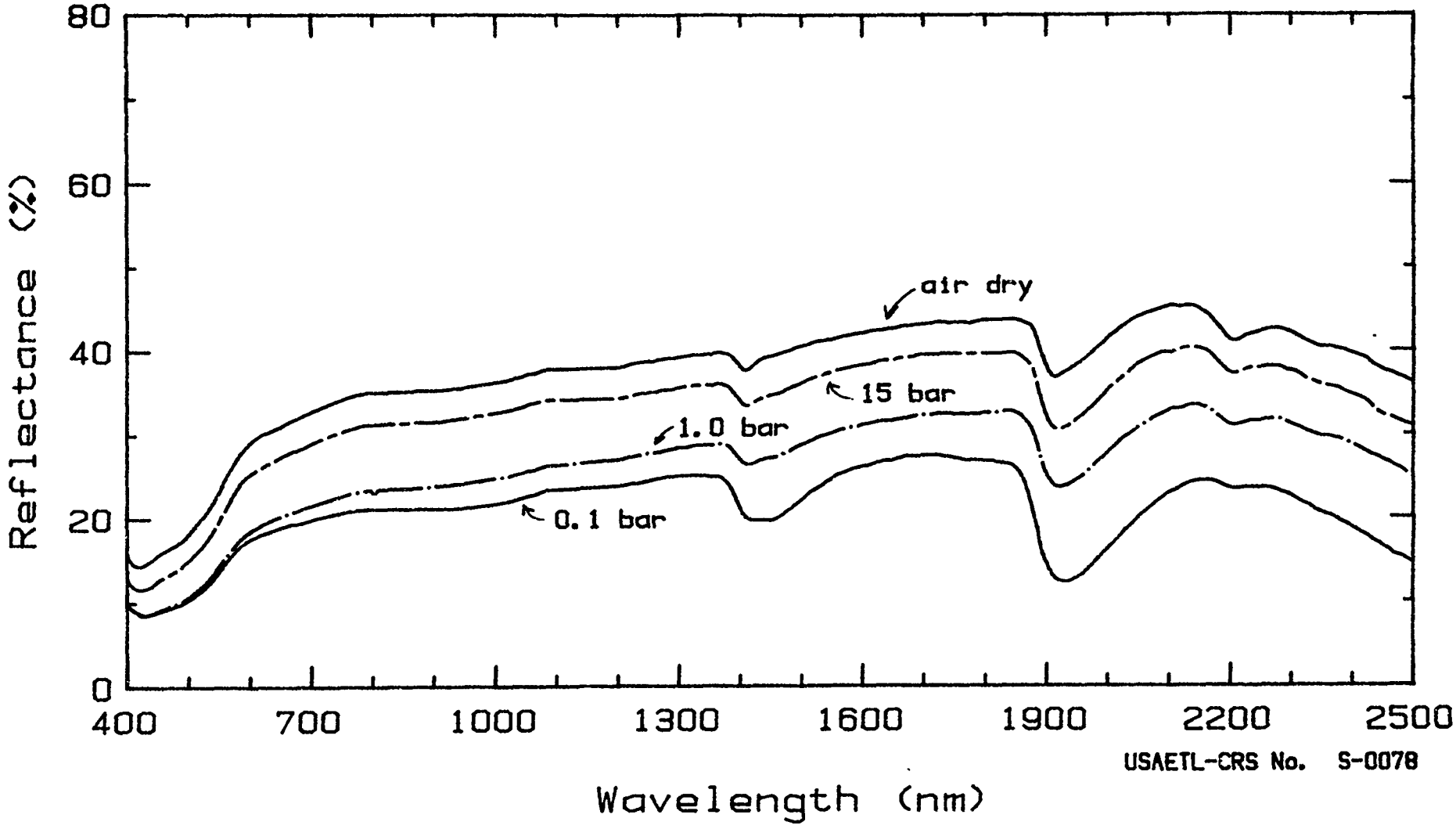
Physical & Chemical Properties of Composite Sample.
Composition: 99.2 % Sand, 0.0 % Silt, 0.8 % Clay.
Moisture Content: 0.1 bar = 3.4 %; 1.0 bar = 1.6 %;
15 bar = 1.2 %; air dry = 0.3 %.
Electrical Conductivity = 0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.0	14.6	19.2	21.2	26.7	23.2
1.0	10.2	15.3	20.6	23.5	31.7	31.8
15	14.3	21.0	27.7	31.4	38.9	38.4
A.D.	17.5	24.6	31.4	35.2	42.7	42.9

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0078.



Spectra of a Sand Dune Soil at Four Moisture Levels.
Danby Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay loam (est.) Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL (est.)
Geomorphic Unit: Playa
Spectrum No.: MOJ34.01, .10, .15.

Site Location: Melville Lake, San Bernardino Co., CA, USA,
34.4 deg. N Latitude; 116.6 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by wet sieving.

Physical & Chemical Properties of Composite Sample.

Composition: 27.5 % Sand, 72.5 % Fines (silt + clay)
Moisture Content: 0.1 bar = 33.2%; 1.0 bar = 23.4 %;
15 bar = 15.8 %; air dry = 9.5 %.
Electrical Conductivity = 33.0 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.6	10.8	13.8	16.9	24.1	16.0
1.0	6.5	9.2	12.0	14.7	22.8	15.8
15	7.8	11.4	15.0	18.7	30.1	23.6

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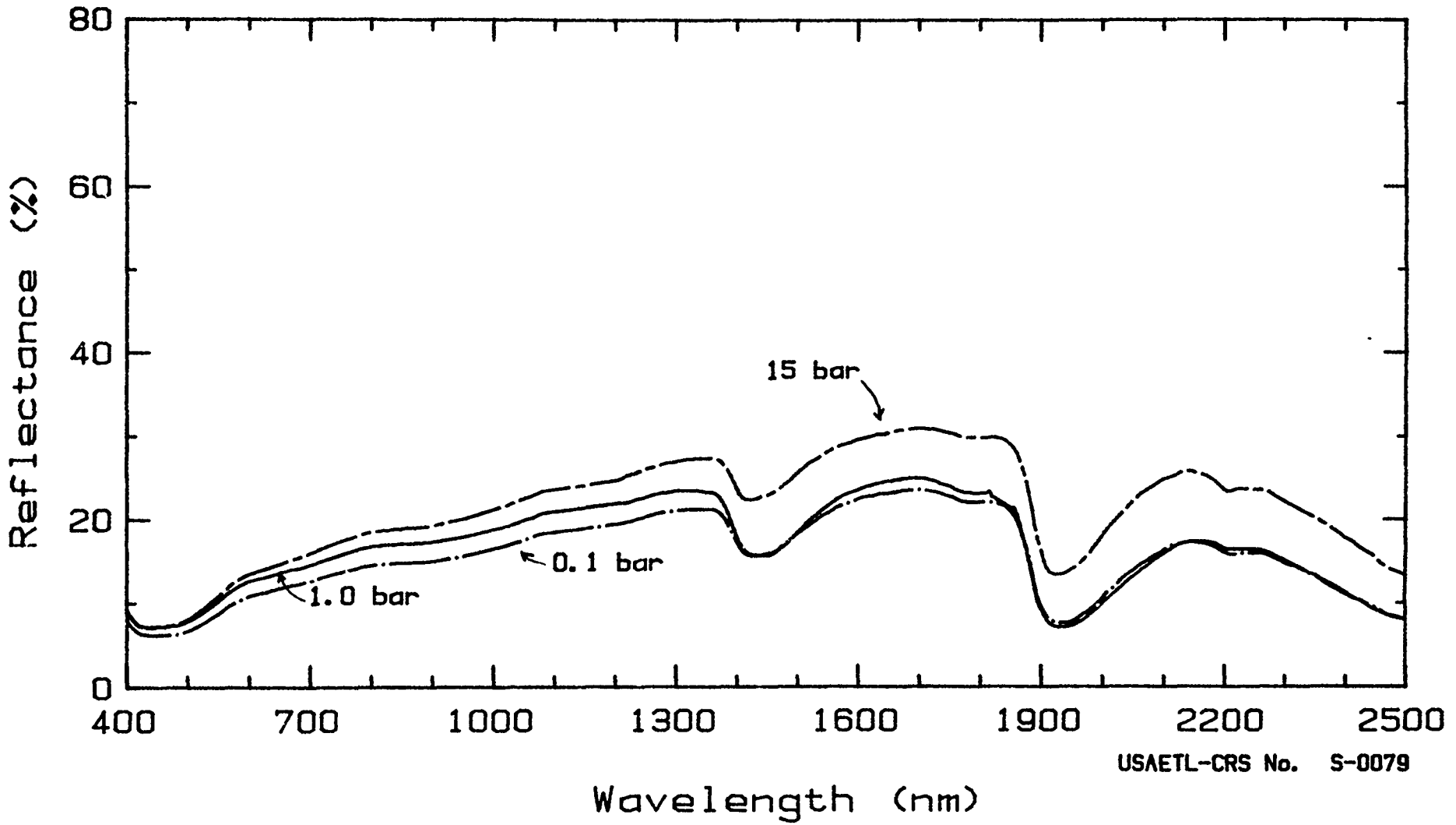
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Spectra of a Playa Soil at Three Moisture Levels.
Melville Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: SC, CL
Geomorphic Unit: Playa
Spectrum No.: MOJ38.01, .10, .15, .20.

Site Location: Melville Lake, San Bernardino Co., CA., USA.
34.4 deg. N Latitude; 116.6 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the playa surface. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

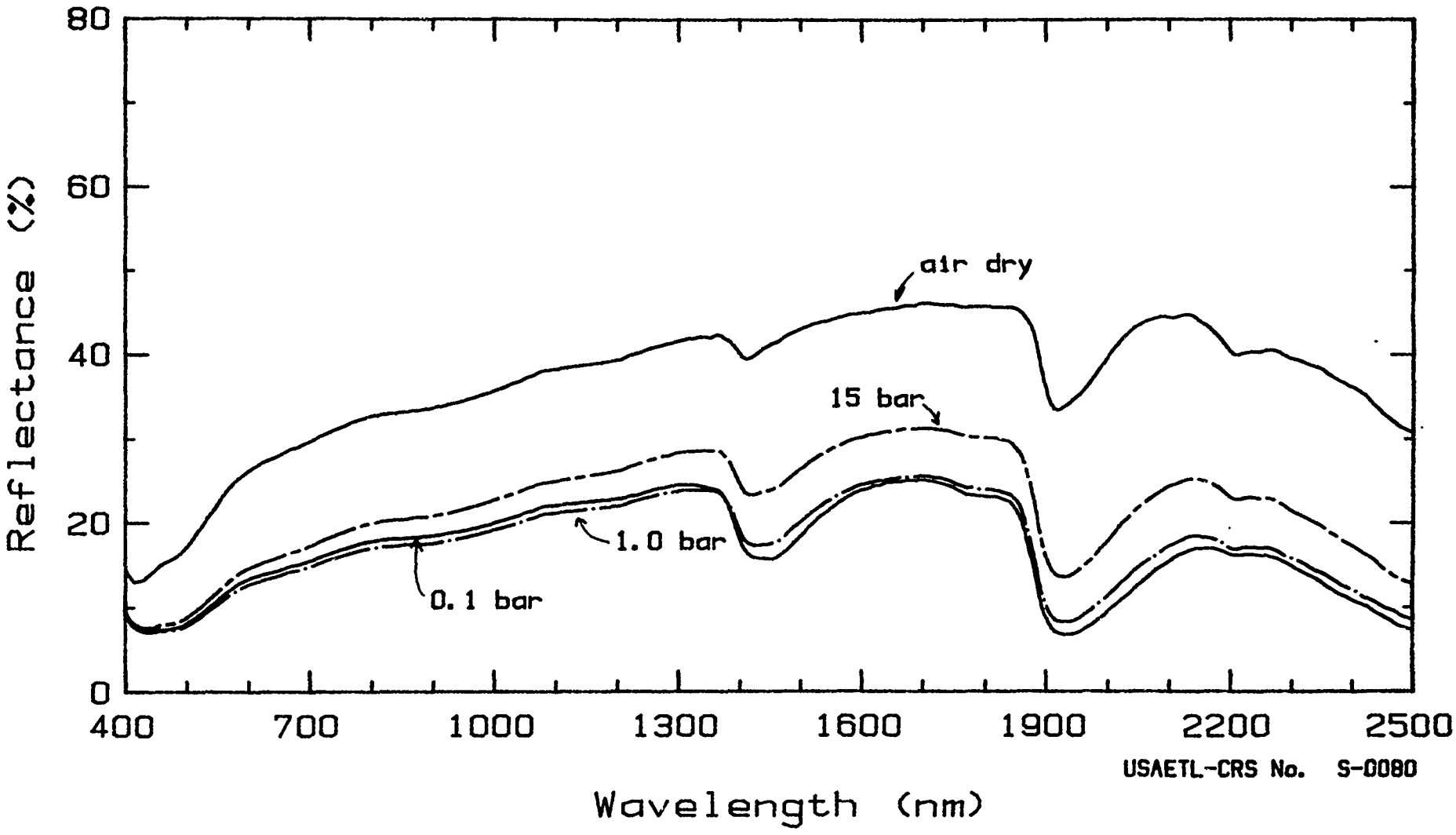
Physical & Chemical Properties of Composite Sample.

Composition: 7.0 % Sand, 62.0 % Silt, 31.0 % Clay
Moisture Content: 0.1 bar = 41.5%; 1.0 bar = 29.8 %;
15 bar = 20.0 %; air dry = 6.8 %.
Electrical Conductivity = 11.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.9	11.4	14.6	18.0	24.3	15.7
1.0	7.7	10.8	14.0	17.2	24.9	16.8
15	8.5	12.4	16.3	20.2	30.6	23.1
A.D.	16.4	23.0	28.3	32.9	45.5	41.5

Compiled by: Melvin B. Satterwhite, Sheet No: S-0080.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Spectra of a Playa Soil at Four Moisture Levels.
Melville Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ06.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Silurian Lake, San Bernardino Co., CA, USA.
35.5 deg. N. Latitude; 116.2 deg. W. Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2.0 cm horizon of the playa. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture in each subsample was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

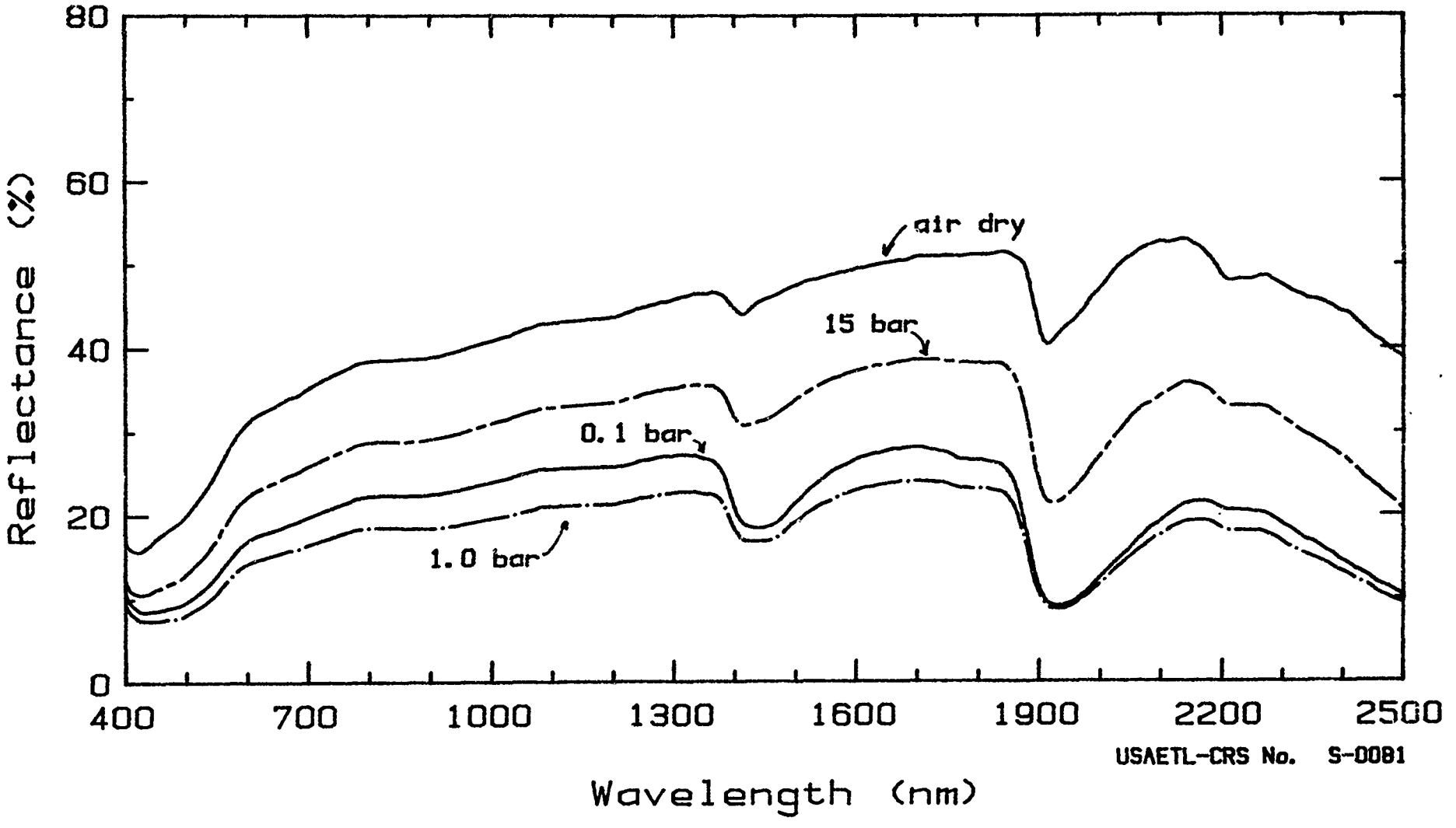
Composition: 38.0 % Sand, 44.0 % Silt, 18.0 % Clay
Moisture Content: 0.1 bar = 34.2 %; 1.0 bar = 26.1 %;
15 bar = 13.2 %; air dry = 4.7 %.
Electrical Conductivity = 2.6 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.4	13.8	18.7	22.3	27.2	19.9
1.0	8.0	11.6	15.7	18.4	23.3	17.7
15	12.4	18.3	24.5	28.8	37.8	33.2
A.D.	19.2	26.6	33.7	38.6	50.2	49.6

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0081.



Spectra of a Playa Soil at Four Moisture Levels.
Silurian Playa, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ36.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Silver Lake, San Bernardino Co., CA, USA.
35.4 deg. N Latitude; 116.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potertials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

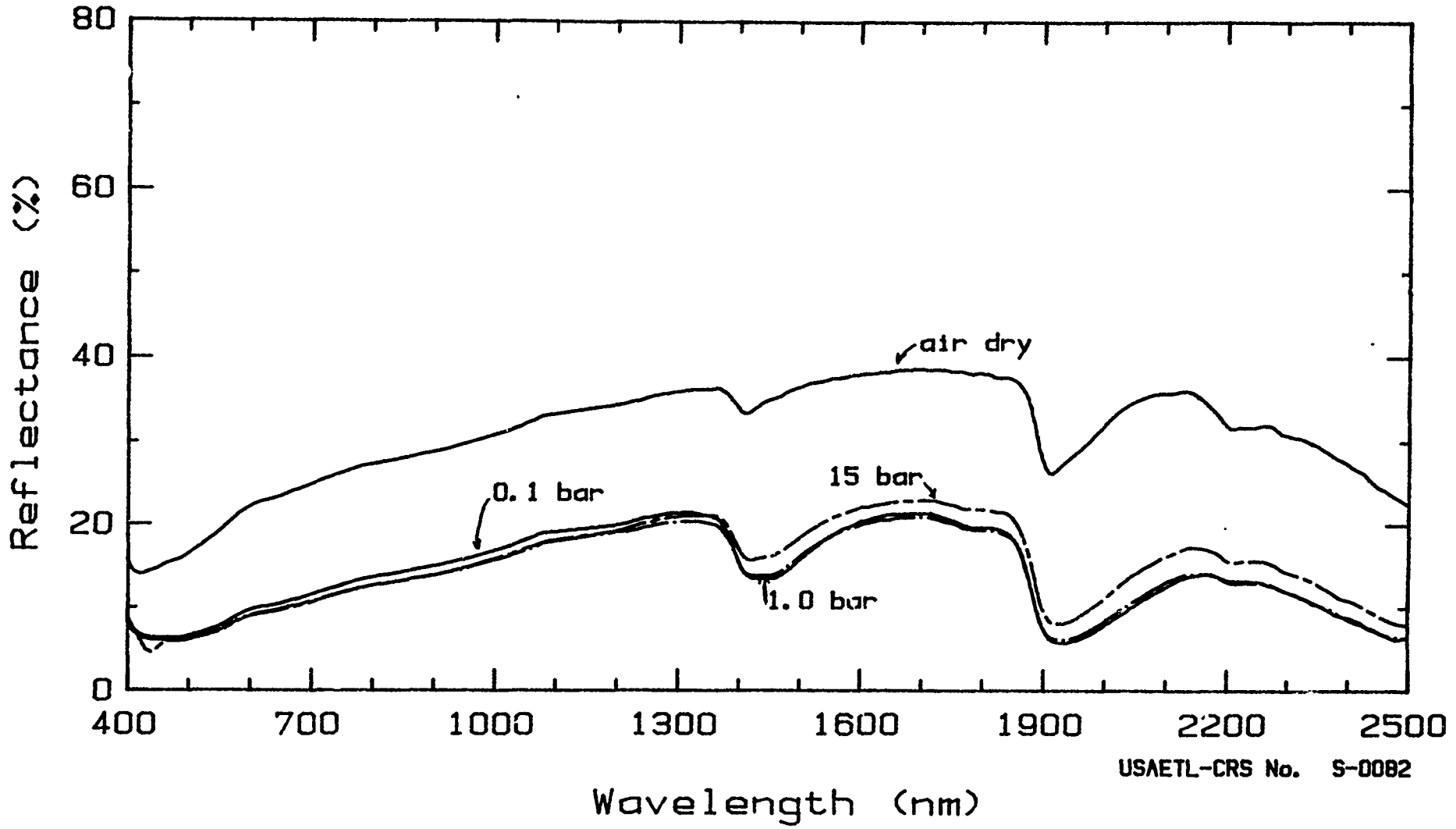
Composition: 7.0 % Sand, 28.0 % Silt, 65.0 % Clay
Moisture Content: 0.1 bar = 55.1%; 1.0 bar = 38.0 %;
15 bar = 28.8 %; air dry = 7.3 %.
Electrical Conductivity = 1.08 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	6.5	8.2	10.7	14.1	20.7	12.8
1.0	6.1	7.7	10.0	13.0	20.3	12.9
15	5.9	7.6	9.9	13.0	22.4	15.6
A.D.	16.0	19.8	23.8	27.7	38.3	32.9

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0082.



Spectra of a Playa Soil at Four Moisture Levels.
Silver Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ47.01, .10, .15.

Date Collected: May 1988
Unified System: CL

Site Location: Silver Lake, San Bernardino Co., CA, USA.
35.4 deg. N Latitude; 116.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm horizon of the playa surface. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

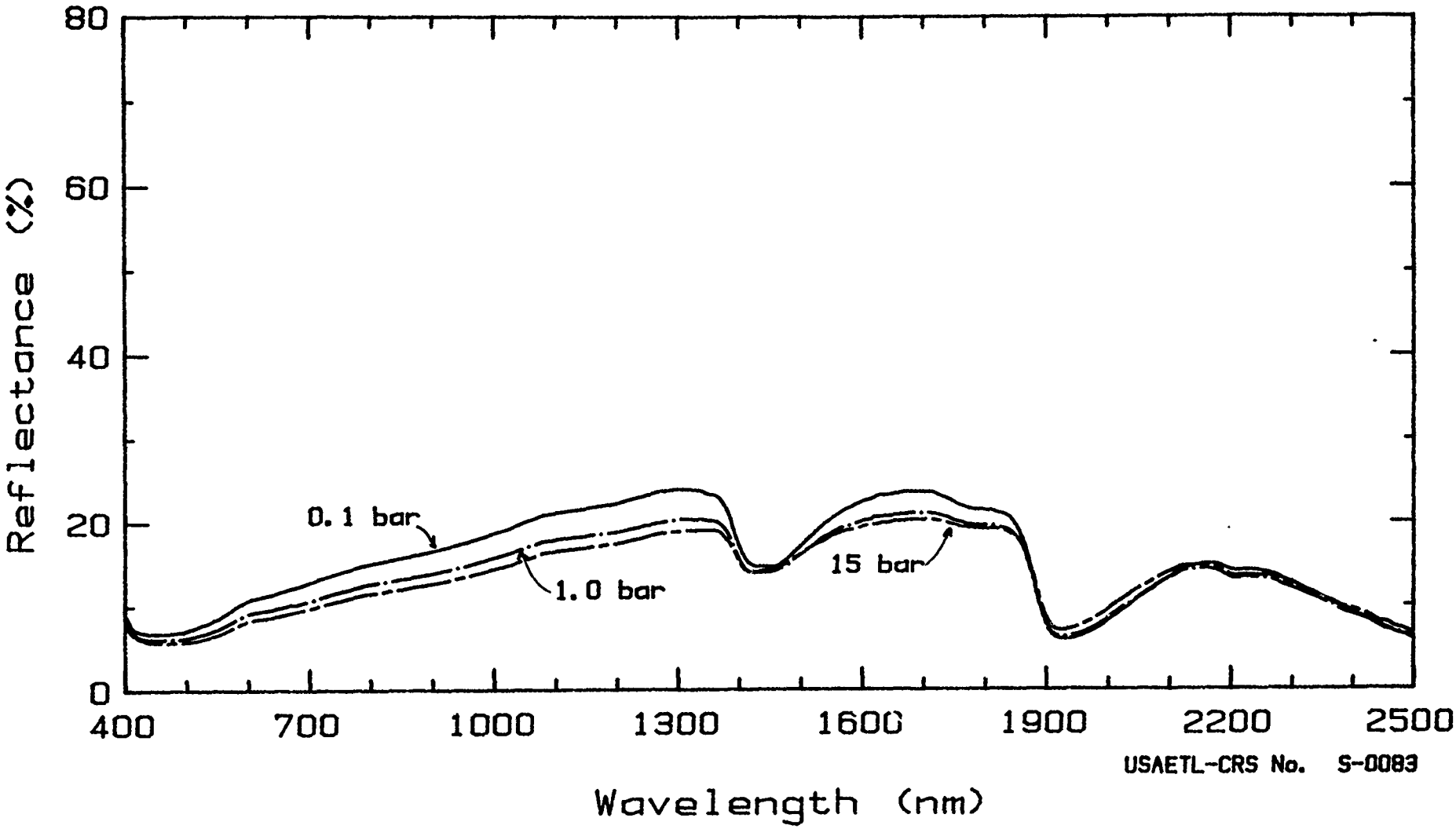
Composition: 9.0 % Sand, 24.0 % Silt, 67.0 % Clay
Moisture Content: 0.1 bar = 55.8%; 1.0 bar = 35.7 %;
15 bar = 27.0 %; air dry = 8.0 %.
Electrical Conductivity = 0.56 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.1	9.1	12.0	15.6	22.8	13.6
1.0	6.2	7.8	10.1	13.0	20.5	13.0
15	5.8	7.1	9.1	11.9	19.8	13.4

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0083.



Spectra of a Playa Soil at Three Moisture Levels.
Silver Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ37. 01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Soggy Lake, San Bernardino Co., CA, USA.
34.5 deg. N Latitude; 116.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm horizon of the hard dry playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture in each subsample was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

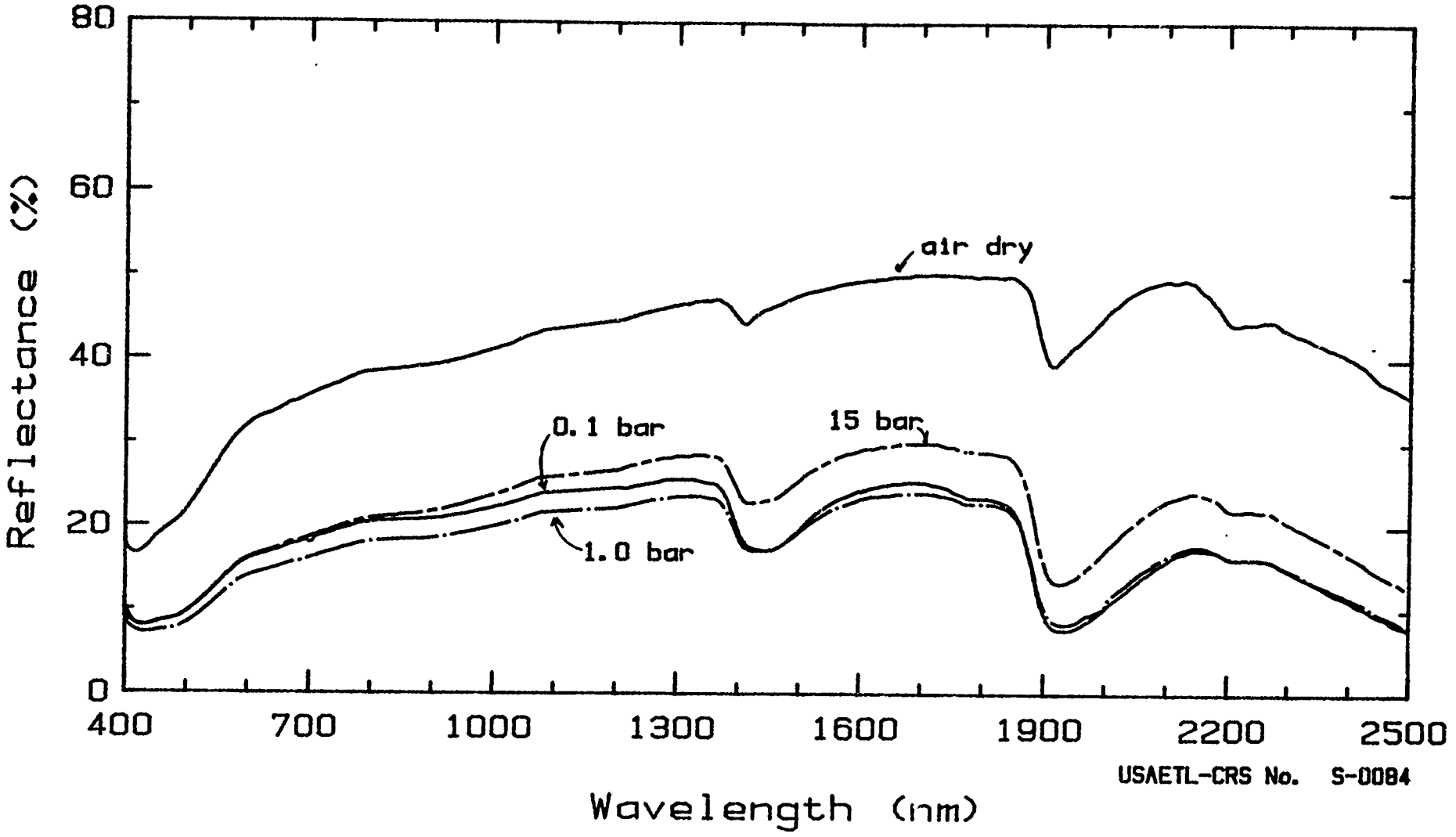
Physical & Chemical Properties of Composite Sample.
Composition: 5.0 % Sand, 26.2 % Silt, 69.0 % Clay
Moisture Content: 0.1 bar = 37.4%; 1.0 bar = 28.1 %;
15 bar = 19.6 %; air dry = 5.2 %.
Electrical Conductivity = 0.41 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.2	13.5	17.4	20.6	24.6	15.9
1.0	8.0	11.8	15.3	18.2	23.5	16.0
15	9.2	13.6	17.6	21.1	29.5	22.0
A.D.	20.9	28.4	34.3	38.7	49.8	45.8

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0084.



Spectra of a Playa Soil at Four Moisture Levels.
Soggy Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL
Spectrum No.: MOJ26.01, .10, .15, .20.

Site Location: Superior Lake, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the hard dry playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

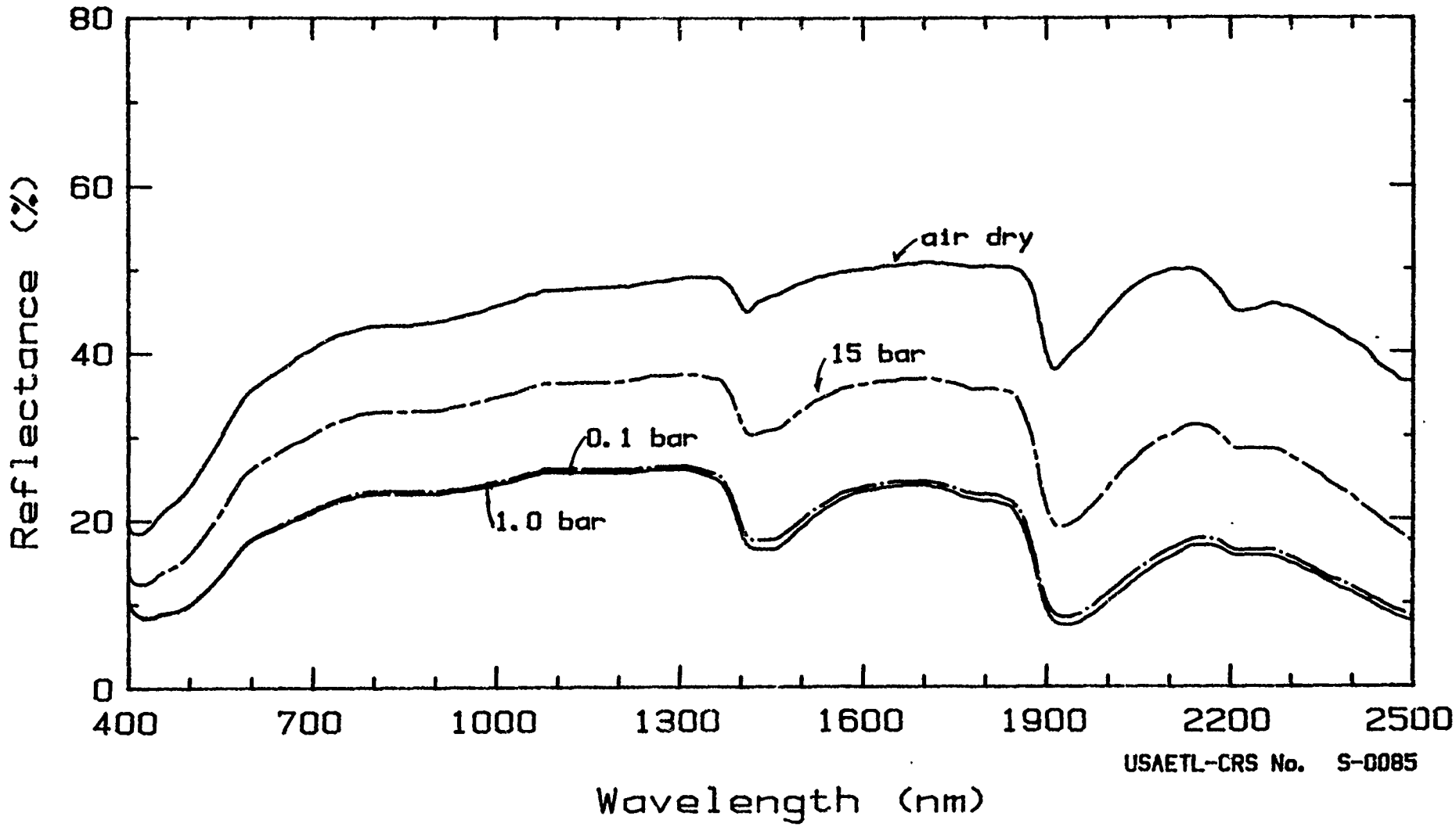
Composition: 0.0 % Sand, 61.0 % Silt, 39.0 % Clay
Moisture Content: 0.1 bar = 36.9 %; 1.0 bar = 31.5 %;
15 bar = 22.2 %; air dry = 7.0 %.
Electrical Conductivity = 0.4 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.7	14.4	19.7	23.1	23.6	15.5
1.0	9.6	14.4	19.9	23.4	24.1	16.2
15	15.2	22.0	28.8	33.0	36.4	28.9
A.D.	23.0	31.0	38.6	43.3	50.4	46.8

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0085.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL
Spectrum No.: MOJ27.01, .10, .15, .20.

Site Location: Superior Lake, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of the hard dry playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

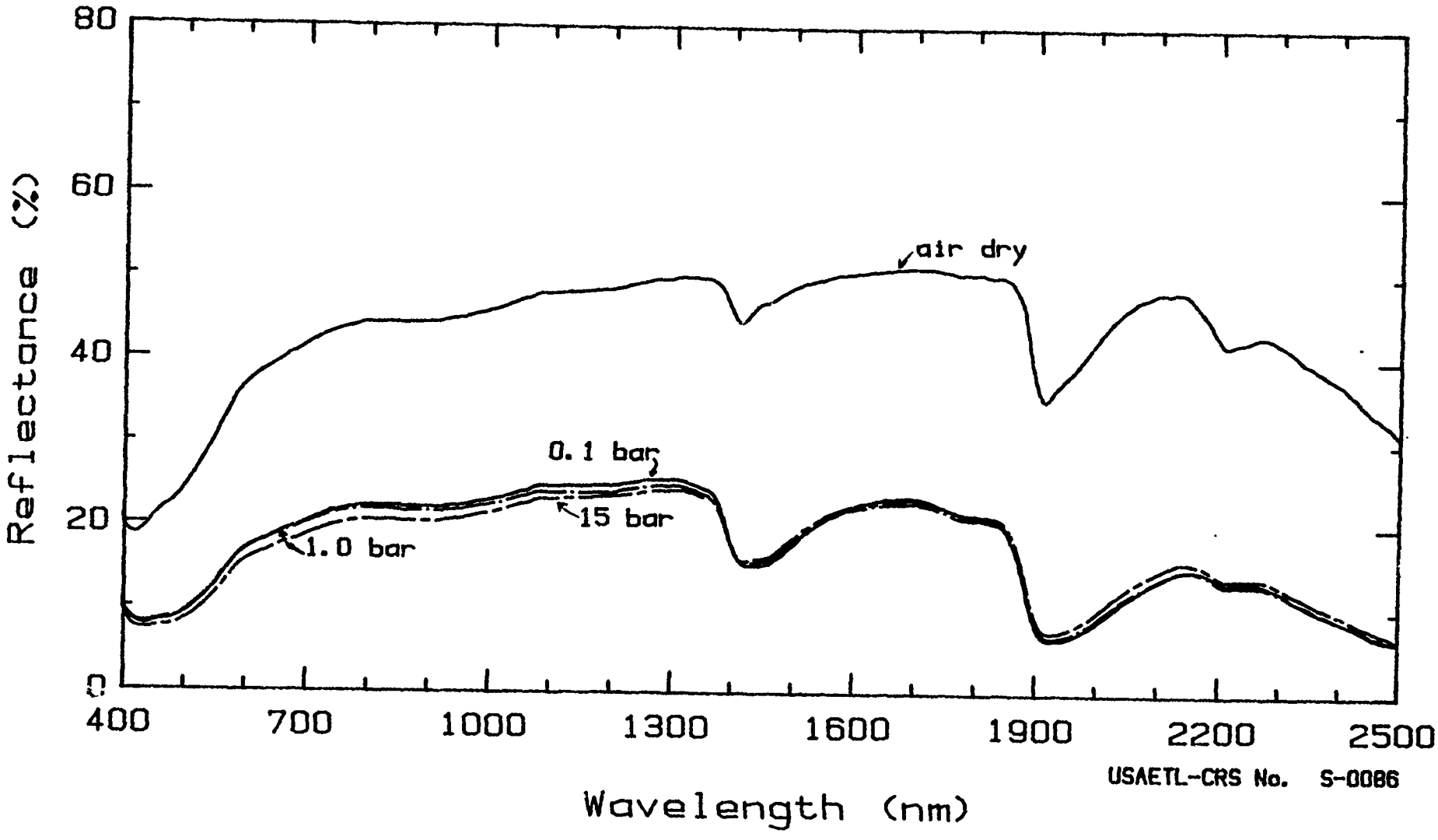
Composition: 9.0 % Sand, 50.0 % Silt, 41.0 % Clay
Moisture Content: 0.1 bar = 31.6 %; 1.0 bar = 27.5 %;
15 bar = 22.3 %; air dry = 6.6 %.
Electrical Conductivity = 0.28 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.0	13.6	19.1	22.2	22.8	13.4
1.0	9.0	13.7	19.0	21.7	22.2	13.3
15	8.2	12.4	17.6	20.4	22.6	14.1
A.D.	23.2	31.8	38.8	44.2	50.8	44.2

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0086.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sandy Loam
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ40.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL-ML

Site Location: Superior Lake, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm soil horizon in the border area at the west end of the playa. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

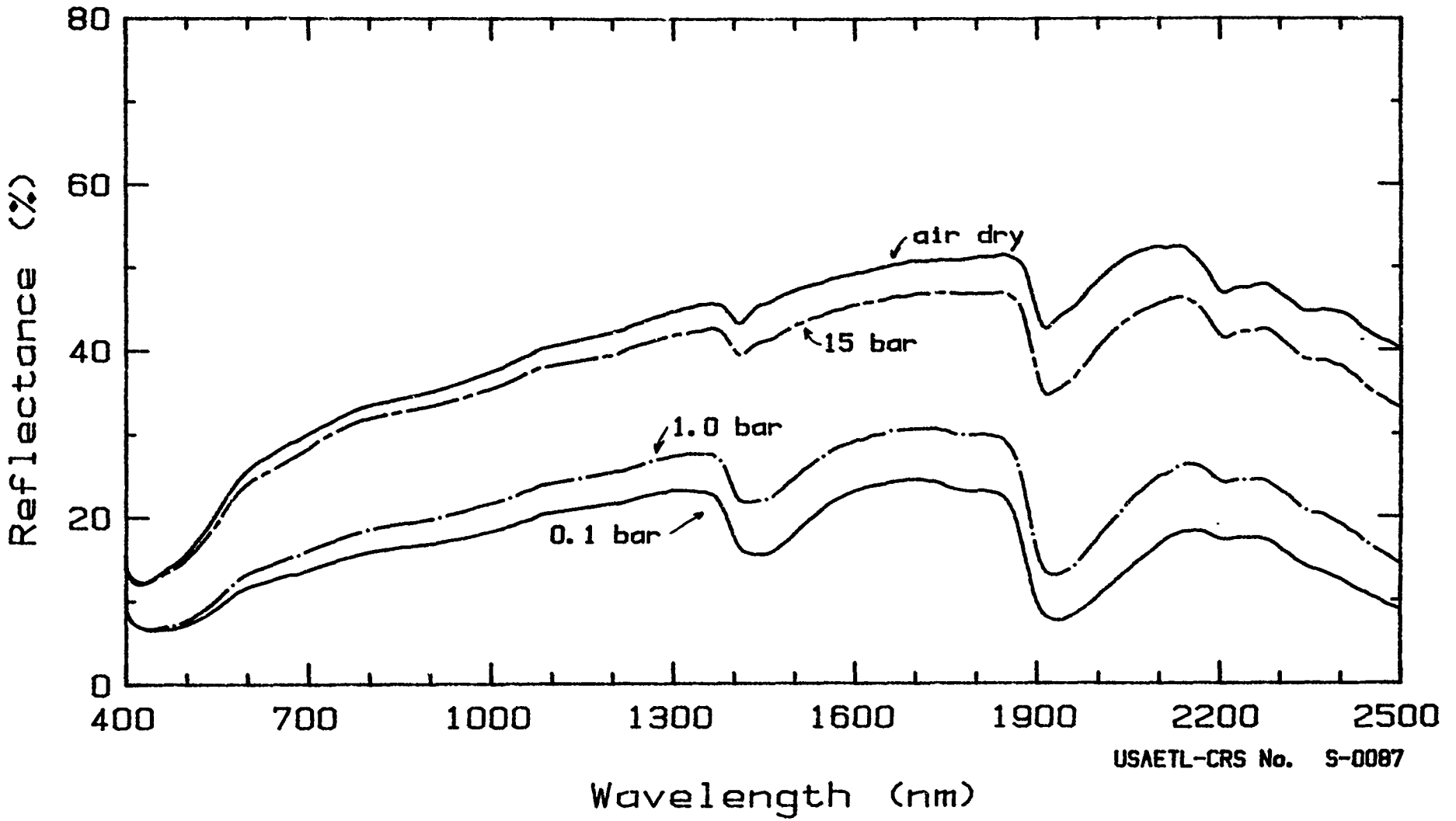
Physical & Chemical Properties of Composite Sample.
Composition: 70.0 % Sand, 22.0 % Silt, 8.0 % Clay
Moisture Content: 0.1 bar = 16.9%; 1.0 bar = 8.8 %;
15 bar = 4.0 %; air dry = 1.2 %.
Electrical Conductivity = 0.08 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.0	9.8	12.9	16.1	23.6	16.9
1.0	7.4	10.9	14.9	18.9	29.7	24.3
15	14.4	20.4	26.6	32.4	46.0	43.0
A.D.	14.9	21.7	28.5	33.9	49.9	48.8

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0087.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: CH, CL
Geomorphic Unit: Playa
Spectrum No.: MOJ41.01, .10, .15, .20.

Site Location: Superior Lake, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. The Halon standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm horizon of the surface crust at the east end of the playa. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

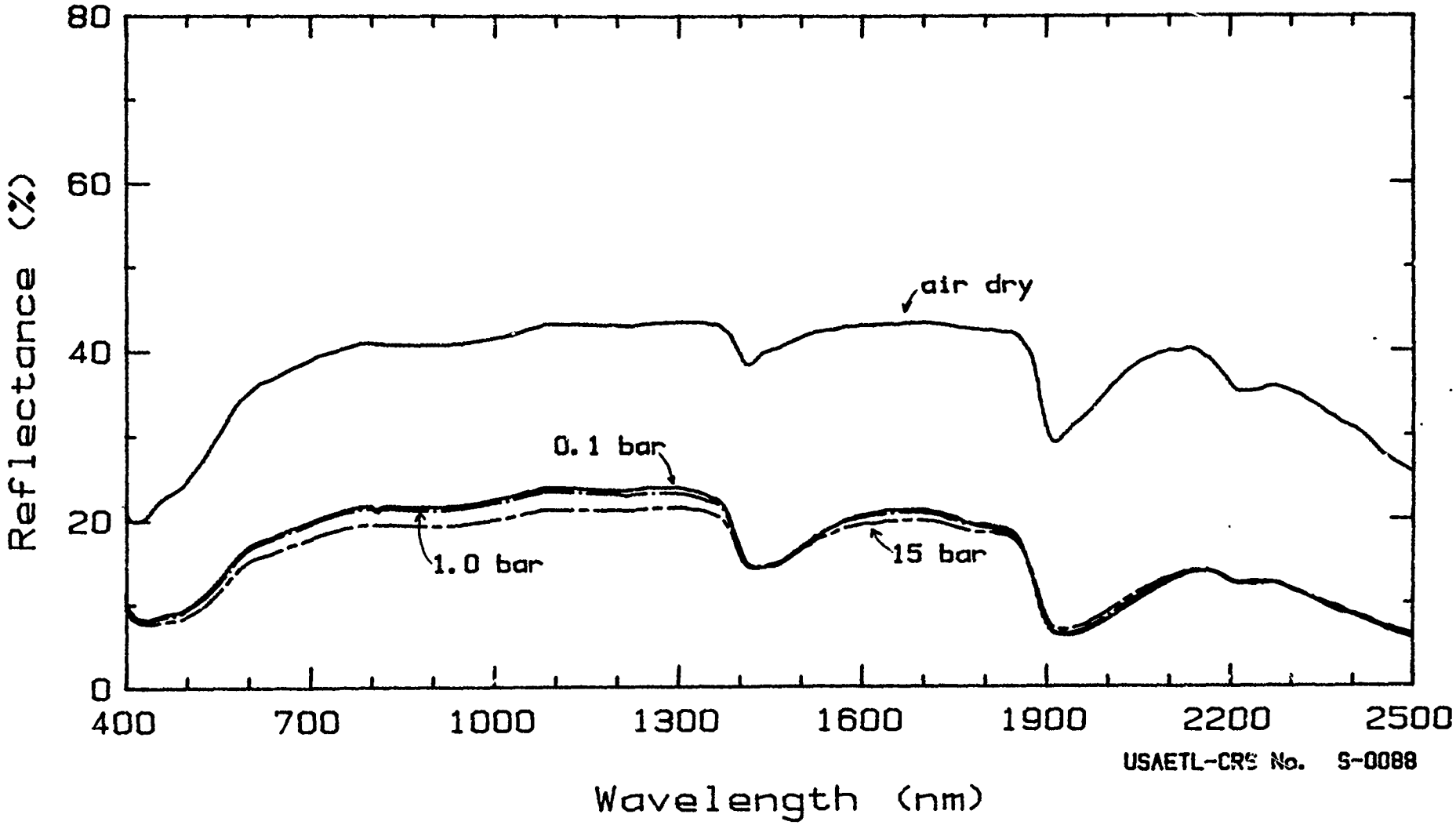
Composition: 3.0 % Sand, 58.0 % Silt, 39.0 % Clay
Moisture Content: 0.1 bar = 38.3%; 1.0 bar = 30.5 %;
15 bar = 25.0 %; air dry = 8.3 %.
Electrical Conductivity = 0.6 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.3	13.7	18.7	21.6	20.7	12.4
1.0	9.1	13.4	18.4	21.3	20.4	12.5
15	8.4	12.2	16.8	19.4	19.6	12.5
A.D.	24.0	31.2	37.6	40.8	43.1	35.9

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0088.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay Loam Date Collected: May 1988
Taxonomy: Aridisol Unified System: CL
Geomorphic Unit: Playa
Spectrum No.: MOJ43.01, .10, .15.

Site Location: Superior Lake, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm surface crust at the east end of the playa. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

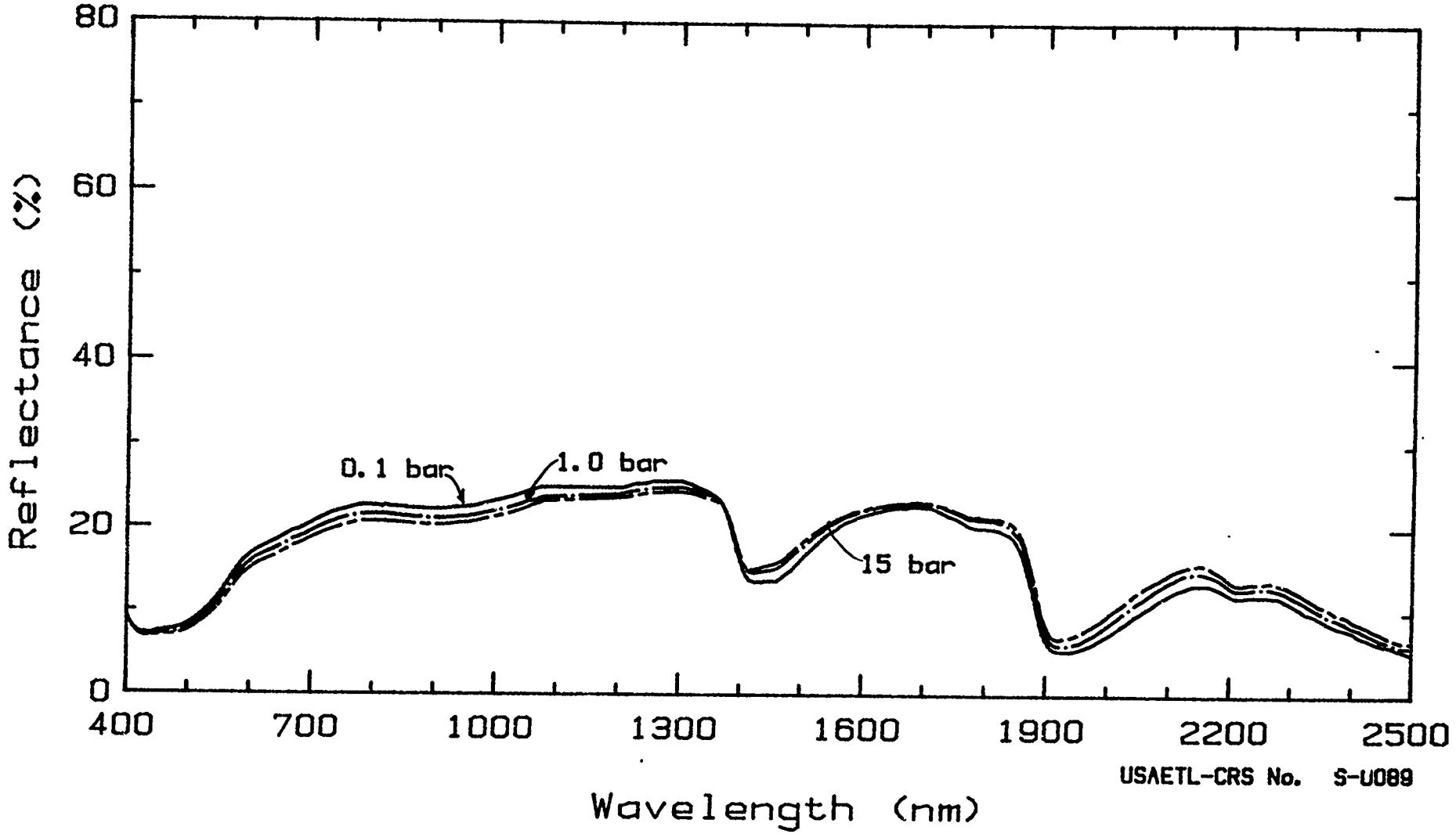
Composition: 10.4 % Sand, 52.0 % Silt, 37.6 % Clay.
Moisture Content: 0.1 bar = 45.6%; 1.0 bar = 32.1 %;
15 bar = 26.5 %; air dry = 11.9 %.
Electrical Conductivity = 9.4 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance(%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	8.0	12.9	19.1	22.4	21.9	11.9
1.0	7.6	12.2	18.1	21.4	22.5	13.0
15	11.6	17.2	20.5	22.5	13.8	54.2

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0089.



Spectra of a Playa Soil at Three Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ51.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Superior Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 117.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1 cm soil horizon at the east end of the playa. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

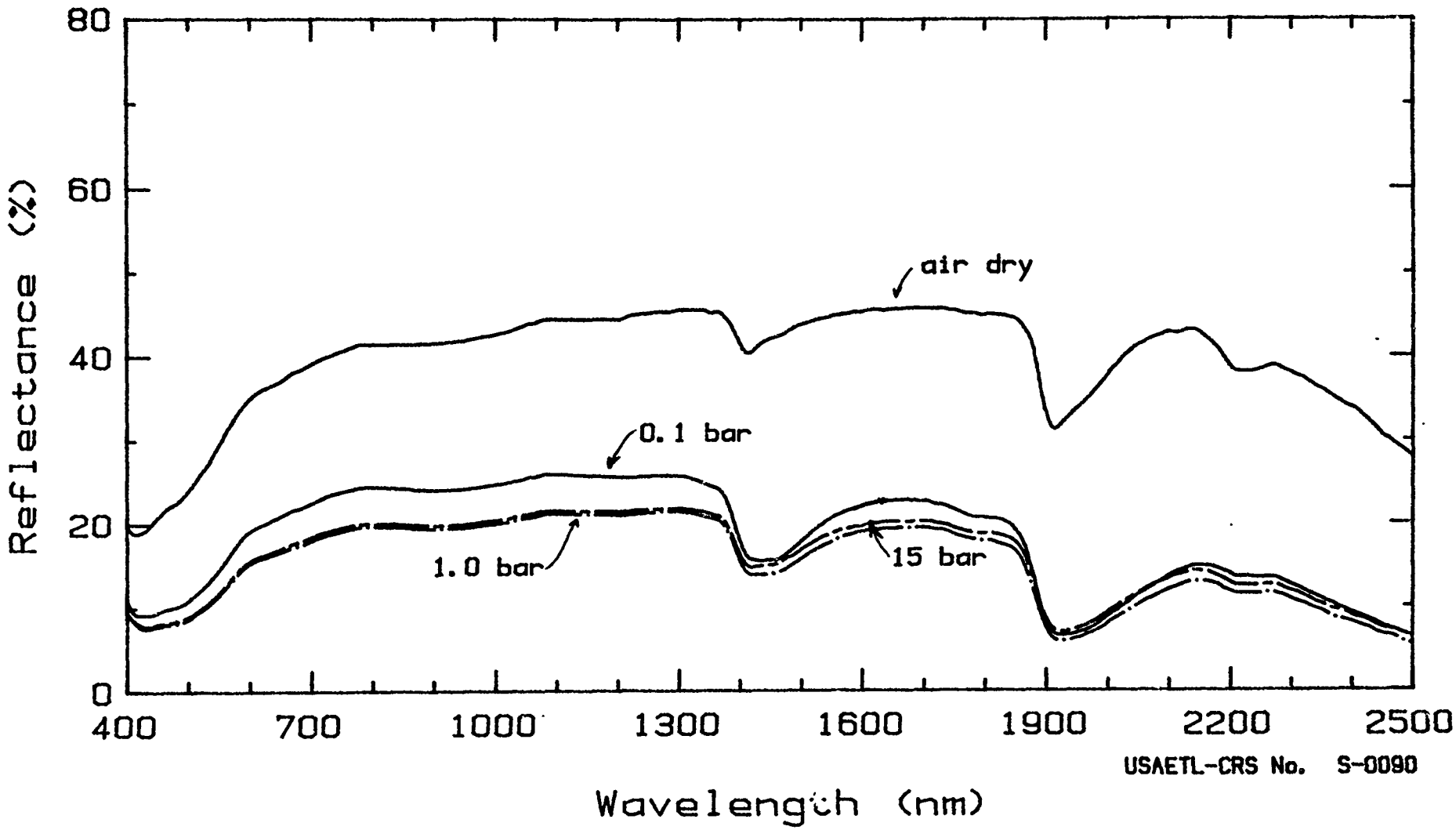
Composition: 4.4 % Sand, 44.0 % Silt; 51.6 % Clay.
Moisture Content: 0.1 bar = 39.8%; 1.0 bar = 30.2 %;
15 bar = 26.3 %; air dry = 10.1 %.
Electrical Conductivity = 0.34 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.5	15.6	21.3	24.3	22.2	13.4
1.0	8.4	12.4	17.0	19.6	19.1	11.7
15	8.7	12.7	17.3	20.0	19.9	12.8
A.D.	23.1	30.7	37.6	41.4	45.5	39.8

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0090.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Silty Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ52.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Superior Lake, San Bernardino Co., CA, USA.
34.2 deg. N Latitude; 117.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 1.5 cm surface horizon at the west end of the playa. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

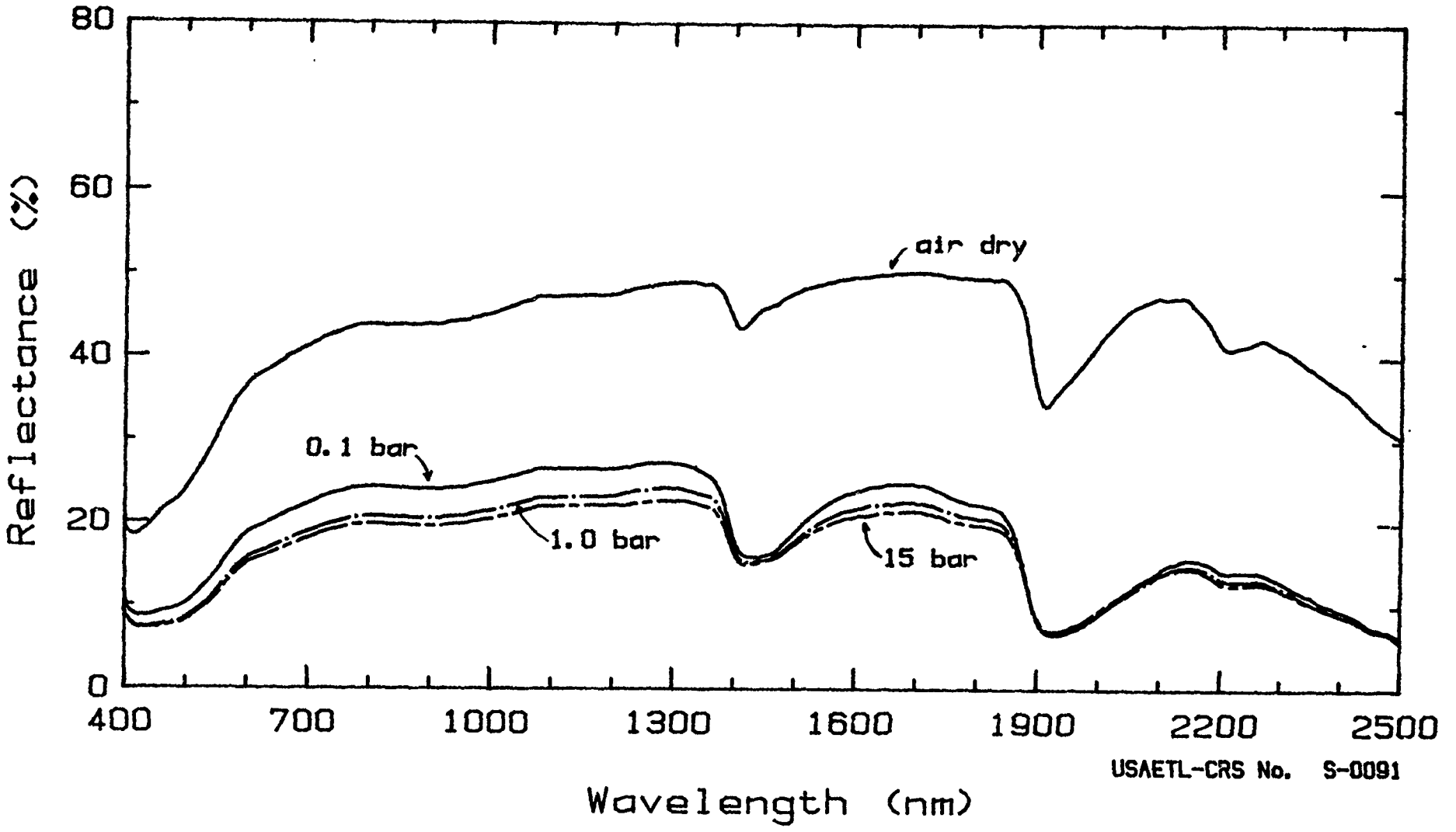
Composition: 14.4 % Sand, 42.0 % Silt; 43.6 % Clay.
Moisture Content: 0.1 bar = 36.7%; 1.0 bar = 29.4 %;
15 bar = 24.1 %; air dry = 7.7 %.
Electrical Conductivity = 0.34 * 10^3 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	9.8	15.0	20.9	24.2	24.0	14.0
1.0	8.1	12.4	17.6	20.6	21.9	13.2
15	7.9	12.0	16.9	19.7	20.9	12.9
A.D.	23.0	31.5	39.5	43.8	49.9	43.3

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-CRS.

Sheet No: S-0091.



Spectra of a Playa Soil at Four Moisture Levels.
Superior Lake, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Aridisol
Geomorphic Unit: Sand Dune
Spectrum No.: MOJ21.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Copper City Road, San Bernardino Co., CA, USA.
35.0 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 4 cm horizon of dry dune surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

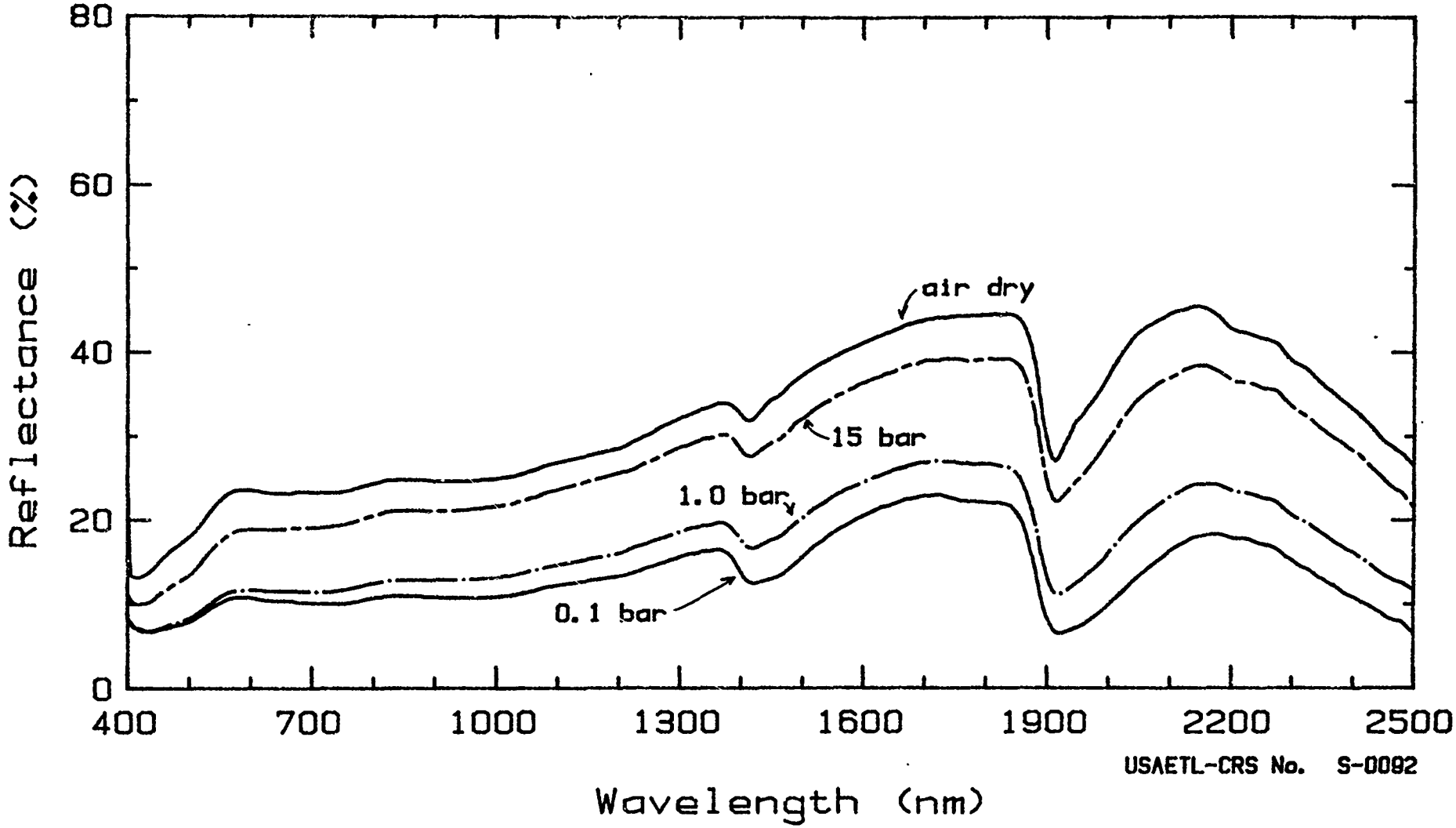
Composition: 86.0 % Sand, 14.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 16.5 %; 1.0 bar = 9.6 %;
15 bar = 7.1 %; air dry = 2.6 %.
Electrical Conductivity = 0.15 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	7.6	10.2	10.3	10.8	21.5	16.6
1.0	8.0	10.9	11.5	12.6	25.6	22.4
15	12.8	17.6	19.0	20.8	37.5	35.8
A.D.	17.1	22.4	23.2	24.5	42.4	42.2

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0092.



Spectra of a Sand Soil at Four Moisture Levels.
Copper City Road, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Clay
Taxonomy: Aridisol
Geomorphic Unit: Playa
Spectrum No.: MOJ28.01, .10, .15, .20.

Date Collected: May 1988
Unified System: CL

Site Location: Rainbow Road, San Bernardino Co., CA, USA.
35.2 deg. N Latitude; 117.1 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the dark gray-colored clay shale stratum in the dissected uplands. The sample was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

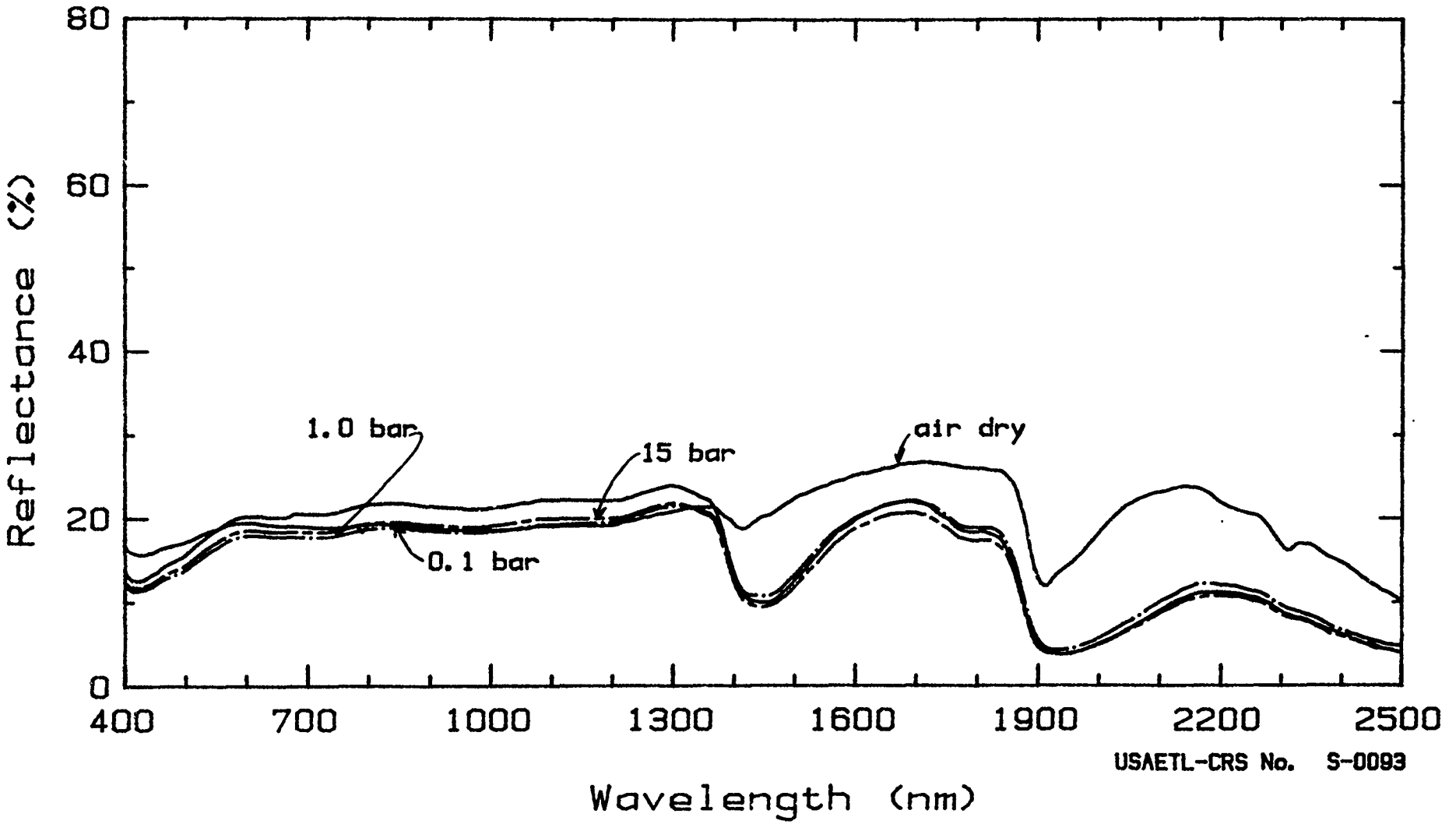
Composition: 0.0 % Sand, 7.0 % Silt, 93.0 % Clay
Moisture Content: 0.1 bar = 114.1%; 1.0 bar = 75.4 %;
air dry = 8.3 %.
Electrical Conductivity = 1.24 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	15.1	18.9	20.3	21.6	20.5	9.9
1.0	13.4	16.7	17.8	18.7	20.7	10.8
15	14.0	17.4	18.4	19.4	19.4	9.5
A.D.	16.9	18.9	19.1	19.1	25.8	20.9

Compiled by: Melvin B. Satterwhite,
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0093.



Spectra of a Clay Soil at Four Moisture Levels.
Rainbow Road, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sandy Loam - Sandy Clay Loam
Date Collected: May 1988
Taxonomy: Aridisol
Unified System: SM
Geomorphic Unit: Playa
Spectrum No.: MOJ22.01, .10, .15, .20.

Site Location: Death Valley, Inyo Co., CA, USA.
36.1 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of dry salt encrusted playa surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition, 0.1, 1.0, and 15 bar pressure potentials. The percent moisture in each subsample was determined gravimetrically (oven-dry weight basis). Textural analysis was by wet sieving.

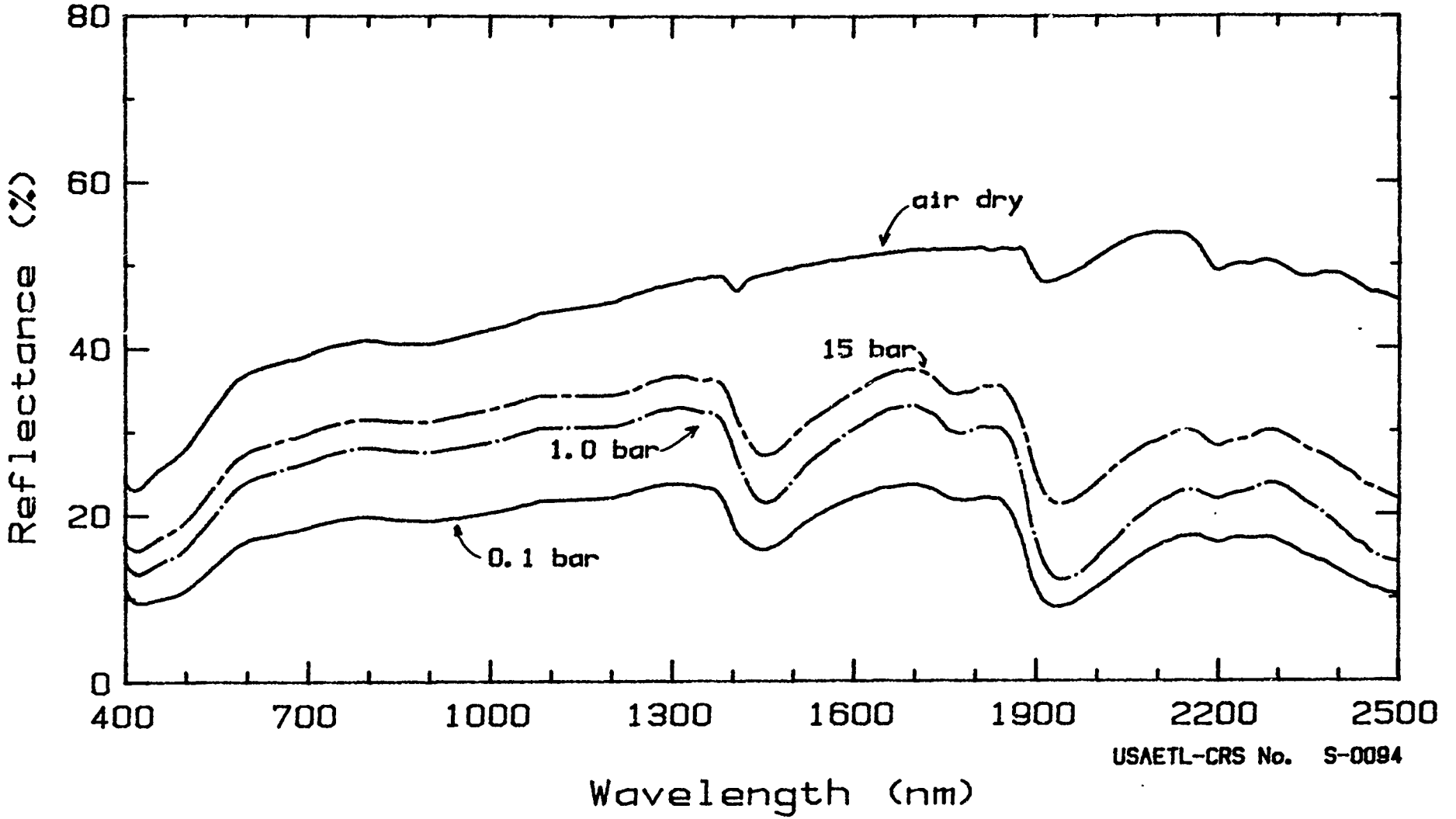
Physical & Chemical Properties of Composite Sample.

Composition: 61.5 % Sand, 38.5 % Fines (silt + clay)
Moisture Content: 0.1 bar = 22.9 %; 1.0 bar = 13.4 %;
15 bar = 10.6 %; air dry = 0.8 %.
Electrical Conductivity = 28.5 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.7	14.7	17.9	19.6	22.6	16.8
1.0	15.4	21.1	25.5	27.8	31.3	22.5
15	18.6	24.5	29.0	31.3	35.7	29.2
A.D.	27.2	33.8	38.4	40.7	51.3	51.1

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.
Sheet No: S-0094.



Spectra of a Playa Soil at Four Moisture Levels.
Death Valley Playa, Inyo Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Torrisamment
Geomorphic Unit: Sand Dune
Spectrum No.: MOJ19.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Devil's Corn Field, Death Valley, Inyo Co., CA, USA.
36.1 deg. N Latitude; 116.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 4 cm horizon of dry sand dune surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectra was taken of each subsample at the air-dry condition, 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer procedure.

Physical & Chemical Properties of Composite Sample.

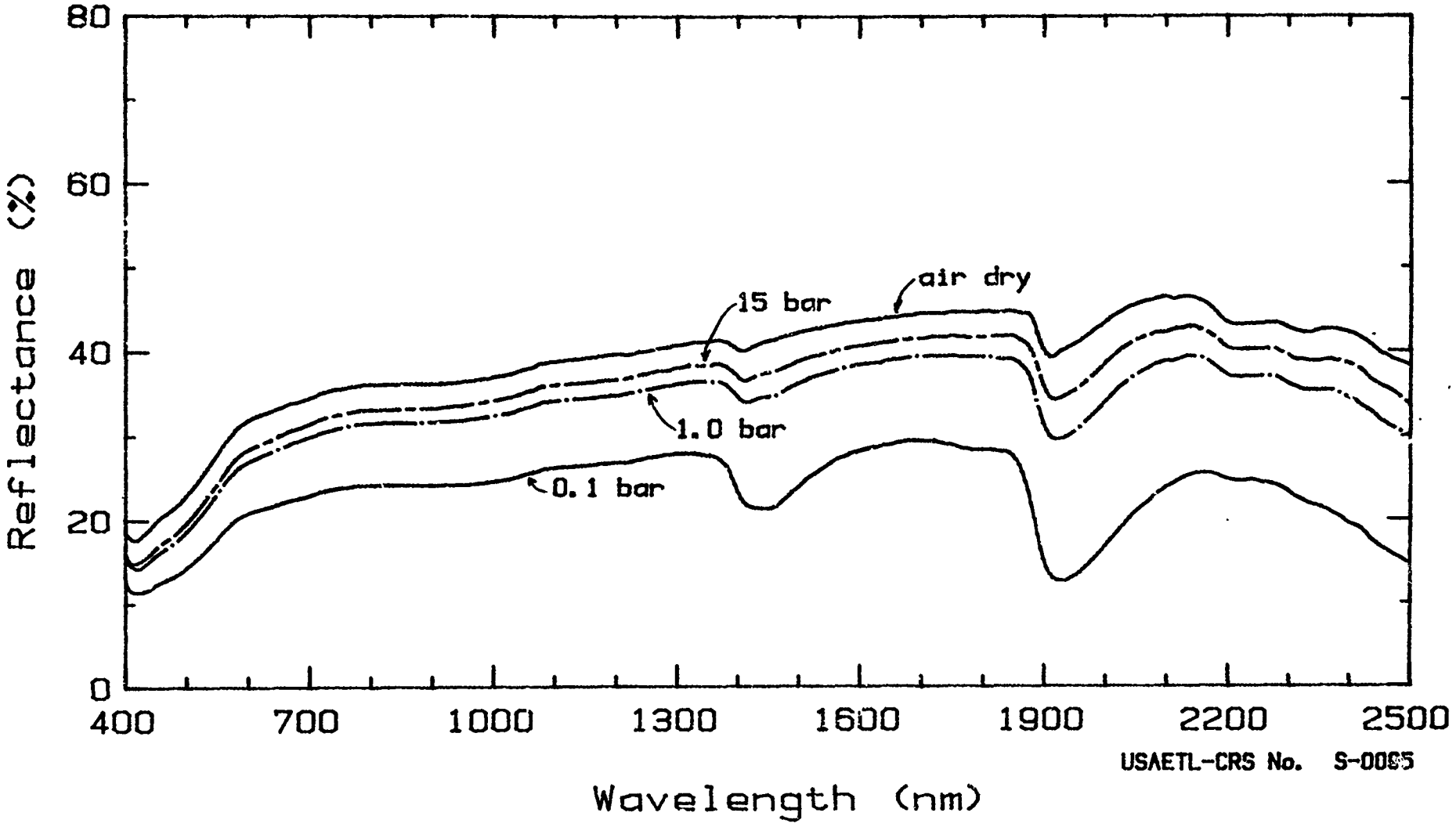
Composition: 100.0 % Sand, 0.0 % Silt, 0.0 % Clay
Moisture Content: 0.1 bar = 6.1 %; 1.0 bar = 2.8 %;
15 bar = 2.3 %; air dry = 0.4 %.
Electrical Conductivity = 0.25 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	13.7	18.5	22.2	24.2	28.7	24.2
1.0	17.8	24.0	28.9	31.6	38.9	37.5
15	18.8	25.2	30.4	33.2	41.2	40.9
A.D.	22.0	28.7	33.6	36.2	44.1	44.2

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0095.



Spectra of Dune Sand at Four Moisture Levels.
Death Valley, Inyo Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamment
Geomorphic Unit: Sand Dune
Spectrum No.: MOJ24.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Kelso Dunes, San Bernardino Co., CA, USA.
34.9 deg. N Latitude; 115.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 2 cm horizon of dry, lee slope of the sand dune surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition and 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer method.

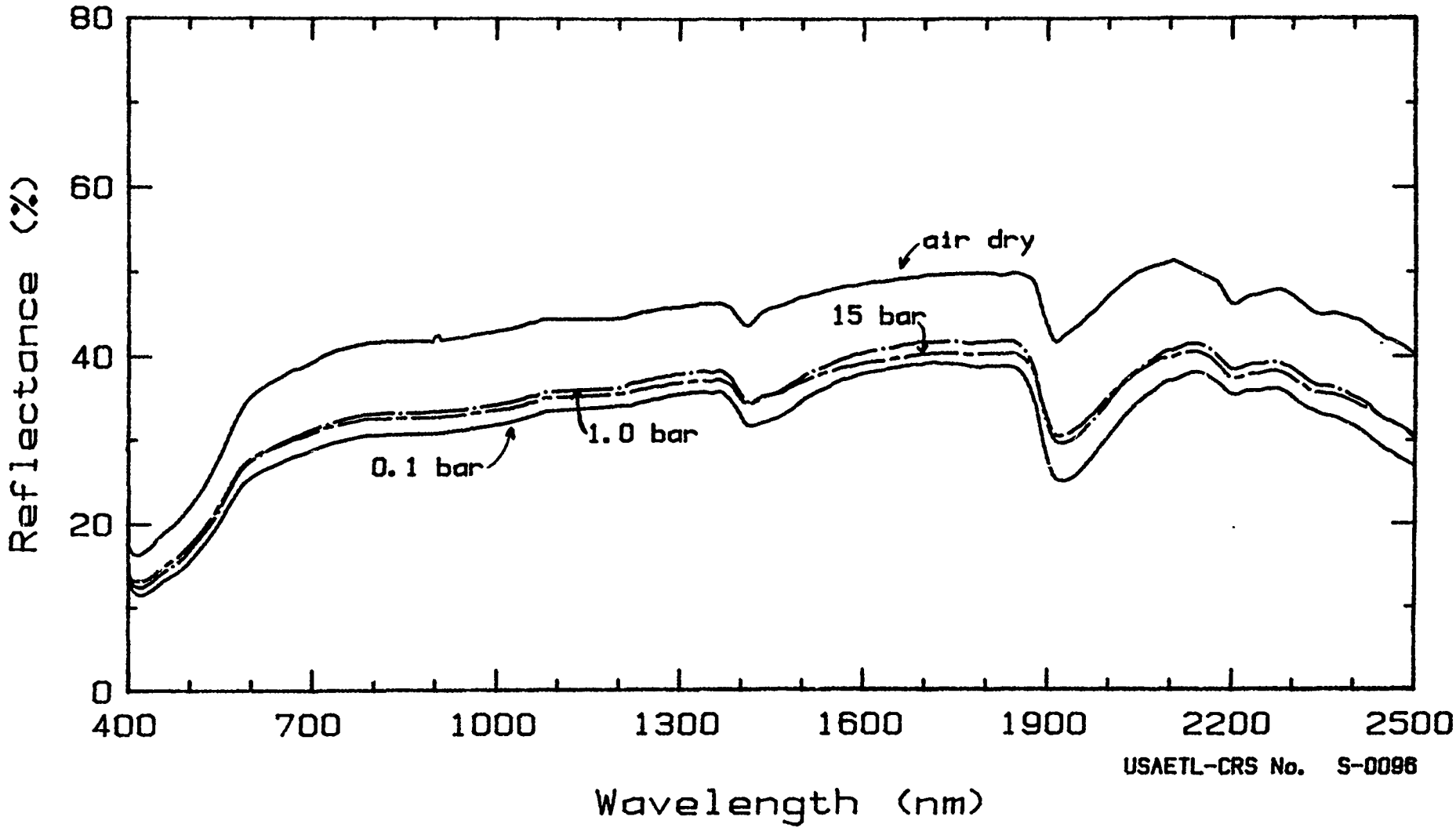
Physical & Chemical Properties of Composite Sample.

Composition: 100.0 % Sand, 0.0 % Silt, 0.0% Clay
Moisture Content: 0.1 bar = 2.6 %; 15.0 bar = 1.5 %;
air dry = 0.3 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	14.7	21.5	27.8	30.8	3[illegible]	36.1
1.0	15.9	23.2	30.1	33.3	[illegible]	30.4
15	16.5	23.6	29.9	32.7	[illegible].7	38.4
A.D.	20.8	29.8	38.0	41.8	49.1	48.1

Compiled by: Melvin B. Satterwhite, Sheet No: S-0096.
J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.



Spectra of a Dune Sand at Four Moisture Levels.
Kelso Dunes, San Bernardino Co., CA, Apr. 1988.

Laboratory Reflectance Spectra of Soil

Soil Texture: Sand
Taxonomy: Typic Torripsamment
Geomorphic Unit: Sand Dune
Spectrum No.: MOJ25.01, .10, .15, .20.

Date Collected: May 1988
Unified System: SM

Site Location: Kelso Dunes, San Bernardino Co., CA, USA.
34.9 deg. N Latitude; 115.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 48.6 cm. A Halon reference standard was positioned horizontally using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: A sample was taken from the 0 to 10 cm horizon of dry, windward slope of the sand dune surface. It was air-dried at room temperature, passed through a soil sieve with openings of 2000 um, then mixed well. The moisture conditions equivalent to the 0.1, 1.0 and 15 bar pressure potentials were created using the pressure plate apparatus. The spectrum was taken of each subsample at the air-dry condition, 0.1, 1.0, and 15 bar pressure potentials. The percent moisture was determined gravimetrically (oven-dry weight basis). Textural analysis was by the hydrometer method.

Physical & Chemical Properties of Composite Sample.

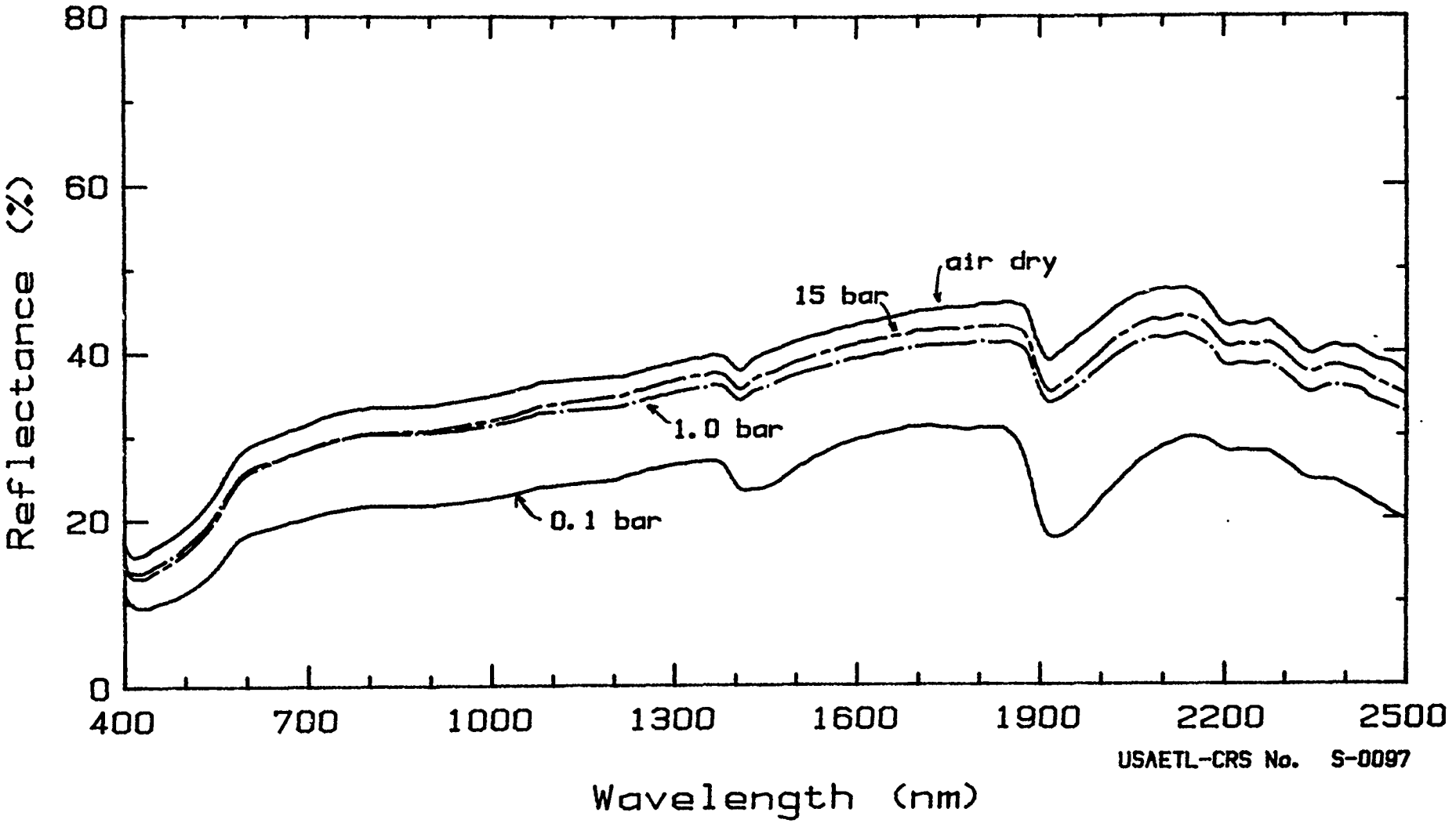
Composition: 99.4 % Sand, 0.6 % Silt, 0.0% Clay
Moisture Content: 0.1 bar = 5.0 %; 1.0 bar = 1.6 %;
15 bar = 1.6 %; air dry = 0.2 %.
Electrical Conductivity = <0.01 * 1000 mmhos/cm @ 25 deg. C.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
0.1	10.8	15.2	19.5	21.7	30.2	28.0
1.0	16.1	22.0	27.5	30.4	40.0	39.2
15	15.4	21.4	27.5	30.5	41.8	41.5
A.D.	18.4	24.6	30.5	33.5	44.1	44.3

Compiled by: Melvin B. Satterwhite, J. Ponder Henley, David H. Nickerson
USAETL-RI-RSD.

Sheet No: S-0097.



Spectra of a Dune Sand at Four Moisture Levels.
Kelso Dunes, San Bernardino Co., CA, Apr. 1988.

Index of Reflectance Spectra for Rock Type Samples

ROCK TYPE	SHEET NUMBER	SPECTRUM NUMBER
Anorthosite	RI.0008	JGR.34, .35
	RI.0010	JGR.28, .29
Basalt	RI.0001	87LCS.56, .57
	RI.0002	LJOR.76, .77, .78, .79
Gabbronorite	RI.0006	JGR.40
	RI.0009	JGR.31, .32
Granite	RI.0005	JGR.69, .70
	RI.0011	JGR.01, .02
	RI.0012	JGR.04, .05
	RI.0013	JGR.13, .14
	RI.0014	JGR.10, .11
	RI.0015	JGR.16, .17
	RI.0016	JGR.19, .20
	RI.0017	JGR.22, .23
	RI.0018	JGR.25, .26
	RI.0019	JGR.07, .08
	RI.0020	JGR.77, .78
	RI.0021	JGR.60
	RI.0028	JGR.62, .63
	RI.0029	JGR.65.
Granodiorite	RI.0007	JGR.37, .38
	RI.0022	JGR.42, .43
	RI.0023	JGR.45, .46
	RI.0024	JGR.48
	RI.0025	JGR.50, .51
	RI.0026	JGR.53
	RI.0027	JGR.55, .56
Leucogranite	RI.0003	JGR.75
	RI.0004	JGR.72, .73
Tonalite	RI.0030	JGR.67

Field Reflectance Spectra of Rock

Rock Type: Basalt Date Collected: 1 Sep 1987
Geomorphic Unit: Lava flow
Spectrum No.: 87LCS.56, .57.

Site Location: Valley of Fire, Lincoln Co., NM, USA.
33.7 deg. N Latitude; 105.9 deg. W Longitude

Procedures:

Spectroradiometric: EG&G spectroradiometer, model 555, 15 degree field of view, 10 nm spectral resolution, spectral range 400 to 1100 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was horizontally positioned using a bubble level.

Sample: Spectra were taken of the two color types of weathered basalt rock: a brown-colored surface (56) and a black-colored surface (57). Both were sunlit, air-dry surfaces and were representative of the other rock surfaces at the sample site.

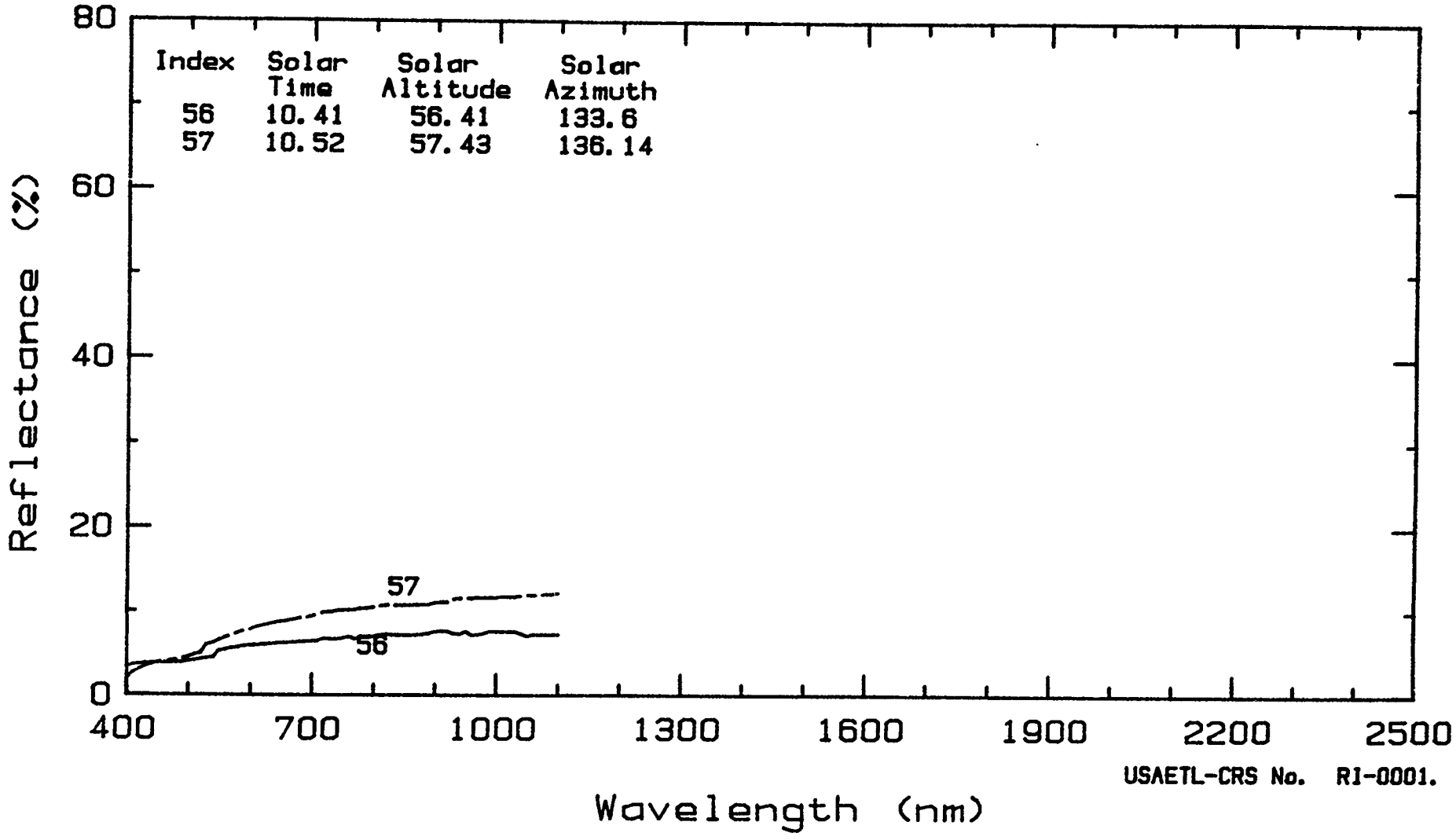
Composition and Physical Properties of Composite Sample.

Moisture Content: air dry.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-:2350 nm
56	4.0	5.2	6.2	7.1		
57	4.3	6.7	8.9	10.6		

Compiled by: Melvin B. Satterwhite. Sheet No: RI-0001.
USAETL-RI-RSD.



Reflectance Spectra of Basalt.
Valley of Fire, Lincoln Co., NM; Sep. 1987.

Field Reflectance Spectra of Rock

Rock Type: Basalt Date Collected: 1 Sep 1987
Geomorphic Unit: Lava flow.
Spectrum No.: LJOR.76, .77, .78, .79.

Site Location: Valley of Fire, Lincoln Co., NM, USA.
33.7 deg. N Latitude; 105.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. A Halon reference standard was positioned horizontally using a bubble level.

Sample: Spectra were taken of two color types of the in situ rock surfaces at this sample site: a smooth, black surface (76, 77) and a smooth, brown surface (78, 79). Both were sunlit, air-dry surfaces and were representative of other basalt surfaces at the sample site.

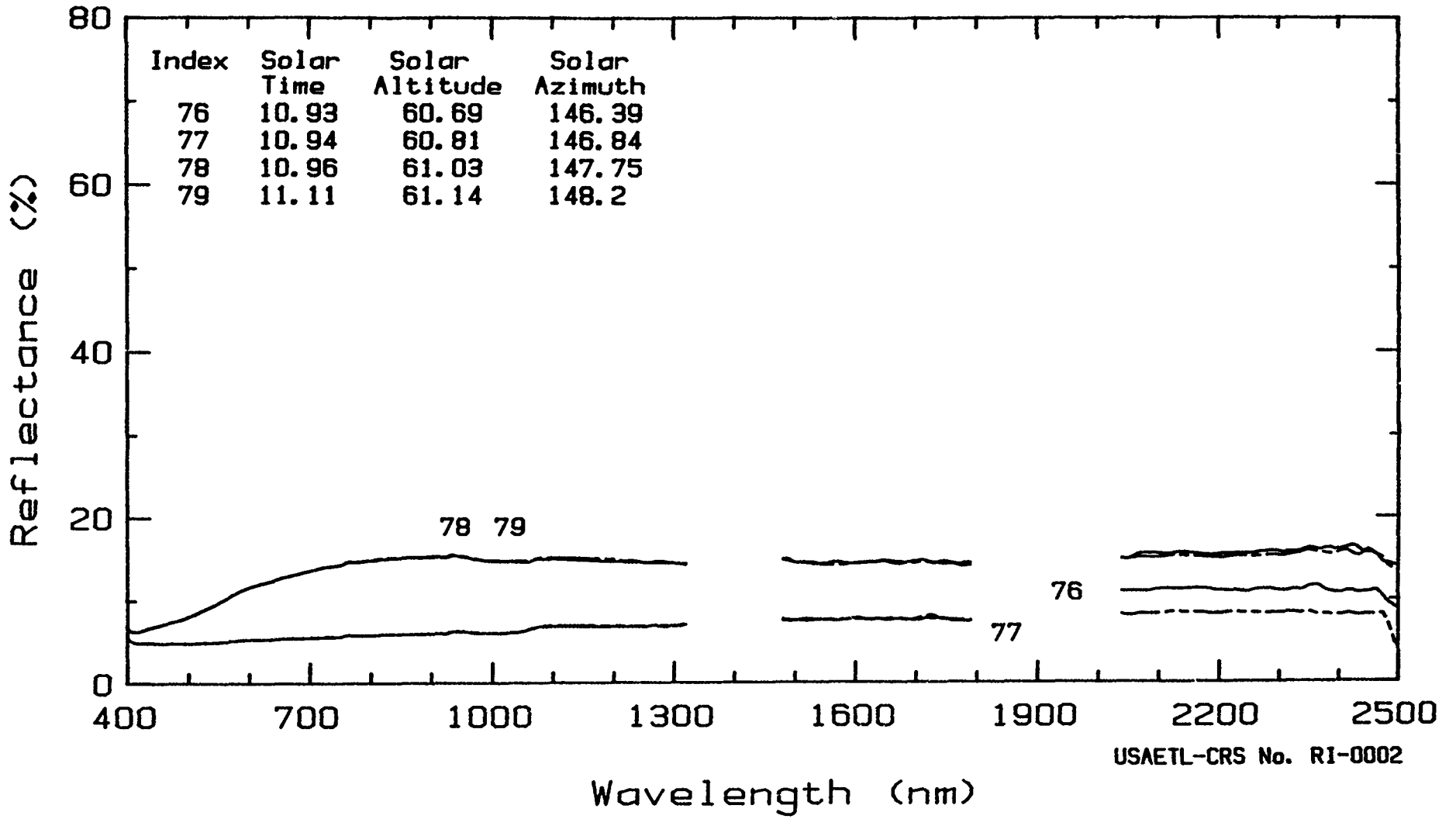
Composition and Physical Properties of Composite Sample.

Moisture Content: air dry.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
76	4.8	5.1	5.4	5.9	7.7	11.2
77	4.8	5.1	5.5	5.9	7.8	8.4
78	7.8	10.2	12.9	15.0	14.6	15.6
79	7.7	10.2	12.9	15.1	14.4	15.3

Compiled by: Melvin B. Satterwhite. Sheet No.: RI-0002.
USAETL-RI-RSD.



Reflectance Spectra of Basalt Rock.
Valley of Fire, Lincoln Co., NM; Sep, 1987.

Laboratory Reflectance Spectra of Rock

Rock Type: Leucogranite
Spectrum No.: JGR.75.
Date Collected: 2 Jun 1988
Sample No.: JE-0402

Site Location: Split Rock, Sweetwater Co., WY, USA.
42.5 deg. N Latitude; 107.4 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum of the "fresh" (75) surface on the rock sample was measured. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

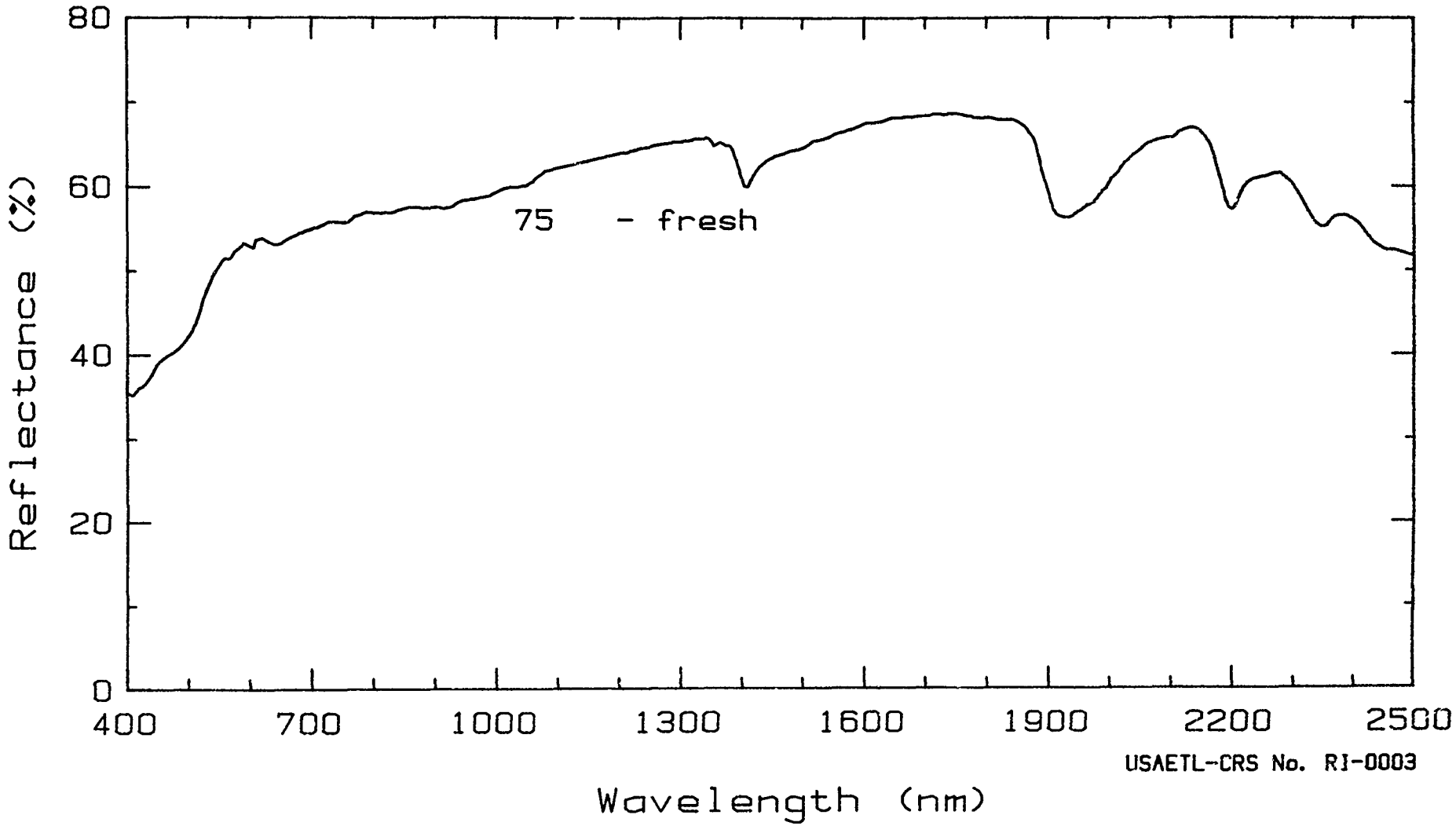
Composition: 35.9% quartz, 28.3% plagioclase, 44.1% K-feldspar, 0.8% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990, USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
75	41.4	50.6	53.8	57.1	67.9	61.6

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0003.



Reflectance Spectra of Leucogranite.
Split Rock, Sweetwater Co., WY; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Leucogranite
Spectrum No.: JGR.72, .73.
Date Collected: 2 Jun 1988
Sample No.: JE-0401

Site Location: Split Rock, Sweetwater Co., WY, USA.
42.5 deg. N Latitude; 107.4 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (73) and the weathered (72) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 32.3% quartz, 28.3% plagioclase, 40.4% K-feldspar, 3.1% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
72	12.7	17.2	22.3	28.4	44.2	38.2
73	38.5	48.3	53.3	56.2	68.2	60.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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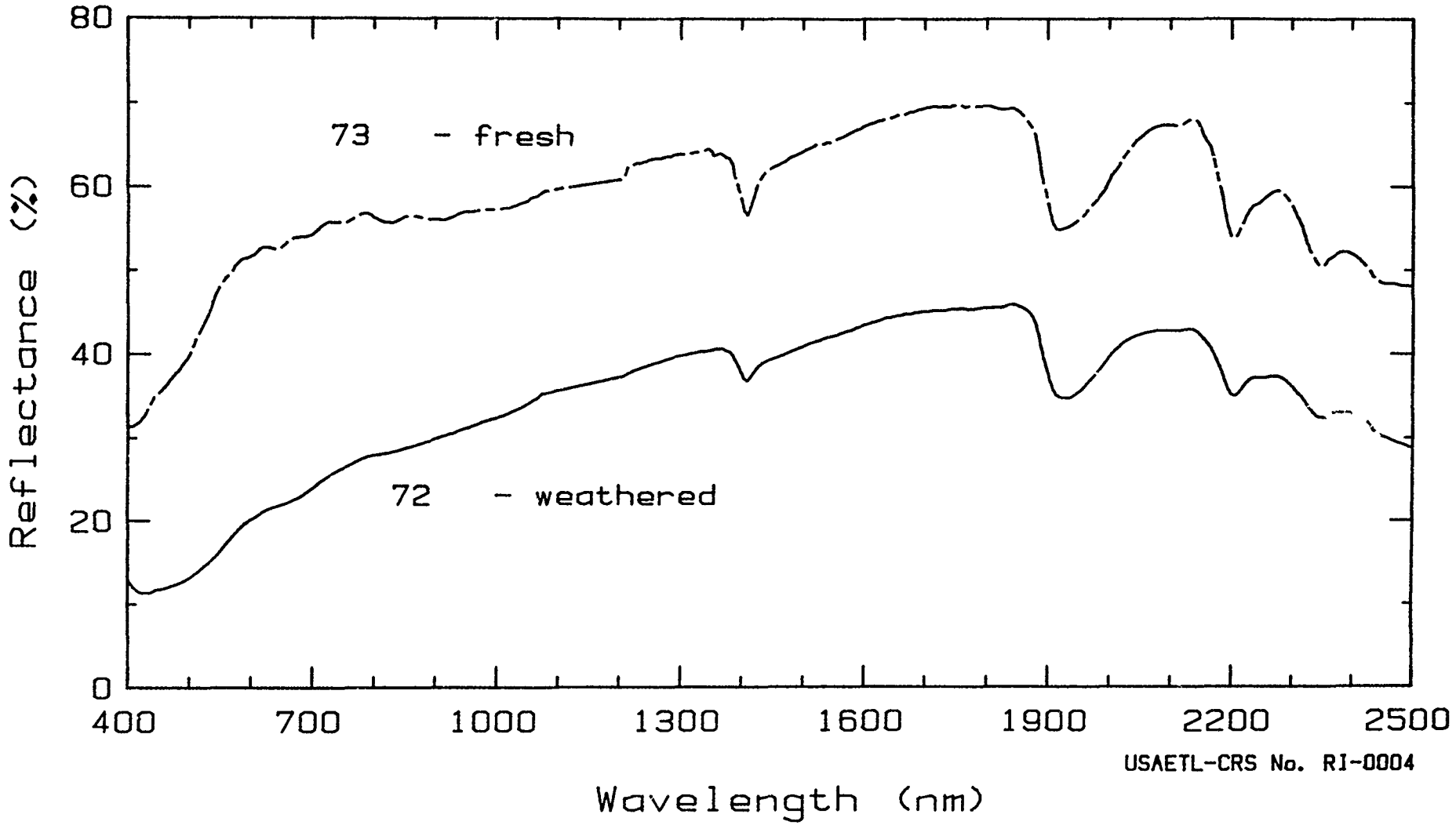


Reflectance Spectra of Leucogranite.
Split Rock, Sweetwater Co., WY; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.69, .70.

Date Collected: 2 Jun 1988
Sample No.: JE-0406

Site Location: Split Rock, Sweetwater Co., WY, USA.
42.5 deg. N Latitude; 107.4 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (70) and the weathered (69) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 34.7% quartz, 35.3% plagioclase, 26.5% K-feldspar, 3.6% dark & other minerals.

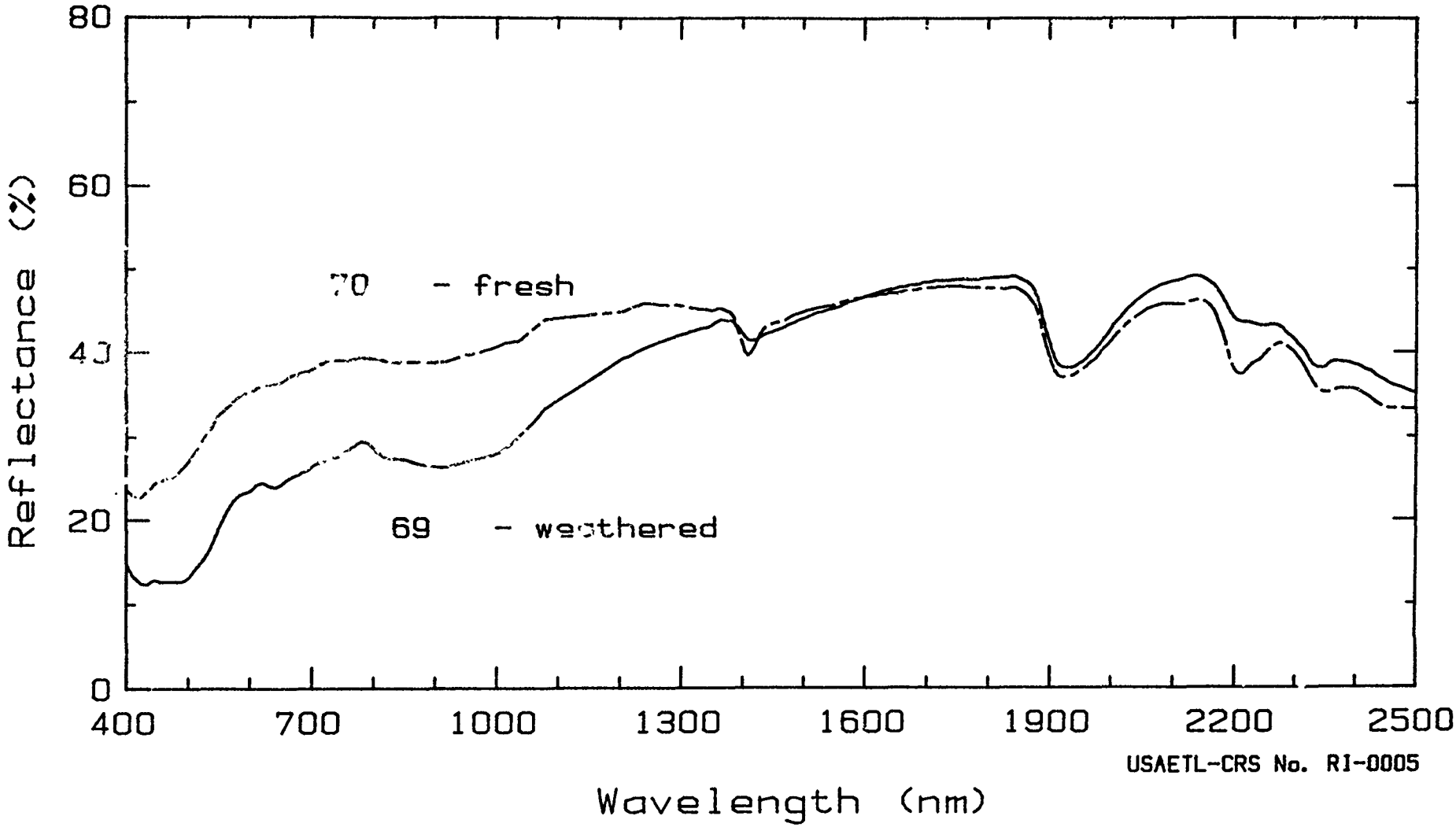
Ref: 1/. Enlen and Zen, 1985. J. Geol. 94:575-584.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
69	13.1	19.8	24.7	27.6	47.5	44.5
70	26.1	32.7	36.9	39.0	47.2	41.3

Compiled by: J. Ponder Henley.
USAETL-RI-CRS.

Sheet No.: RI-0005.



Reflectance Spectra of Granite.
Split Rock, Sweetwater Co., WY; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Gabbronorite
Spectrum No.: JGR.40.

Date Collected: 2 Jun 1988
Sample No.: JE-505-x

Site Location: Stillwater Complex, Stillwater Co., MT, USA.
42.4 deg. N Latitude; 109.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (40) surface on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 65.6% plagioclase, 27.2% orthopyroxene, 7.2% clinopyroxene 2/

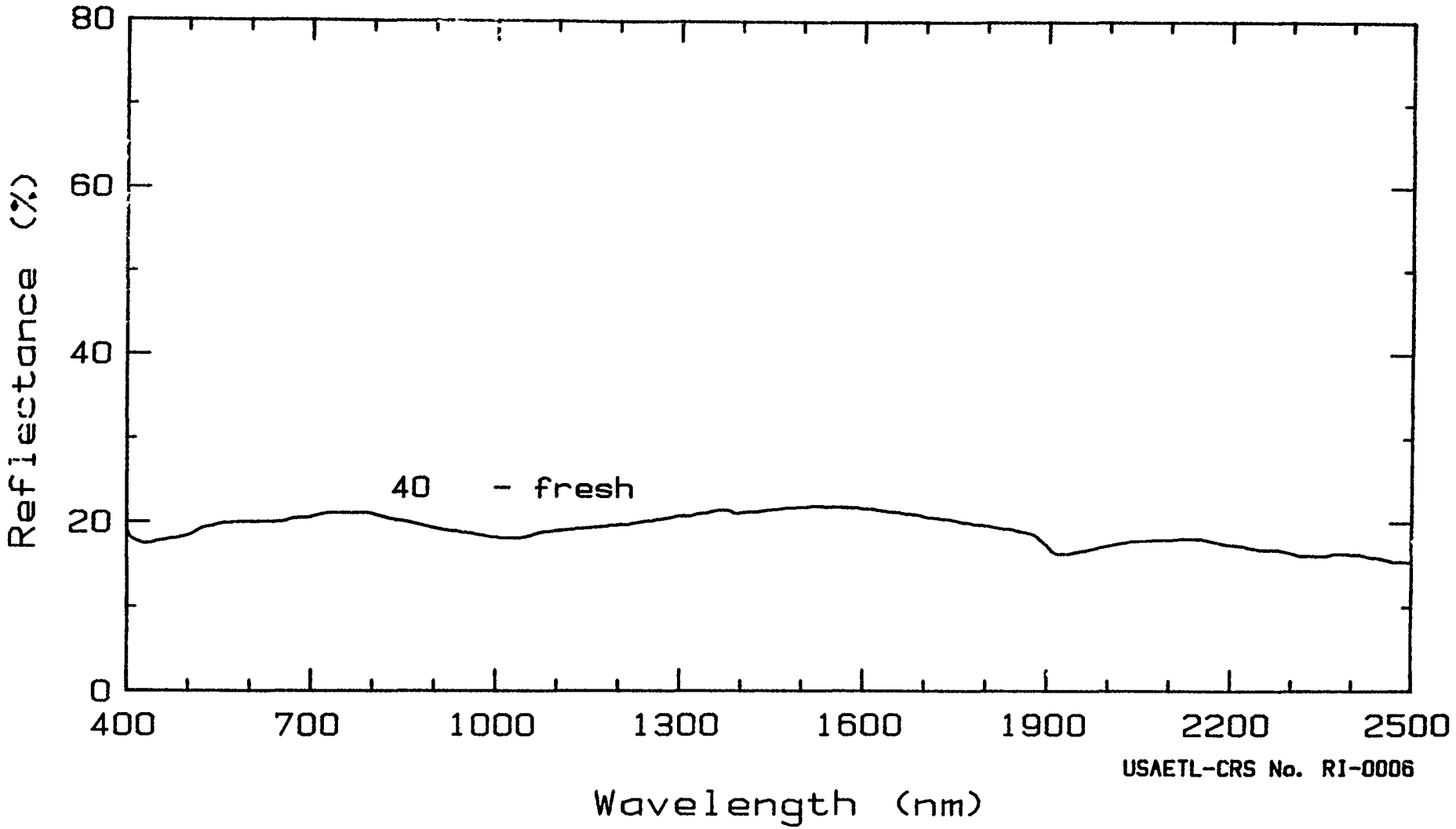
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
40	18.3	19.8	20.3	20.4	21.1	17.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0006.



Reflectance Spectra of Gabbronorite
Stillwater Complex, Stillwater Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.37, .38.
Date Collected: 2 Jun 1988
Sample No.: JE-0504

Site Location: Stillwater Complex, Stillwater Co., MT, USA.
45.4 deg. N Latitude; 109.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (38) and the weathered (37) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 30.4% quartz, 36.3% plagioclase, 15.6% K-feldspar, 17.7% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
37	14.8	17.4	19.8	21.5	29.6	31.2
38	22.6	25.2	26.6	27.0	31.7	32.3

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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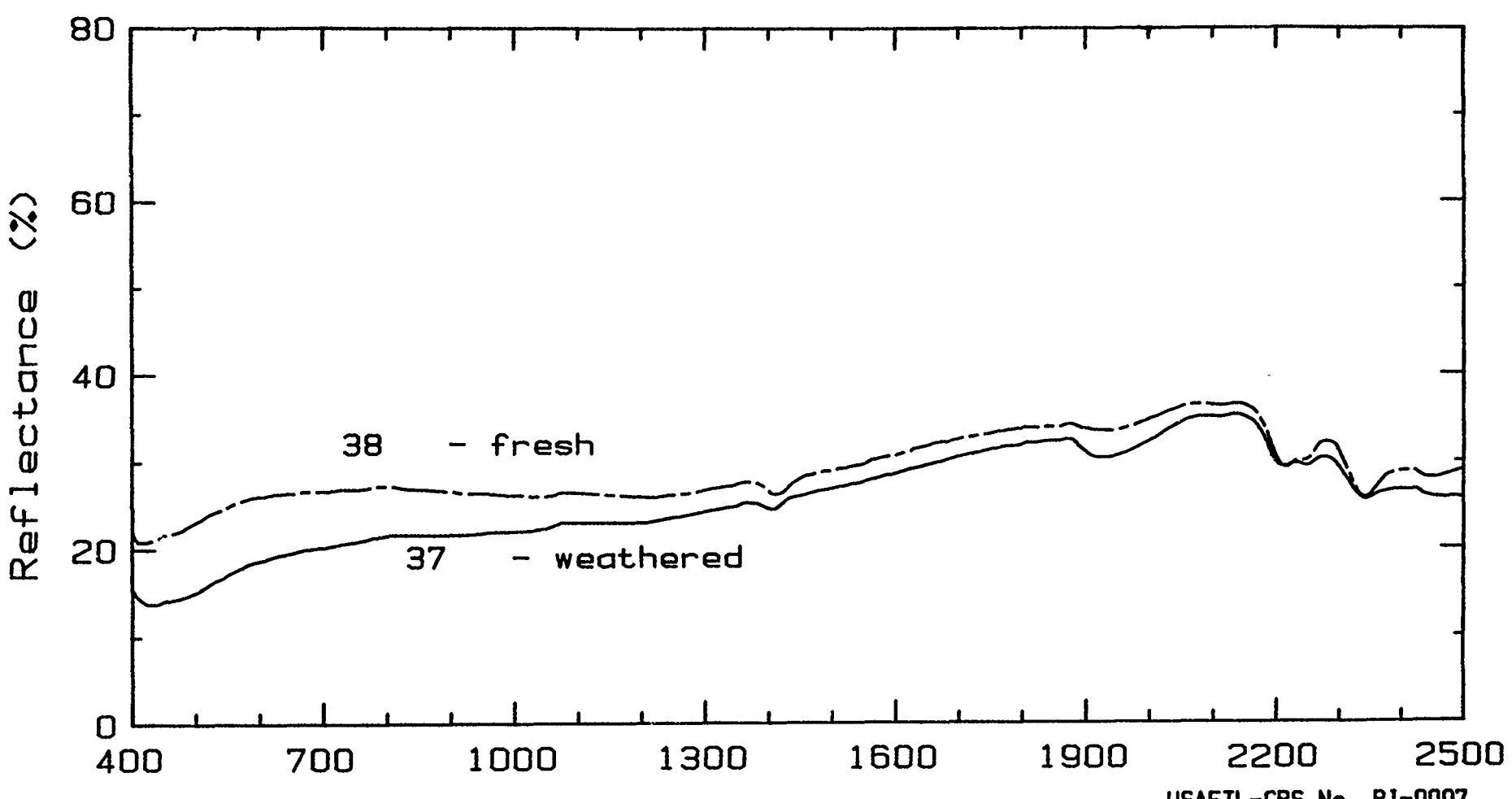


Reflectance Spectra of Granodiorite.
Stillwater Complex, Stillwater Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Anorthosite
Spectrum No.: JGR.34, .35.
Date Collected: 2 Jun 1988
Sample No.: JE-0508

Site Location: Stillwater Complex, Stillwater Co., MT, USA.
45.4 deg. N Latitude; 109.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (35) and the weathered (34) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

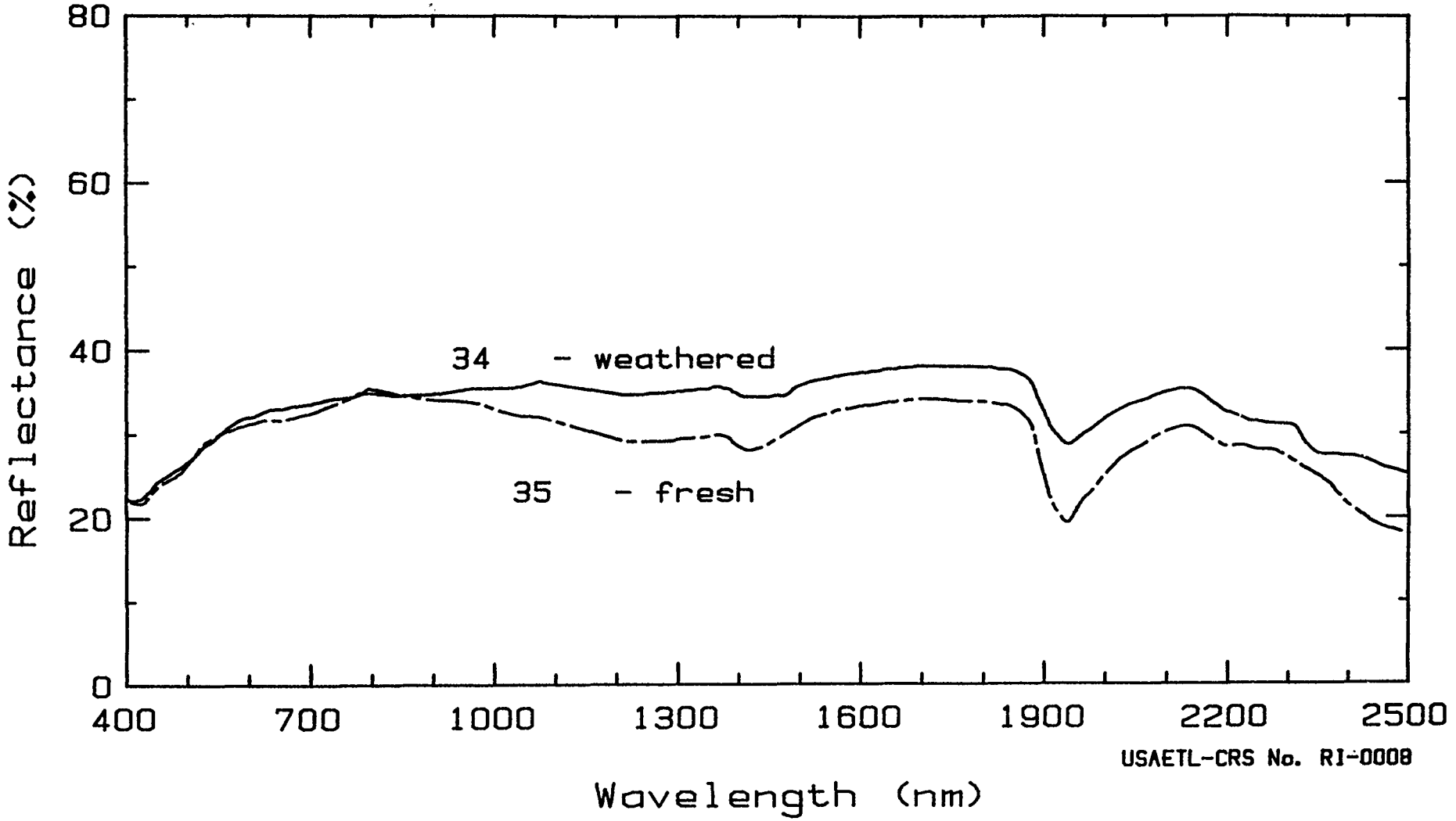
Composition: 87.6% plagioclase, 11.2% orthopyroxens, 1.2% clinopyroxene 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990, USGS Open File Report 90-48.E

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
34	26.0	30.3	33.2	34.7	37.7	32.4
35	25.6	30.1	31.9	34.7	33.7	28.5

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0008.



Reflectance Spectra of Anorthosite.
Stillwater Complex, Stillwater Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Gabbronorite
Spectrum No.: JGR.31, .32.
Date Collected: 2 Jun 1988
Sample No.: JE-0505-5

Site Location: Stillwater Complex, Stillwater Co., MT, USA.
45.4 deg. N Latitude; 109.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (32) and the weathered (31) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

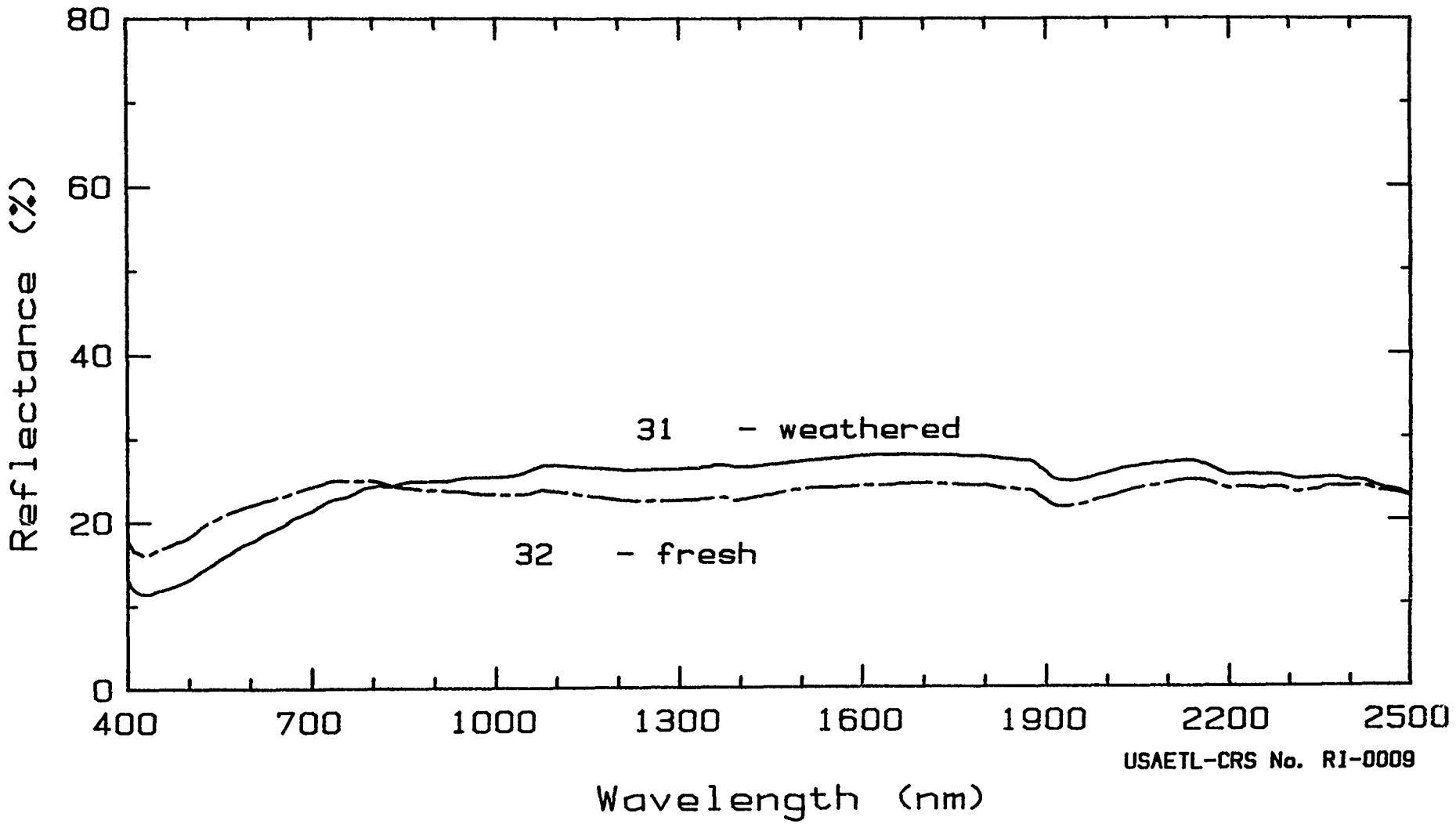
Composition: 65.6% plagioclase, 27.2% orthopyroxene, 7.2% clinopyroxene 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
31	12.8	15.9	19.9	24.4	27.9	25.9
32	17.8	20.8	23.3	24.4	24.3	24.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0009.



Reflectance Spectra of Gabbronorite
Stillwater Complex, Stillwater Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Anorthosite
Spectrum No.: JGR.28, .29.
Date Collected: 2 Jun 1988
Sample No.: JE-0506

Site Location: Stillwater Complex, Stillwater Co., MT, USA.
45.4 deg. N Latitude; 109.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (29) and the weathered (28) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

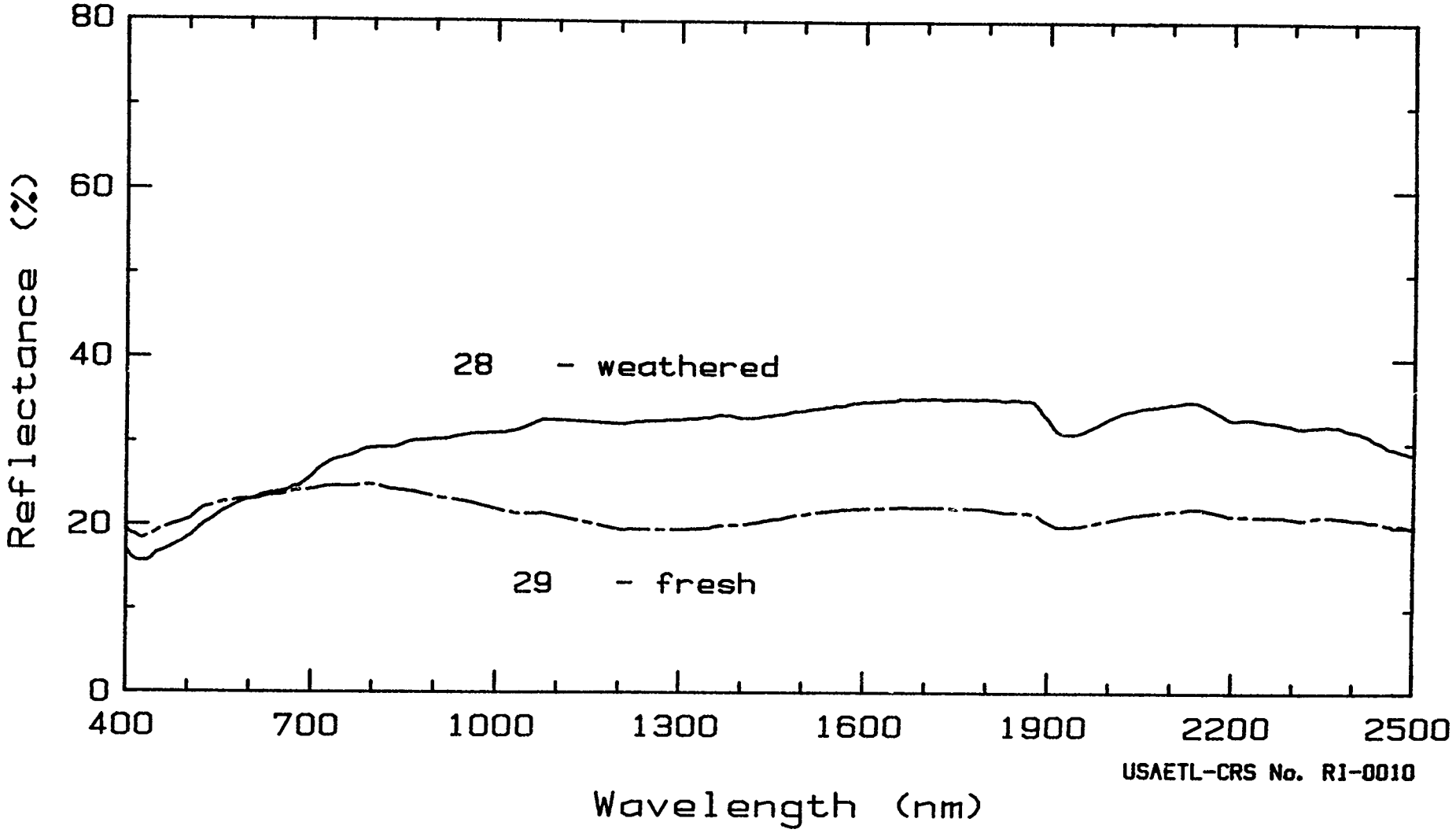
Composition: 76.9% plagioclase, 14.8% orthopyroxene, 8.3% clinopyroxene 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen. 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
28	17.9	21.6	24.3	29.5	35.0	33.2
29	20.3	22.6	23.8	24.3	22.1	21.4

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0010.



Reflectance Spectra of Anorthosite.
Stillwater Complex, Stillwater Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.01, .02.

Date Collected: 2 Jun 1988
Sample No.: JE-0615

Site Location: Dartmoor, Devonshire, England.
50.5 deg. N Latitude; 3.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (2) and the weathered (1) surfaces on the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 38% quartz, 9.4% plagioclase, 38.2% K-feldspar, 9.4% tourmaline, 4.9% other minerals 2/

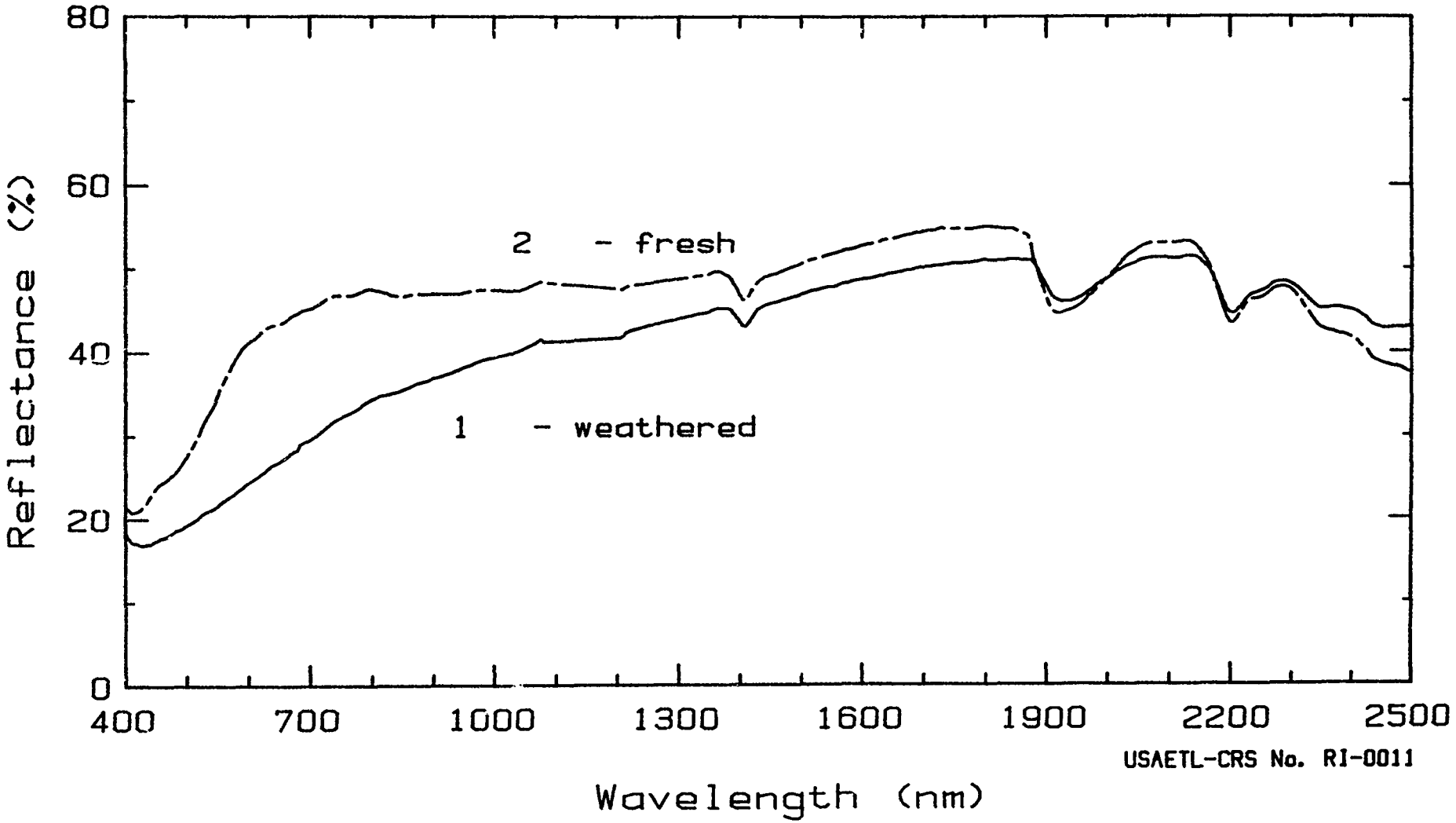
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen. 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 550-750 nm	Band 7 2080-2350 nm
1	18.7	22.2	27.4	35.0	49.4	48.2
2	26.3	36.1	43.9	47.0	53.5	48.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0011.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.04, .05.

Date Collected: 2 Jun 1988
Sample No.: JE-0619/20

Site Location: Dartmoor, Devonshire, England.
50.5 deg. N Latitude; 3.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel t>ta, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (5) and the weathered surface with some crustose lichen (4) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 39.2% quartz, 18.1% plagioclase, 30.8% K-feldspar, 14.7% tourmaline, 7.2% other minerals 2/

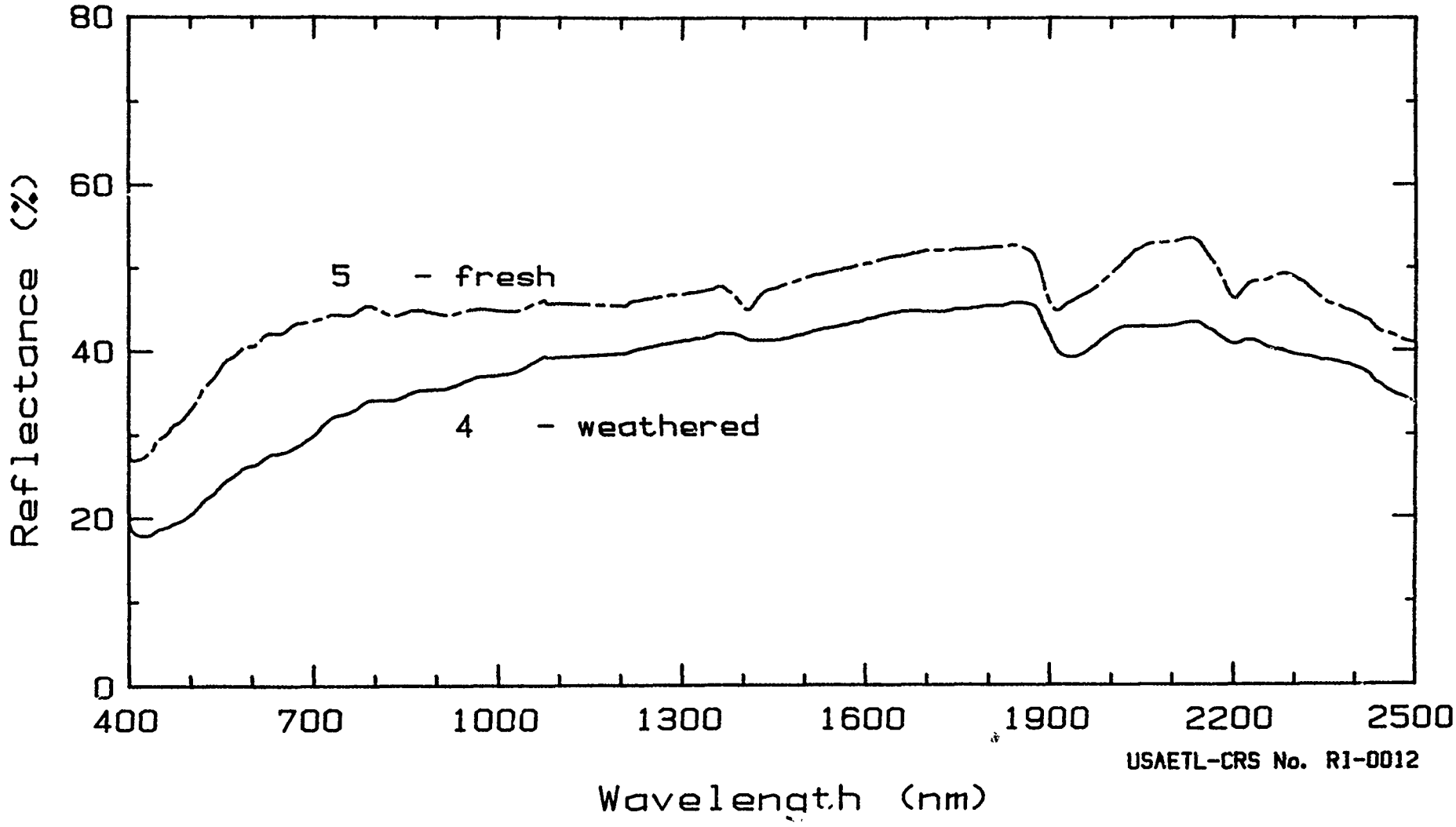
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
4	19.9	24.3	28.3	34.4	44.3	41.2
5	31.9	38.4	42.7	44.8	51.3	49.7

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0012.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.13, .14.
Date Collected: 2 Jun 1988
Sample No.: JE-0613

Site Location: Dartmoor, Devonshire, England.
50.6 deg. N Latitude; 3.7 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (14) and the weathered surfaces (13) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

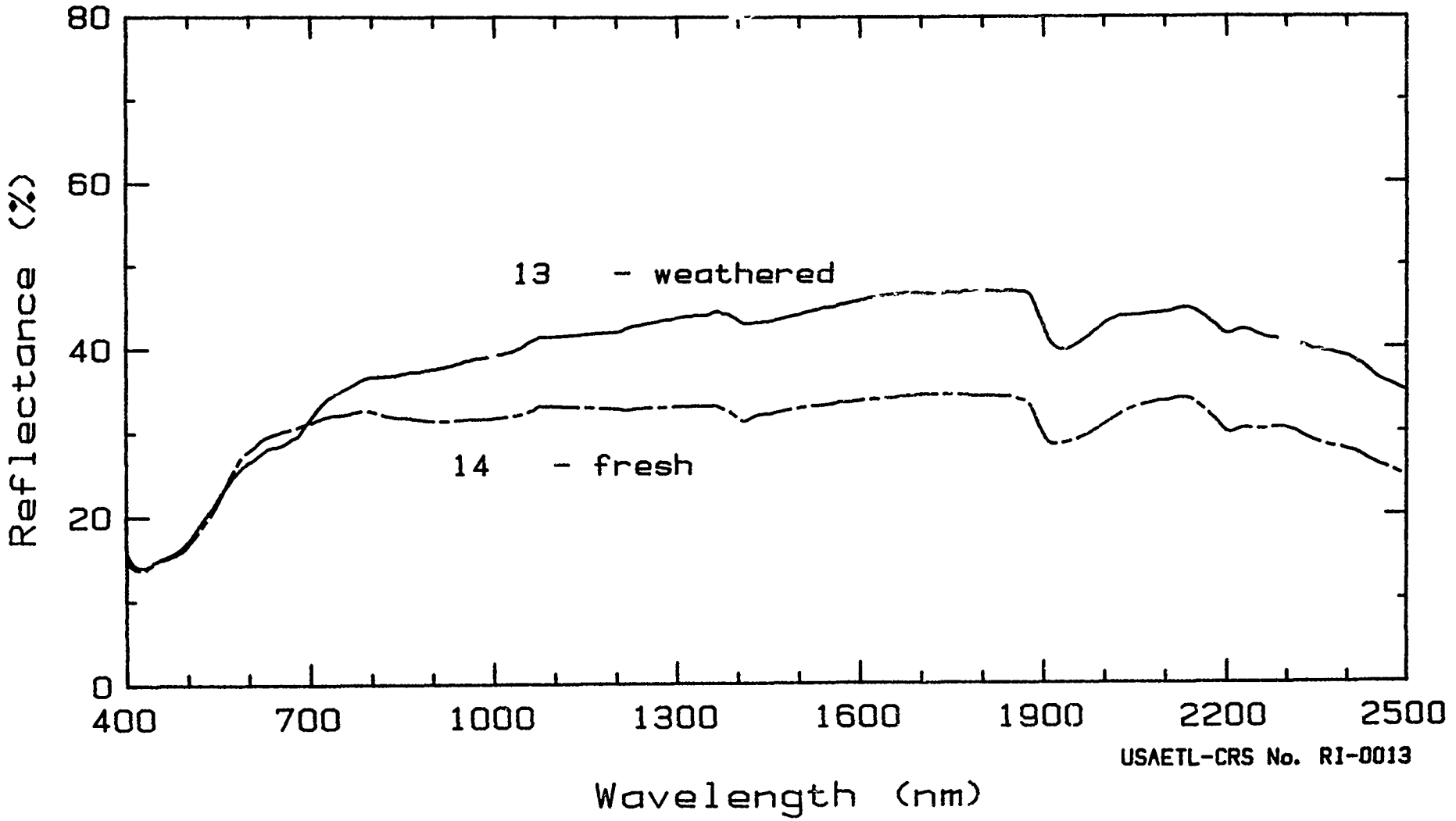
Composition: 31.2% quartz, 17.5% plagioclase, 31.7% K-feldspar, 12.3% tourmaline, 7.3% other minerals 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
13	16.3	23.0	29.0	36.8	46.2	42.3
14	16.0	23.2	30.2	32.0	34.0	31.3

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0013.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.10, .11.
Date Collected: 2 Jun 1988
Sample No.: JE-0632

Site Location: Dartmoor, Devonshire, England.
50.6 deg. N Latitude; 3.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (11) and the weathered surfaces (10) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 34% quartz, 20.2% plagioclase, 31.1% K-feldspar, 11.1% tourmaline, 3.6% other minerals 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen. 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
10	16.2	18.9	22.2	25.6	43.7	42.0
11	18.6	26.1	31.7	36.0	42.5	39.0

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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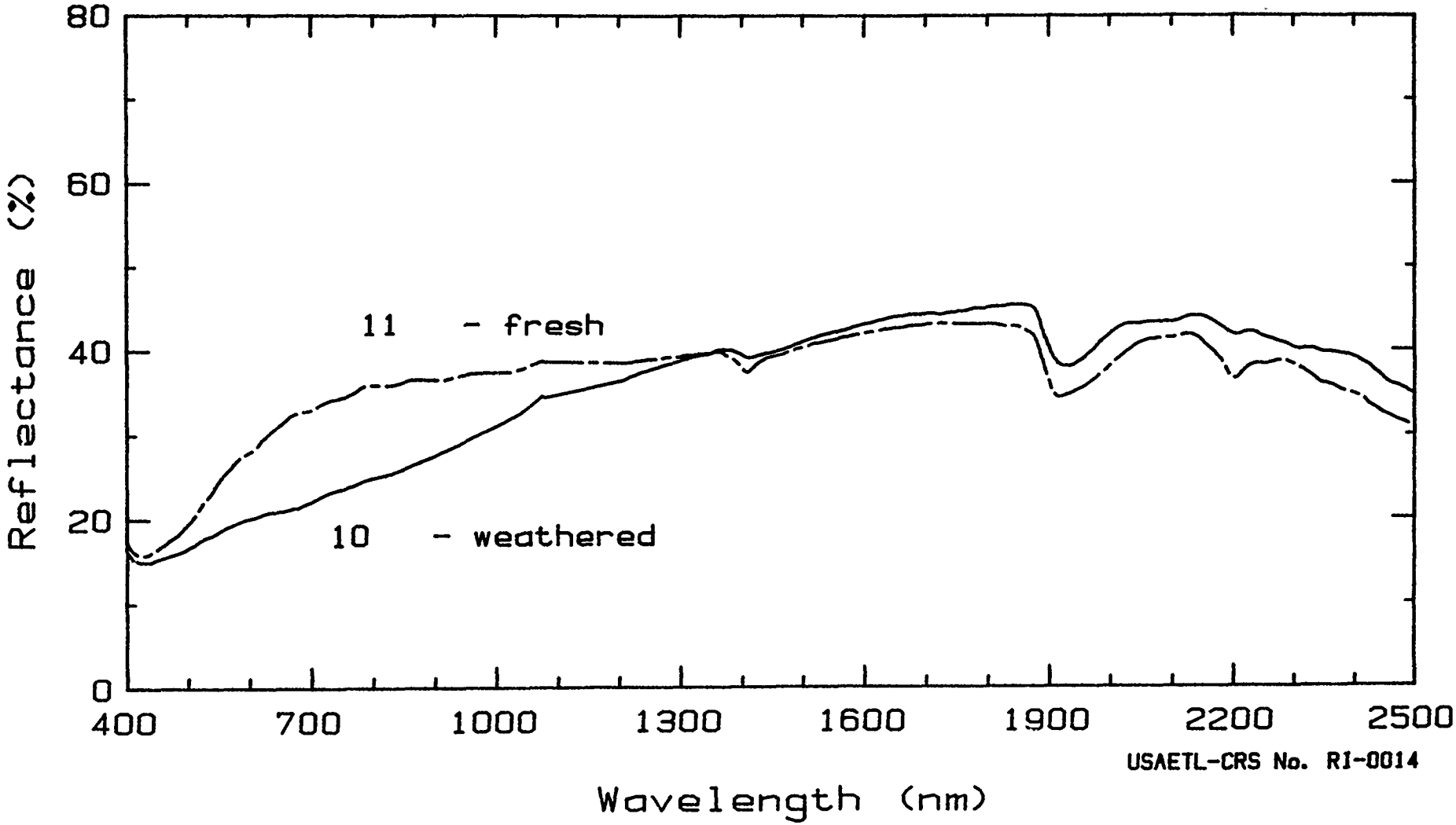


Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.16, .17.
Date Collected: 2 Jun 1988
Sample No.: JE-0632

Site Location: Dartmoor, Devonshire, England.
50.7 deg. N Latitude; 4.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (17) and the weathered surfaces (16) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

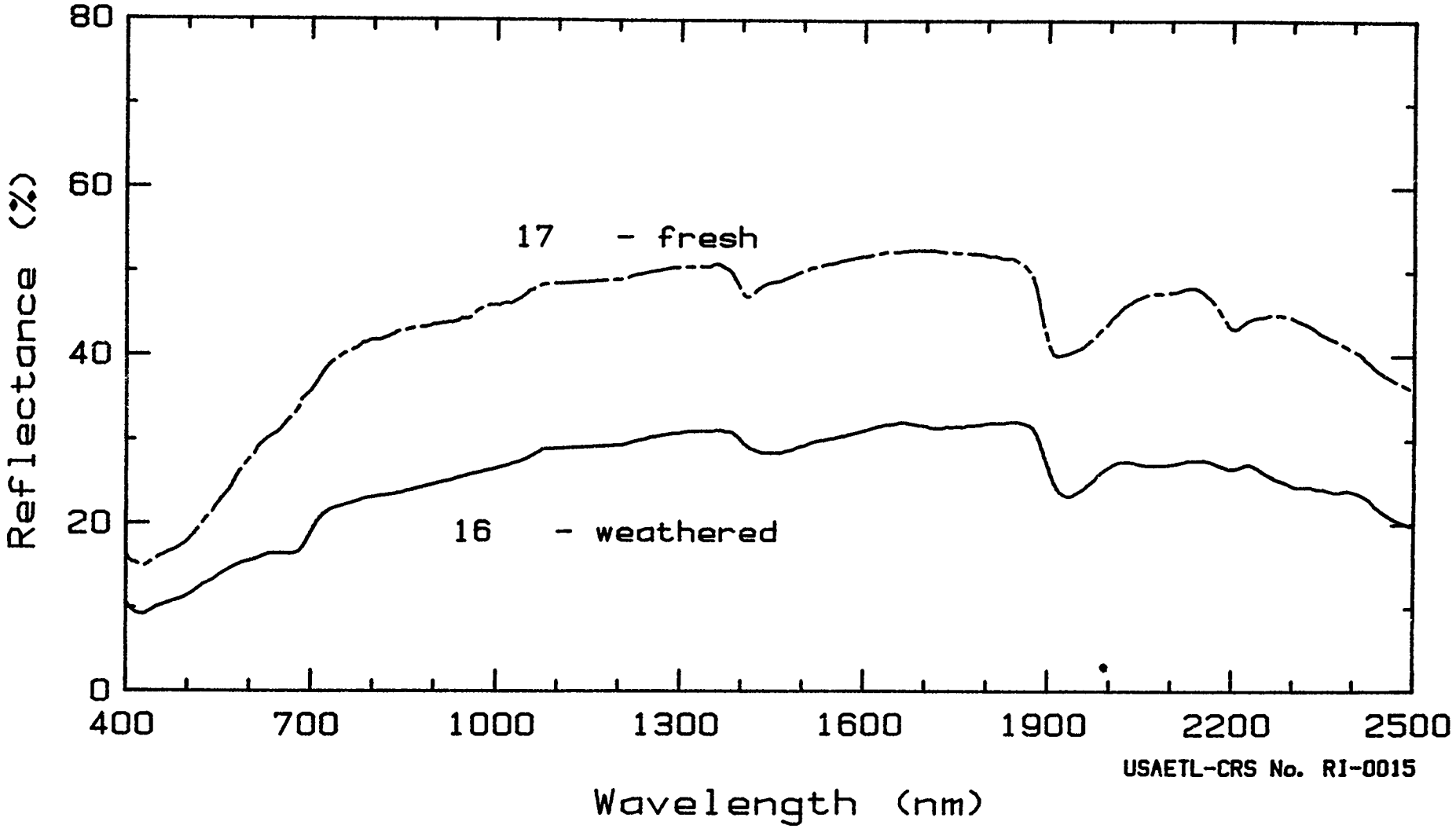
Composition: 37.9% quartz, 18.1% plagioclase, 39.6% K-feldspar, 3.1% mica, 1.3% tourmaline 2/

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
16	11.0	14.2	16.6	23.6	31.4	26.2
17	17.4	23.5	32.2	42.3	52.1	45.3

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0015.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England: June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.19, .20.
Date Collected: 2 Jun 1988
Sample No.: JE-0634

Site Location: Dartmoor, Devonshire, England.
50.6 deg. N Latitude; 3.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (20) and the weathered surfaces (19) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 29.3% quartz, 25.1% plagioclase, 23.2% K-feldspar, 14.2% tourmaline, 8.2% other 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
19	14.7	18.4	22.2	31.2	37.4	34.3
20	24.4	29.8	34.0	38.0	43.0	39.5

Compiled by: J. Ponder Henley.
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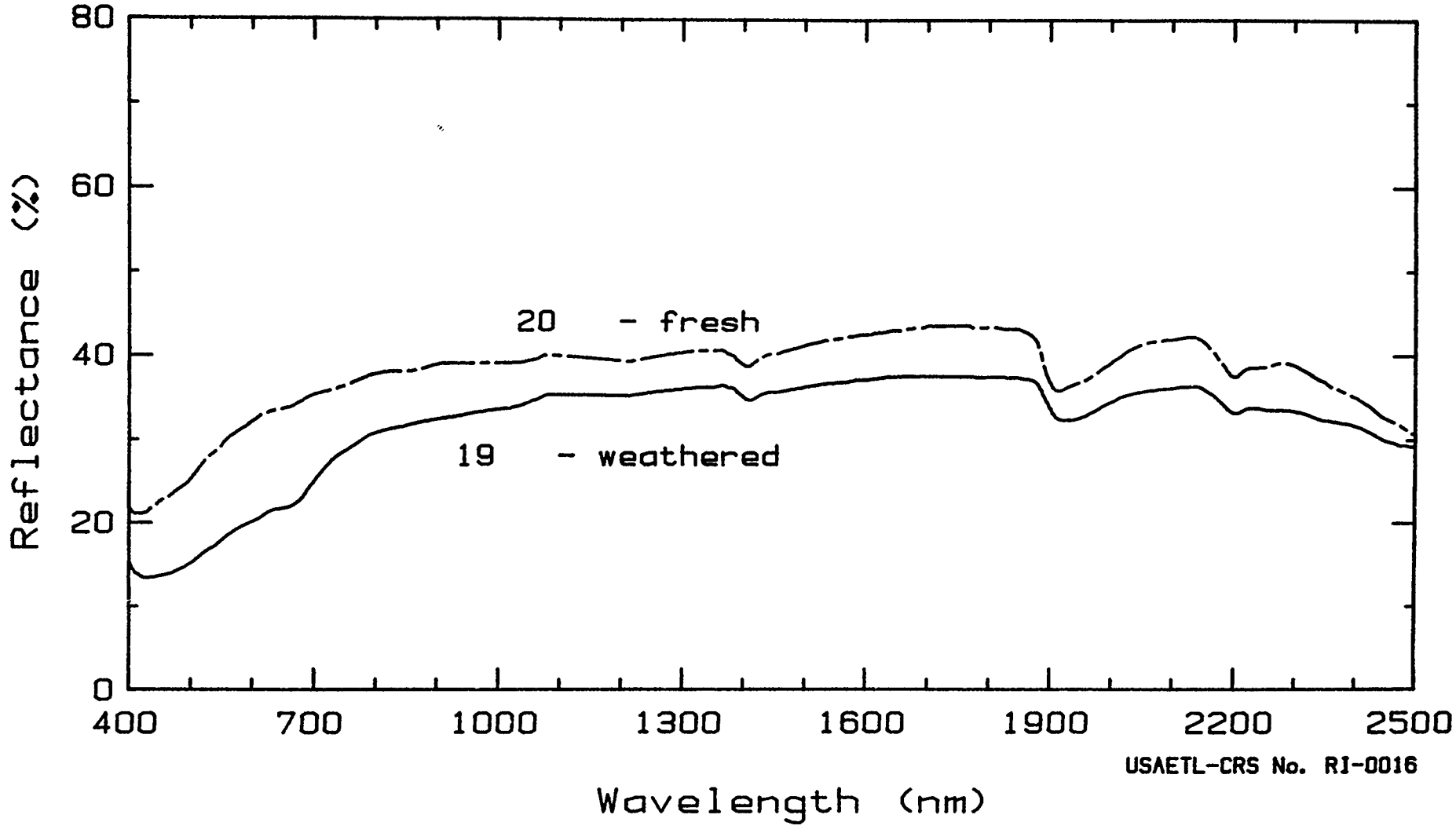


Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.22, .23.
Date Collected: 2 Jun 1988
Sample No.: JE-0654

Site Location: Dartmoor, Devonshire, England.
50.5 deg. N Latitude; 4.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" surface (23) and the weathered surface with dark toned crustose lichen (22) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

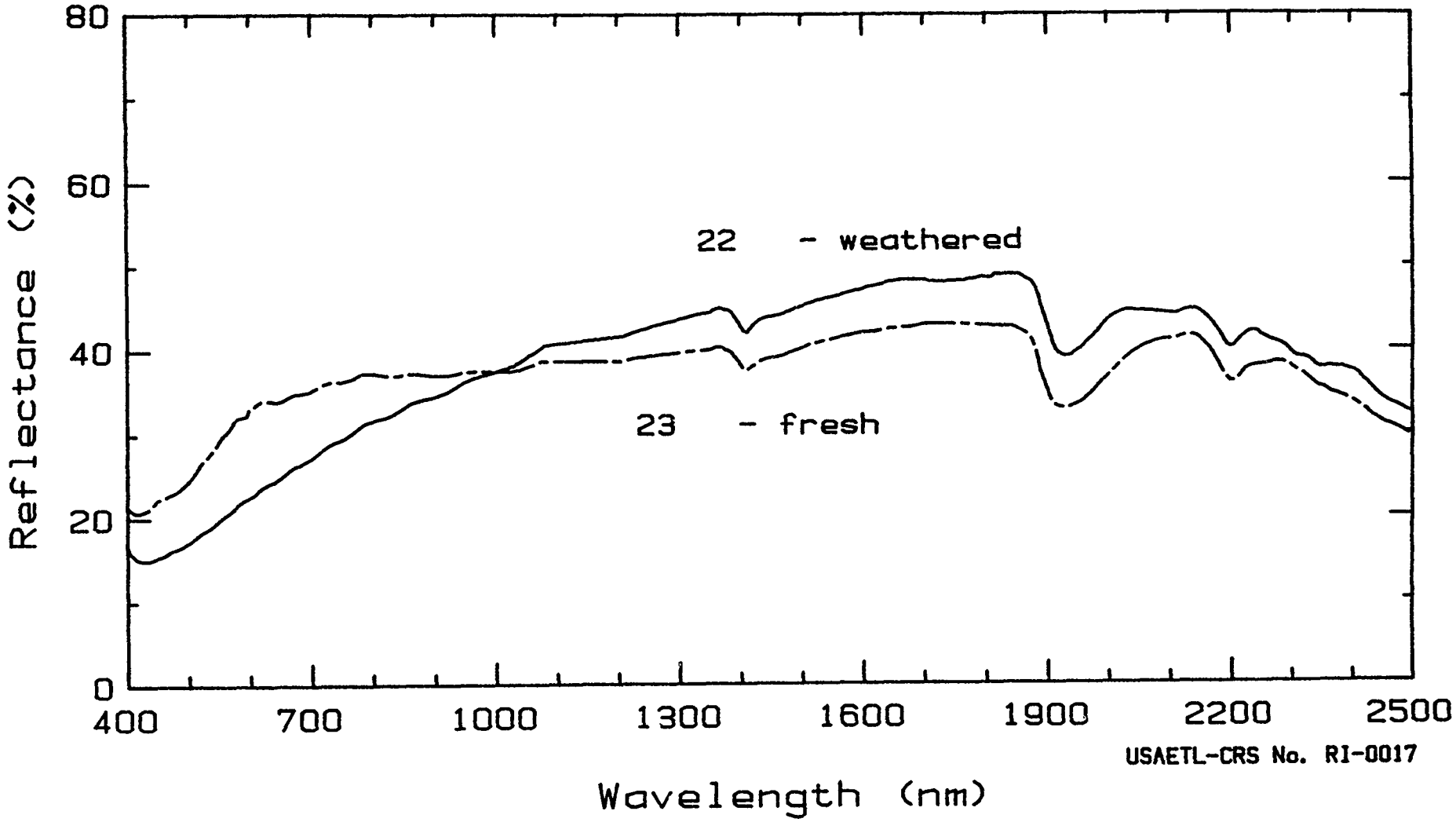
Composition: 30.7% quartz, 17.7% plagioclase, 29.7% K-feldspar, 10.4% tourmaline, 11.5% other 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
22	16.7	20.4	25.5	32.5	47.8	41.7
23	23.9	30.0	34.5	37.1	42.5	38.6

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0017.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.25, .26.
Date Collected: 2 Jun 1988
Sample No.: JE-0647

Site Location: Dartmoor, Devonshire, England.
50.6 deg. N Latitude; 4.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (26) and the weathered surfaces (25) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 33.5% quartz, 16.1% plagioclase, 33.5% K-feldspar, 12.5% tourmaline, 4.3% other 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
25	17.0	19.4	23.9	29.4	37.4	37.2
26	27.4	35.0	39.9	43.4	49.7	46.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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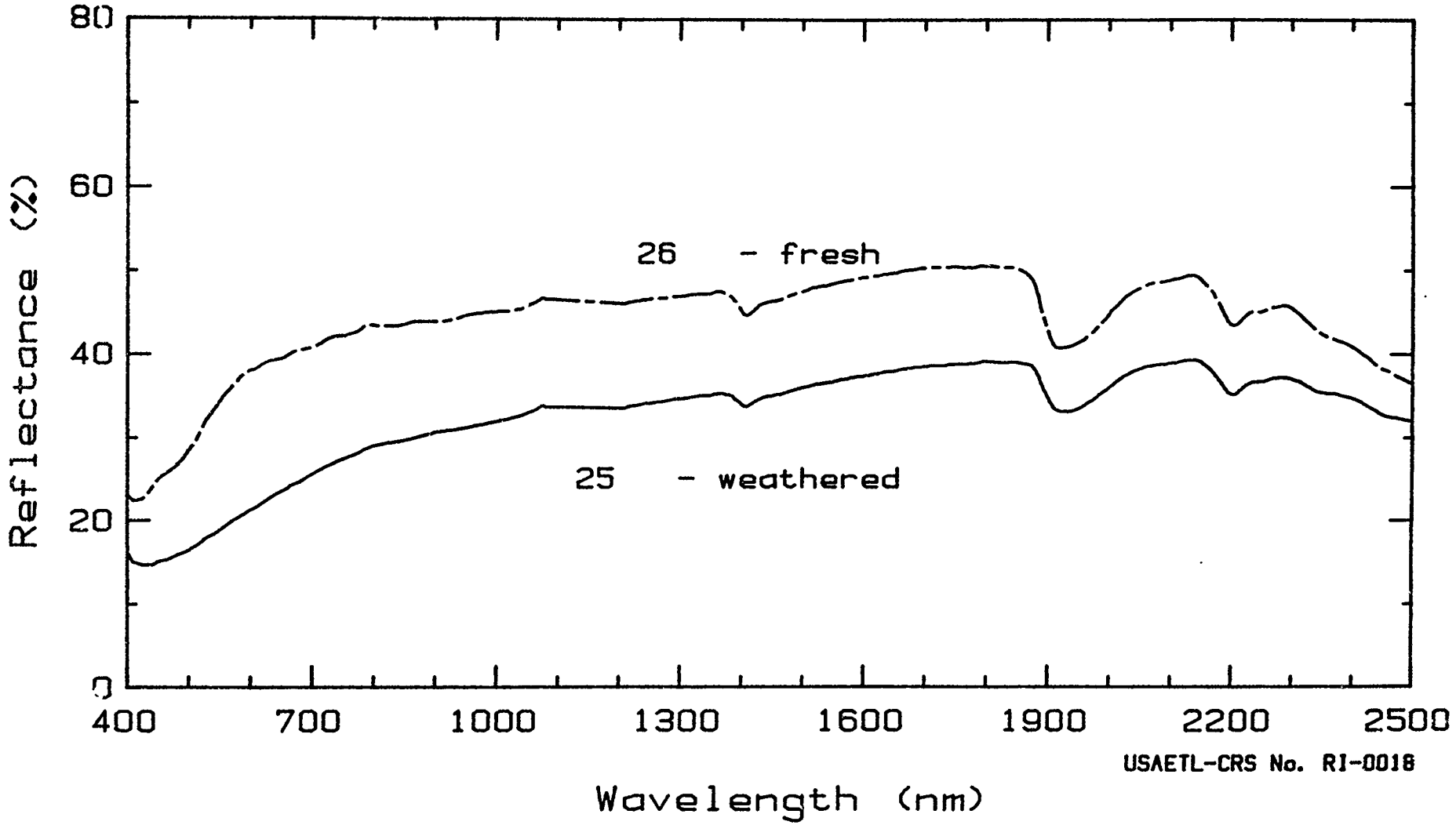

Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.07, .08.
Date Collected: 2 Jun 1988
Sample No.: JE-0657

Site Location: Dartmoor, Devonshire, England.
50.6 deg. N Latitude; 4.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (8) and the weathered surfaces (7) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 37.2% quartz, 14.1% plagioclase, 38.7% K-feldspar, 4.3% tourmaline, 5.7% other 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
7	13.1	16.6	23.5	34.3	47.3	40.9
8	17.6	27.3	37.2	40.9	48.7	43.4

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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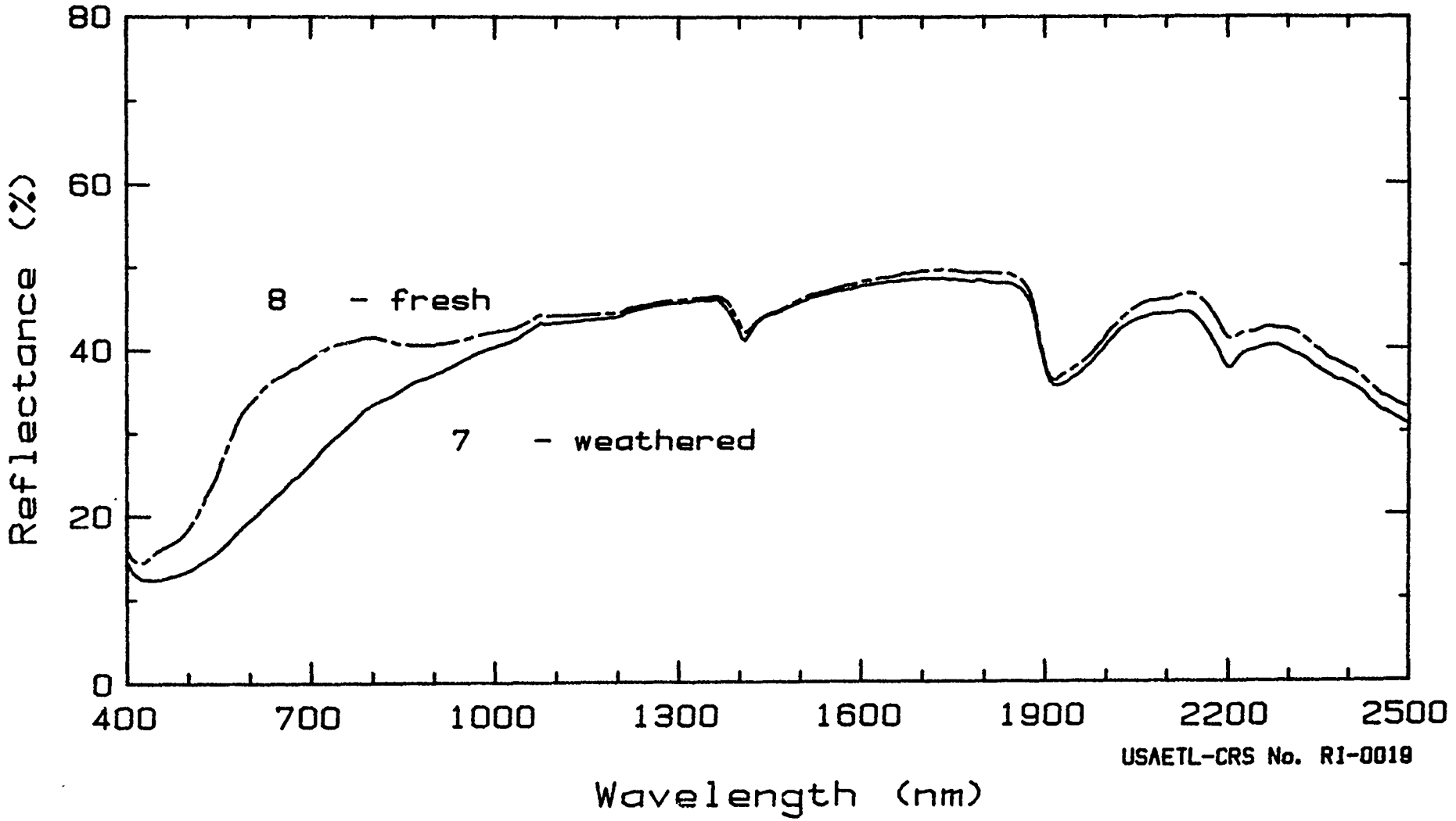

Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.77, .78.
Date Collected: 2 Jun 1988
Sample No.: JE-0631

Site Location: Dartmoor, Devonshire, England.
50.5 deg. N Latitude; 4.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (78) and the weathered surfaces (77) of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 30.7% quartz, 25.7% plagioclase, 30.0% K-feldspar, 5.5% tourmalene, 8.4% other 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
77	11.6	14.5	19.8	27.2	41.1	35.6
78	19.9	24.2	32.2	34.8	43.3	35.6

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
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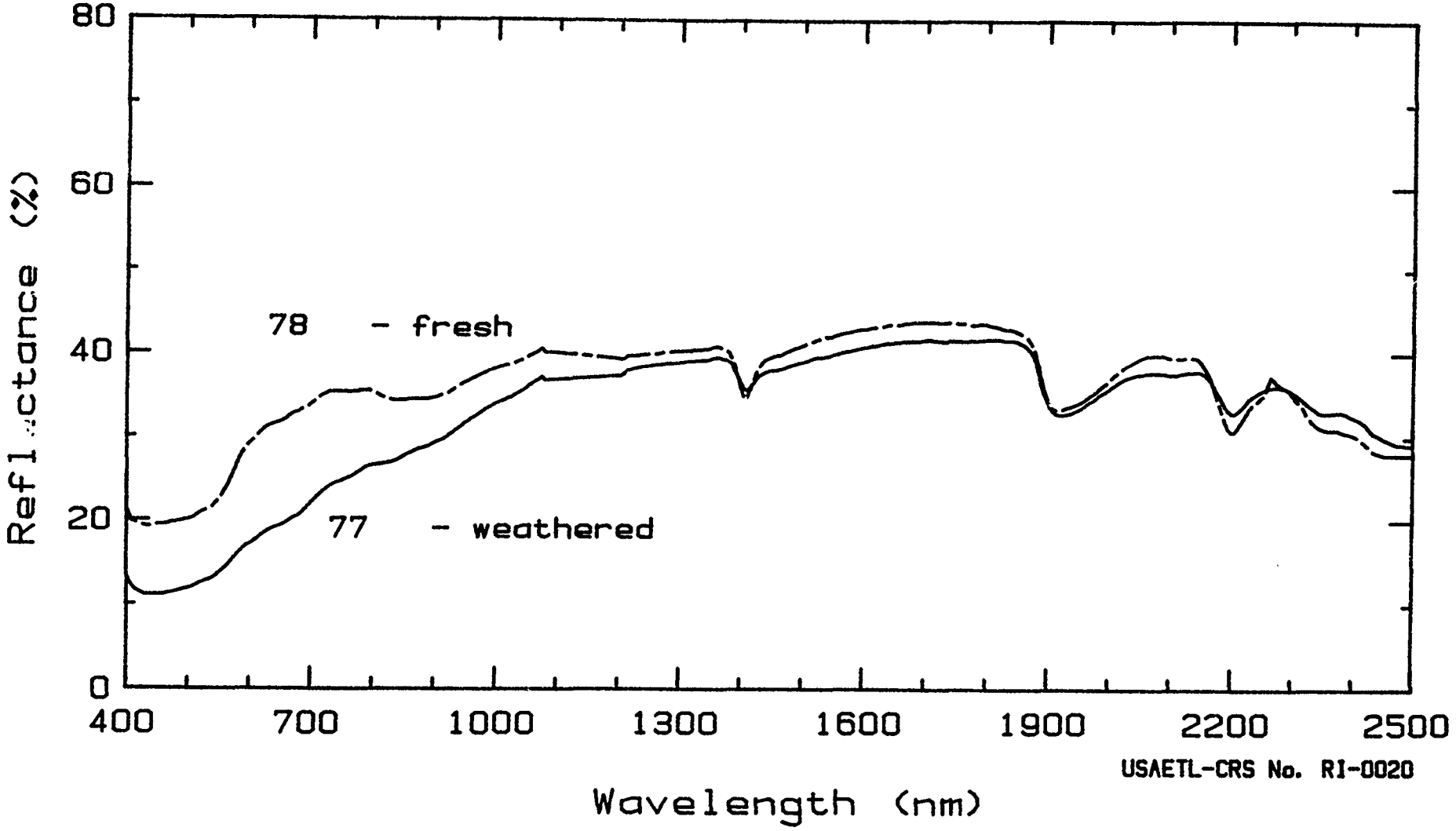


Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.60.

Date Collected: 2 Jun 1988
Sample No.: JE-0124

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 112.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (60) rock surface. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 23.1% quartz, 32.7% plagioclase, 26.2% K-feldspar, 18% dark & other minerals ?/.

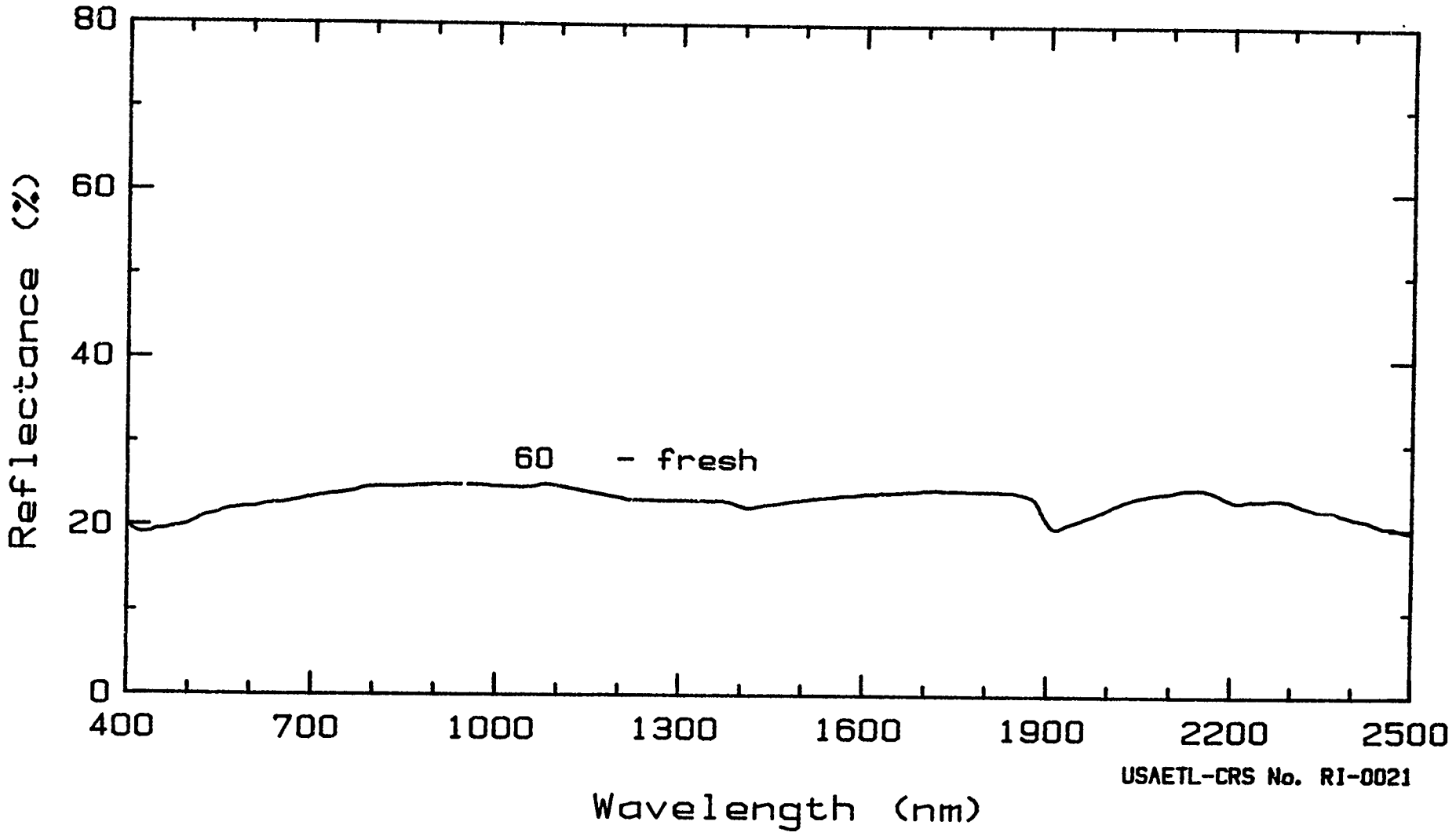
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
60	20.0	21.8	22.9	24.7	24.2	23.6

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No: RI-0021.



Reflectance Spectra of Granite.
Dartmoor, County Devon, England; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.42, .43.
Date Collected: 2 Jun 1988
Sample No.: JE-0134

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 112.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (43) and the weathered (42) surfaces of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

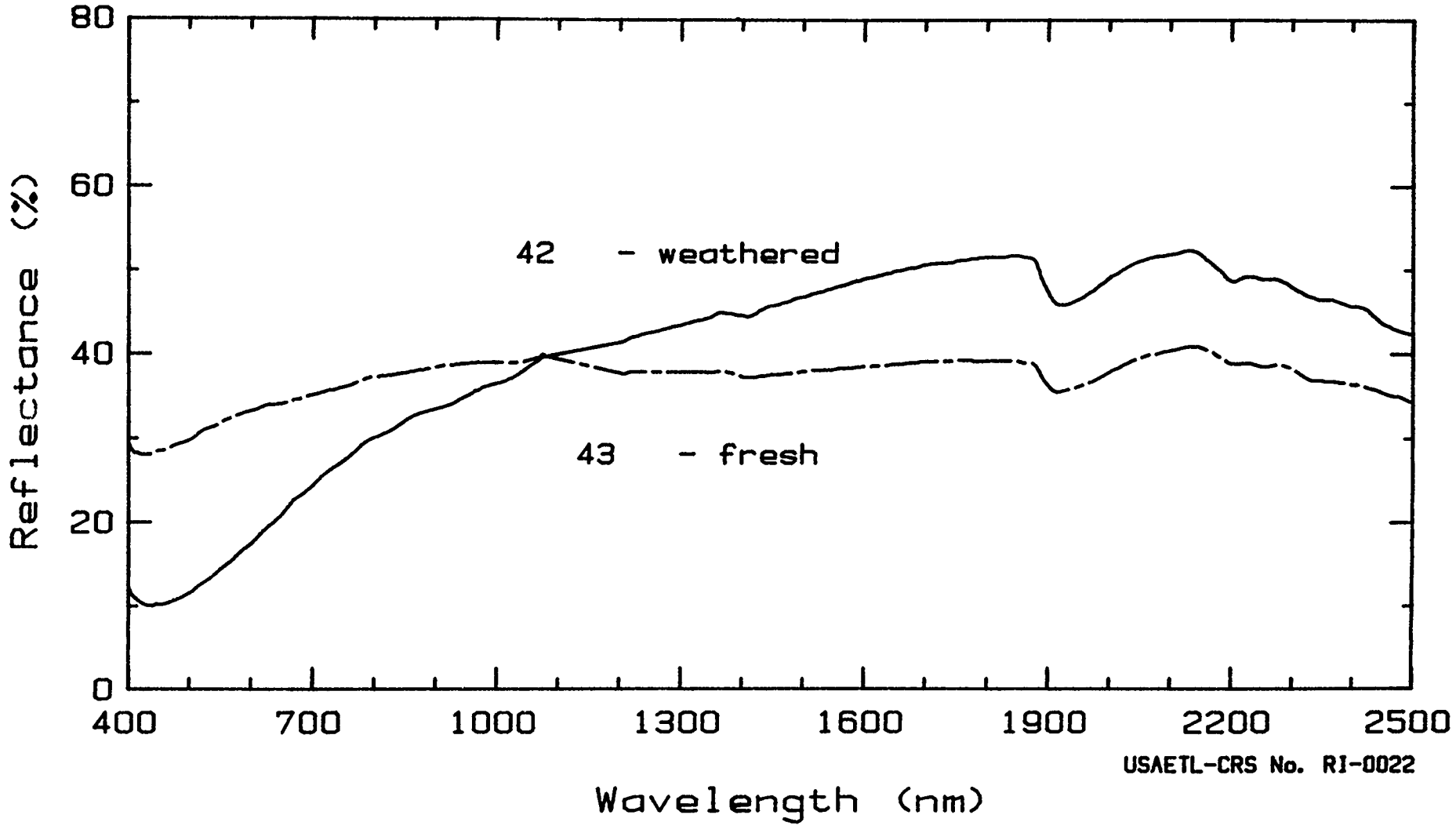
Composition: 22.3% quartz, 33.6% plagioclase, 21.8% K-feldspar, 22.4% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Reprot 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
42	11.1	15.0	21.7	31.1	49.8	49.6
43	29.4	32.1	34.4	37.5	38.8	39.1

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0022.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.45, .46.
Date Collected: 2 Jun 1988
Sample No.: JE-0122

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.4 deg. N Latitude; 112.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (46) and the weathered (45) surfaces of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

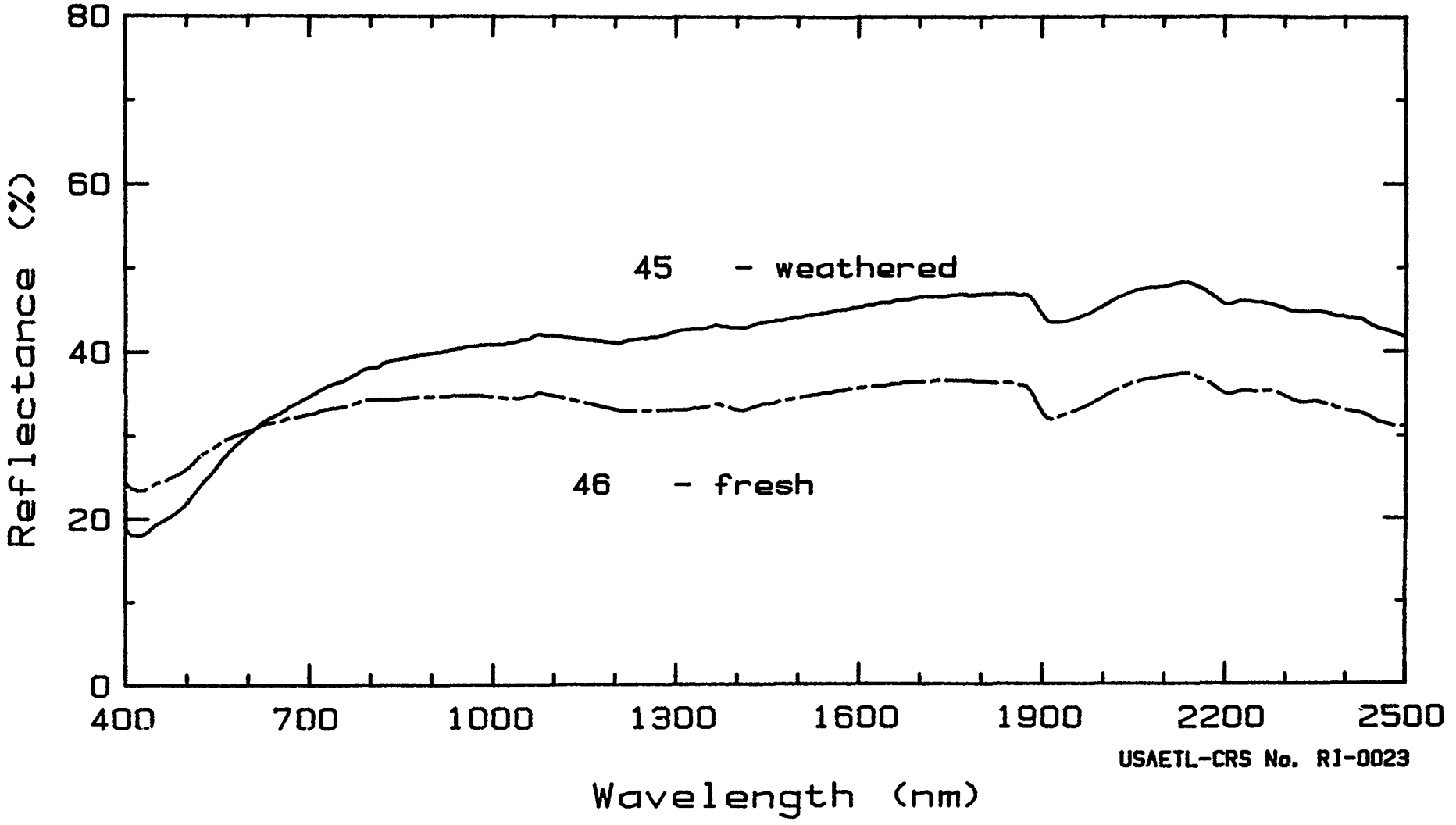
Composition: 25.0% quartz, 28.4% plagioclase, 26.8% K-feldspar, 19.7% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
45	21.2	27.2	33.1	38.6	45.9	46.3
46	25.5	29.2	31.9	34.4	36.0	35.6

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0023.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.48.

Date Collected: 2 Jun 1988
Sample No.: JE-0137

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 113.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (48) surface of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 25.8% quartz, 31.0% plagioclase, 19.9% K-feldspar, 23.4% dark & other minerals 2/.

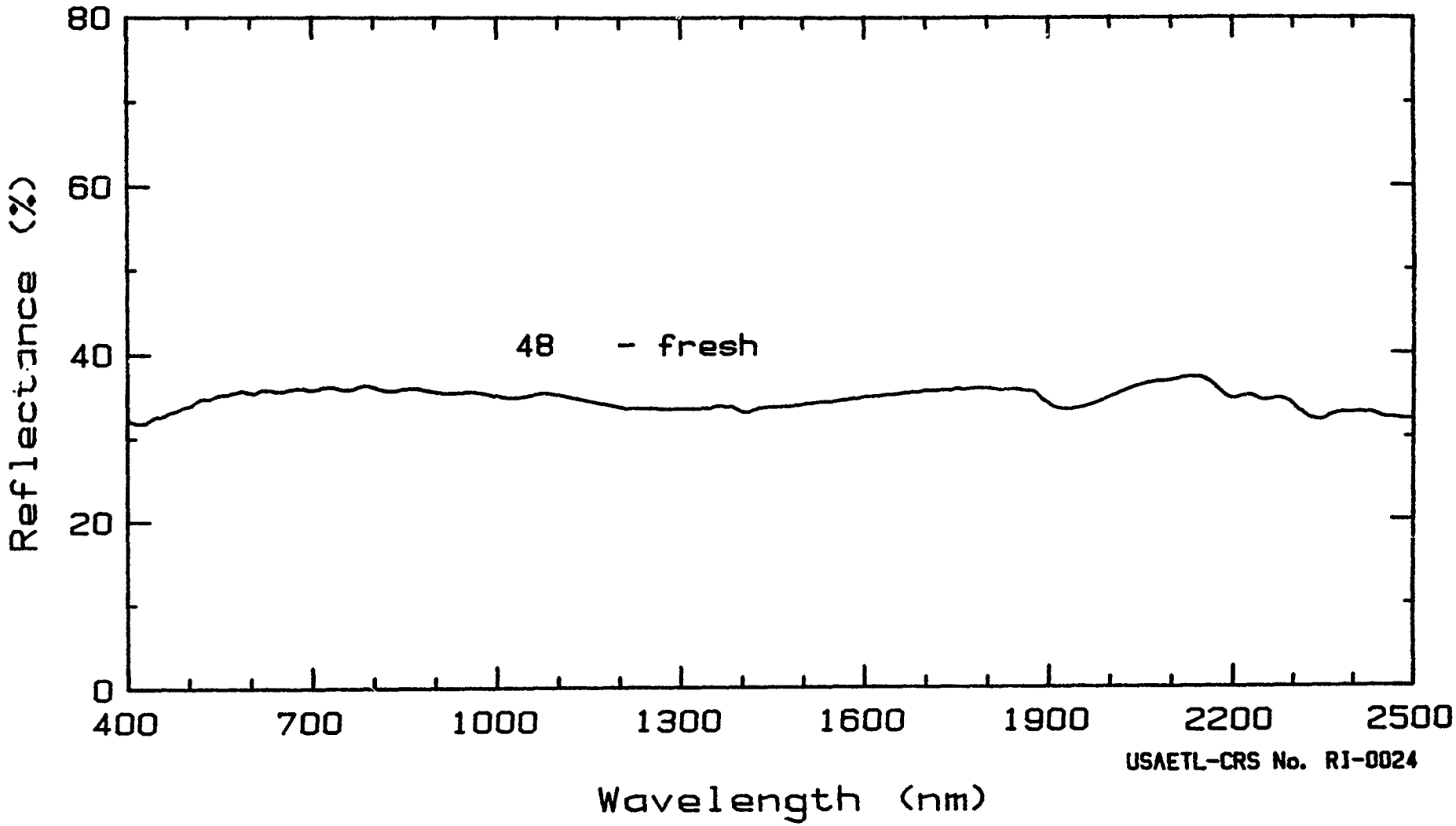
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
48	33.5	35.2	35.8	35.9	35.2	35.0

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0024.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.50, .51.
Date Collected: 2 Jan 1988
Sample No.: JE-0101

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.4 deg. N Latitude; 112.8 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (51) and the weathered (50) surfaces of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

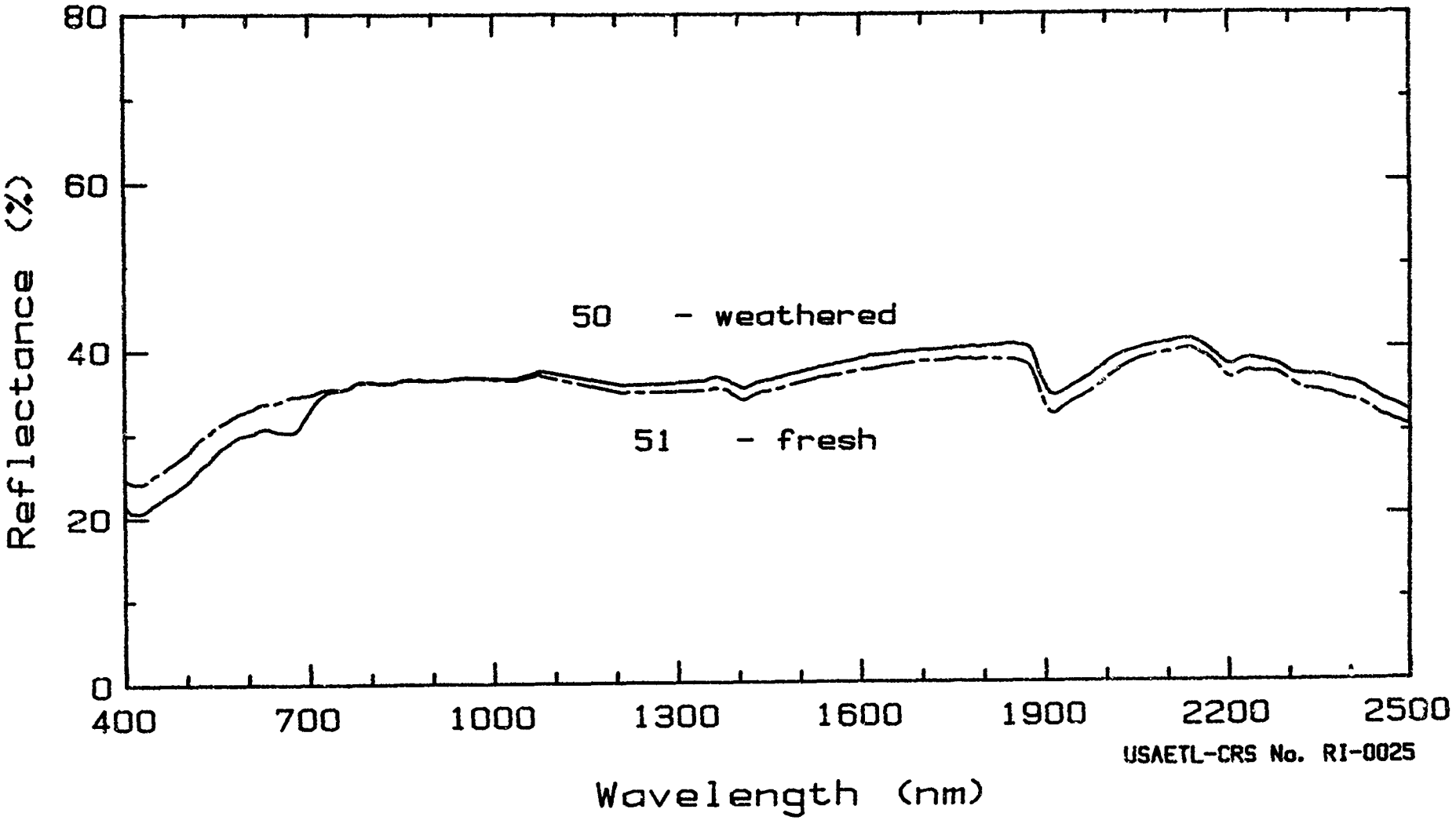
Composition: 21.9% quartz, 37.3% plagioclase, 22.9% K-feldspar, 17.9% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
50	23.5	28.2	30.5	36.3	39.3	38.8
51	27.0	31.3	34.2	36.2	37.9	37.5

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0025.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.53.

Date Collected: 2 Jun 1988
Sample No.: JE-0107

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 113.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (53) surface of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 18.8% quartz, 33.5% plagioclase, 22.7% K-feldspar, 25.1% dark & other minerals 2/.

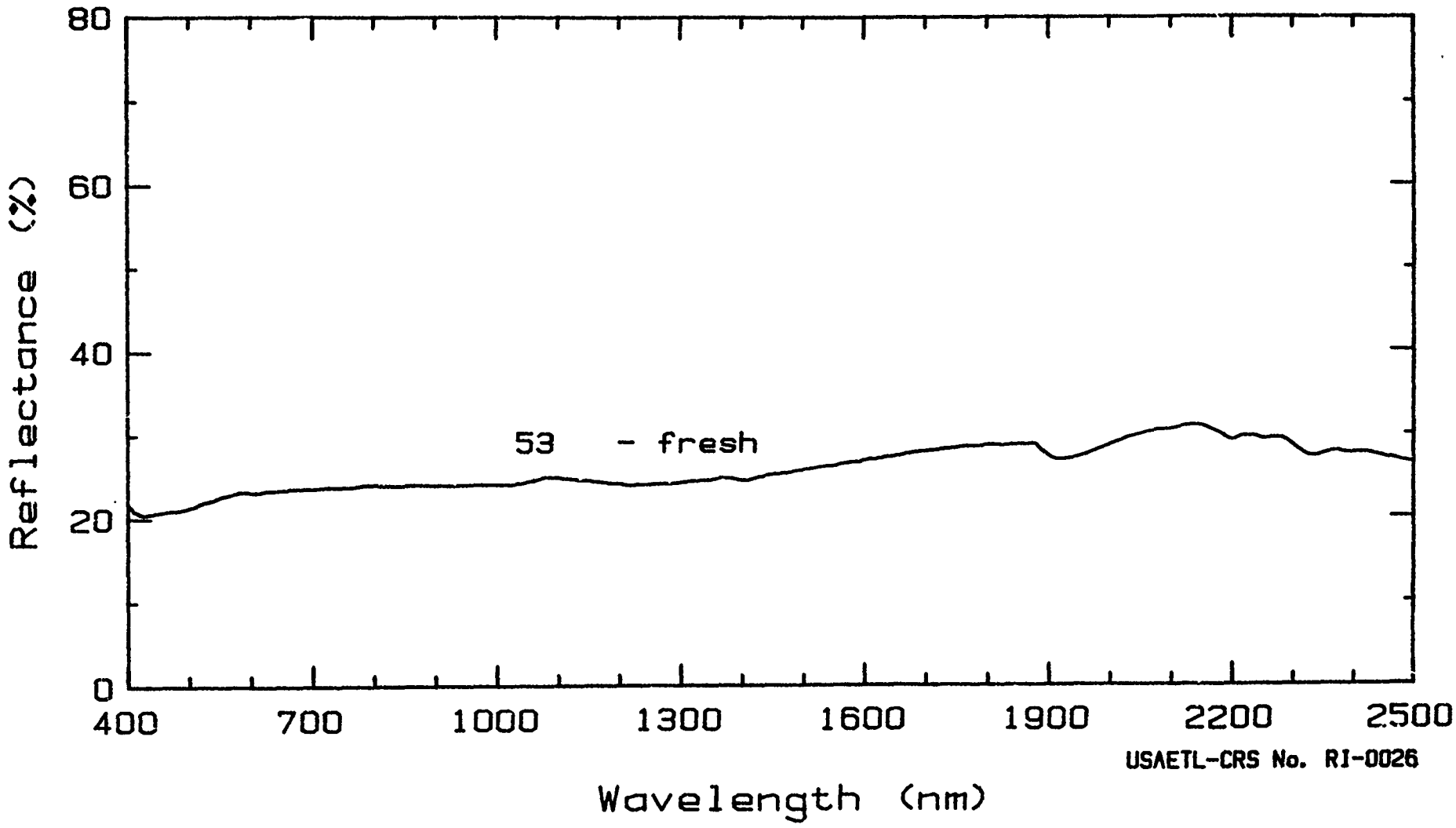
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
53	21.2	22.7	23.5	24.0	27.4	29.6

Compiled by: J. Ponder Henley.
USAETL-RI-KSD.

Sheet No.: RI-0026.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granodiorite
Spectrum No.: JGR.55, .56.
Date Collected: 2 Jun 1988
Sample No.: JE-0105

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.5 deg. N Latitude; 113.0 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (56) and the weathered (55) surfaces of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

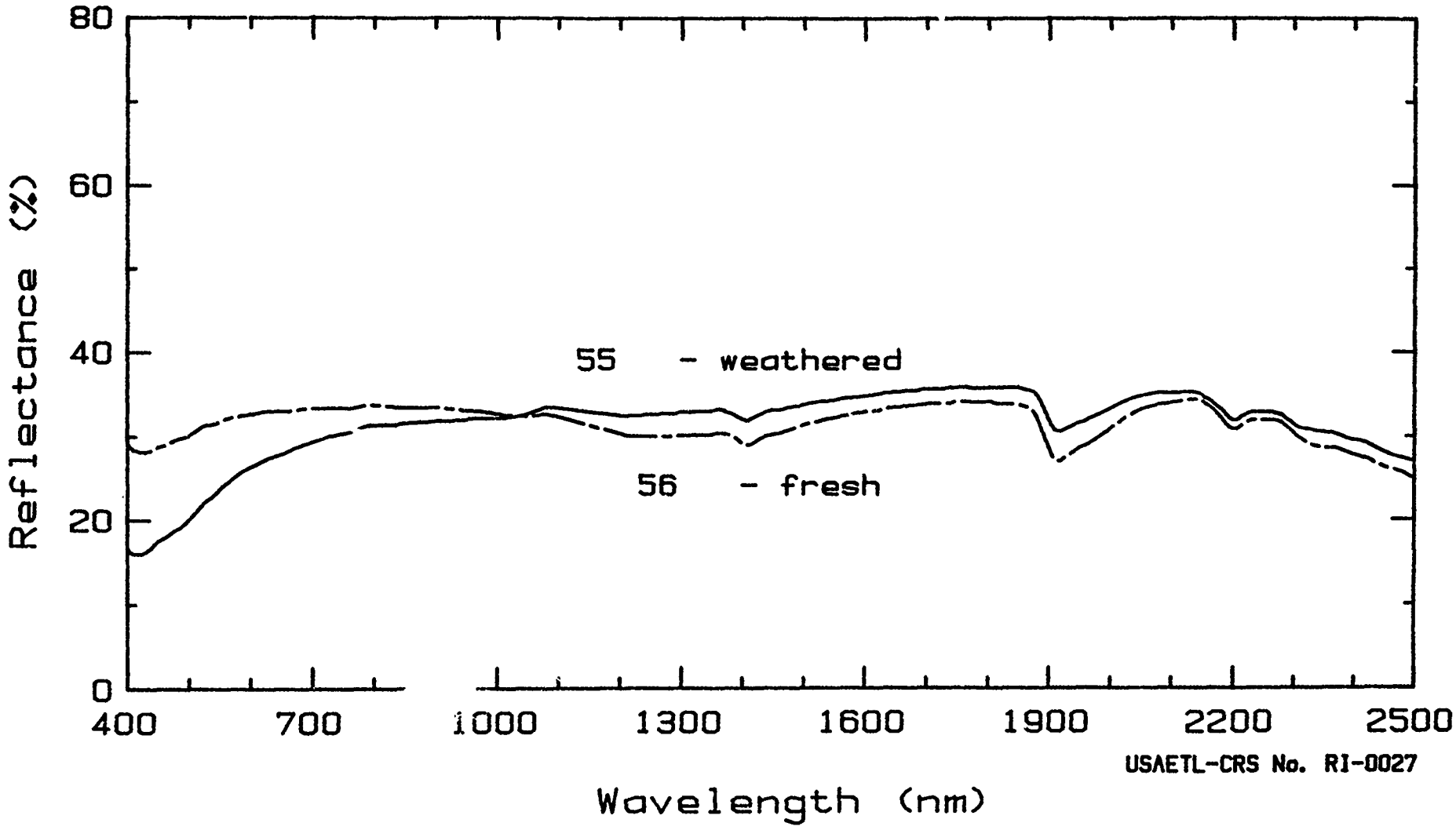
Composition: 20.7% quartz, 34.4% plagioclase, 22.5% K-feldspar, 22.4% dark & other minerals 2/.

Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
55	19.3	24.2	28.2	31.4	35.2	33.0
56	29.7	31.9	33.1	33.5	33.3	31.9

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.
Sheet No.: RI-0027.



Reflectance Spectra of Granodiorite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.62, .63.

Date Collected: 2 Jun 1988
Sample No.: JE-0128

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.4 deg. N Latitude; 113.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectra were taken of the "fresh" (63) and the weathered (62) surfaces of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 23.5% quartz, 31.7% plagioclase, 30.4% K-feldspar, 14.4% dark & other minerals 2/.

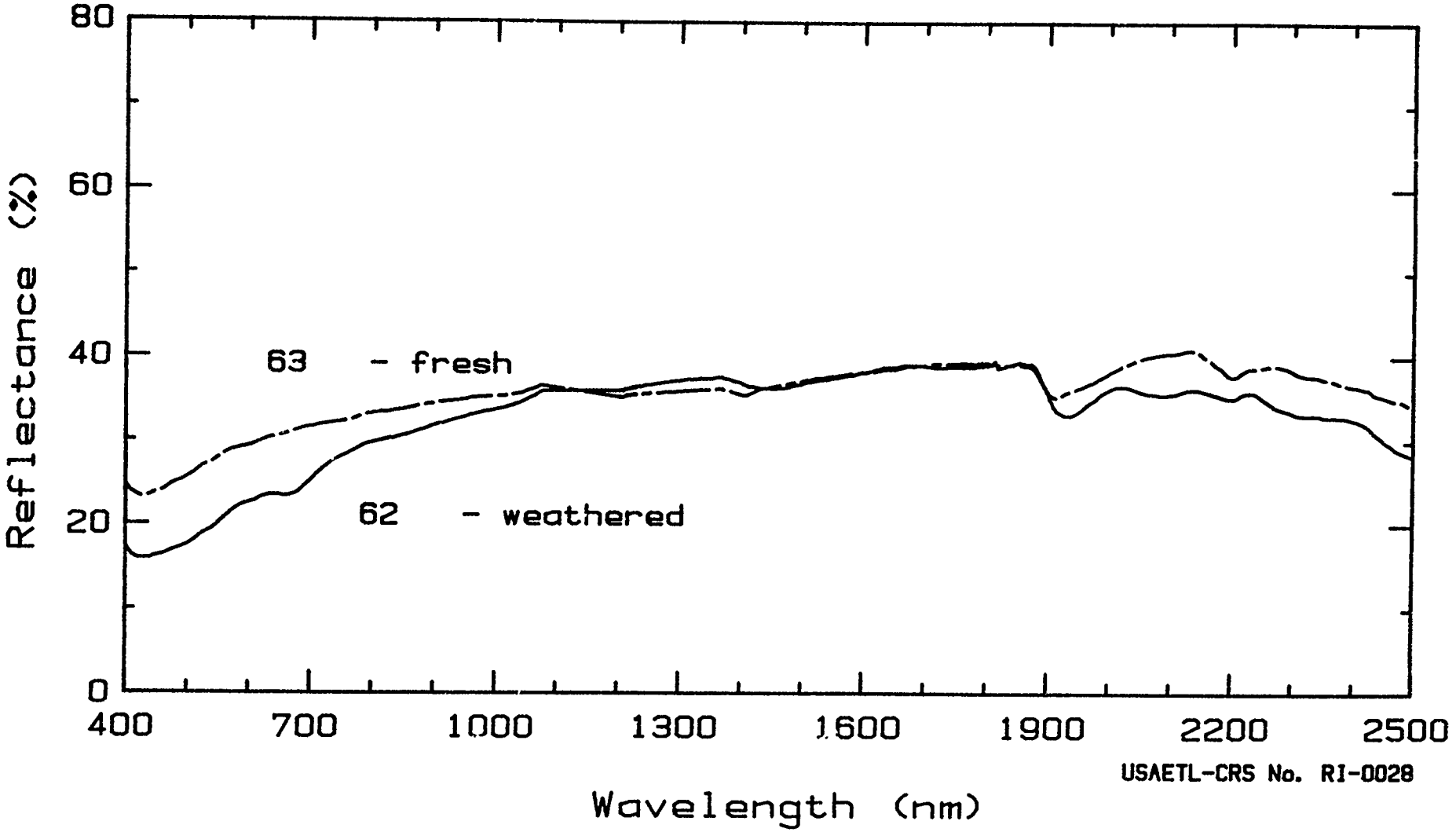
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
62	17.2	20.7	23.6	30.2	38.5	34.9
63	25.0	28.2	30.7	33.5	38.6	39.0

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0028.



Reflectance Spectra of Granite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Granite
Spectrum No.: JGR.65.

Date Collected: 2 Jun 1988
Sample No.: JE-0115

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 113.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color tempera- ture of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (65) surface of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 29.6% quartz, 32.4% plagioclase, 25.0% K-feldspar, 13.0% dark & other minerals 2/.

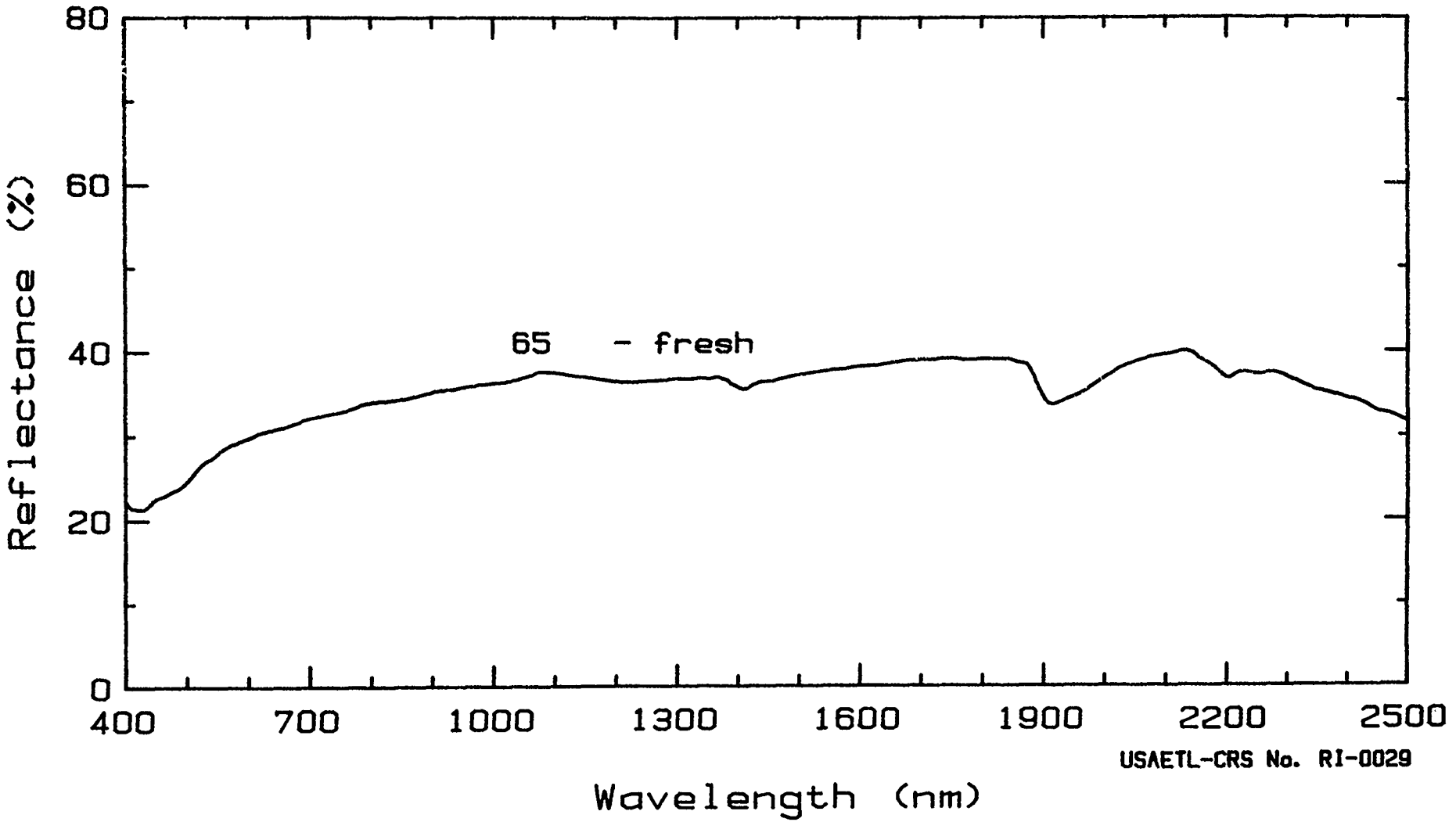
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Reprot 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
65	24.0	28.3	31.2	34.2	38.6	37.8

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0029.



Reflectance Spectra of Granite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Rock

Rock Type: Tonalite
Spectrum No.: JGR.67.

Date Collected: 2 Jun 1988
Sample No.: JE-0131

Site Location: Pioneer Mtns, Beaverhead Co., MT, USA.
45.6 deg. N Latitude; 113.9 deg. W Longitude

Procedures:

Spectroradiometric: Geophysical Environmental Research, Mark IV, spectroradiometer, SN:fb-024; 4 degree field of view, spectral resolution 1.5 nm between 360 nm and 1300 nm, and 3.5 to 4.5 nm between 1300 nm and 2500 nm. Nadir viewing angle. Viewing height was 100 cm. The reference standard was a pressed Halon plate that was horizontally positioned using a bubble level. Light source was a Lowel tota, 500 watt, Tungsten-Halogen lamp at a color temperature of 3200 degrees K.

Sample: The spectrum was taken of the "fresh" (67) surface of the rock sample. Composition was determined on cut slabs by modal analysis 1/.

Composition and Physical Properties.

Composition: 23.5% quartz, 41.5% plagioclase, 7.1% K-feldspar, 28.0% dark & other minerals 2/.

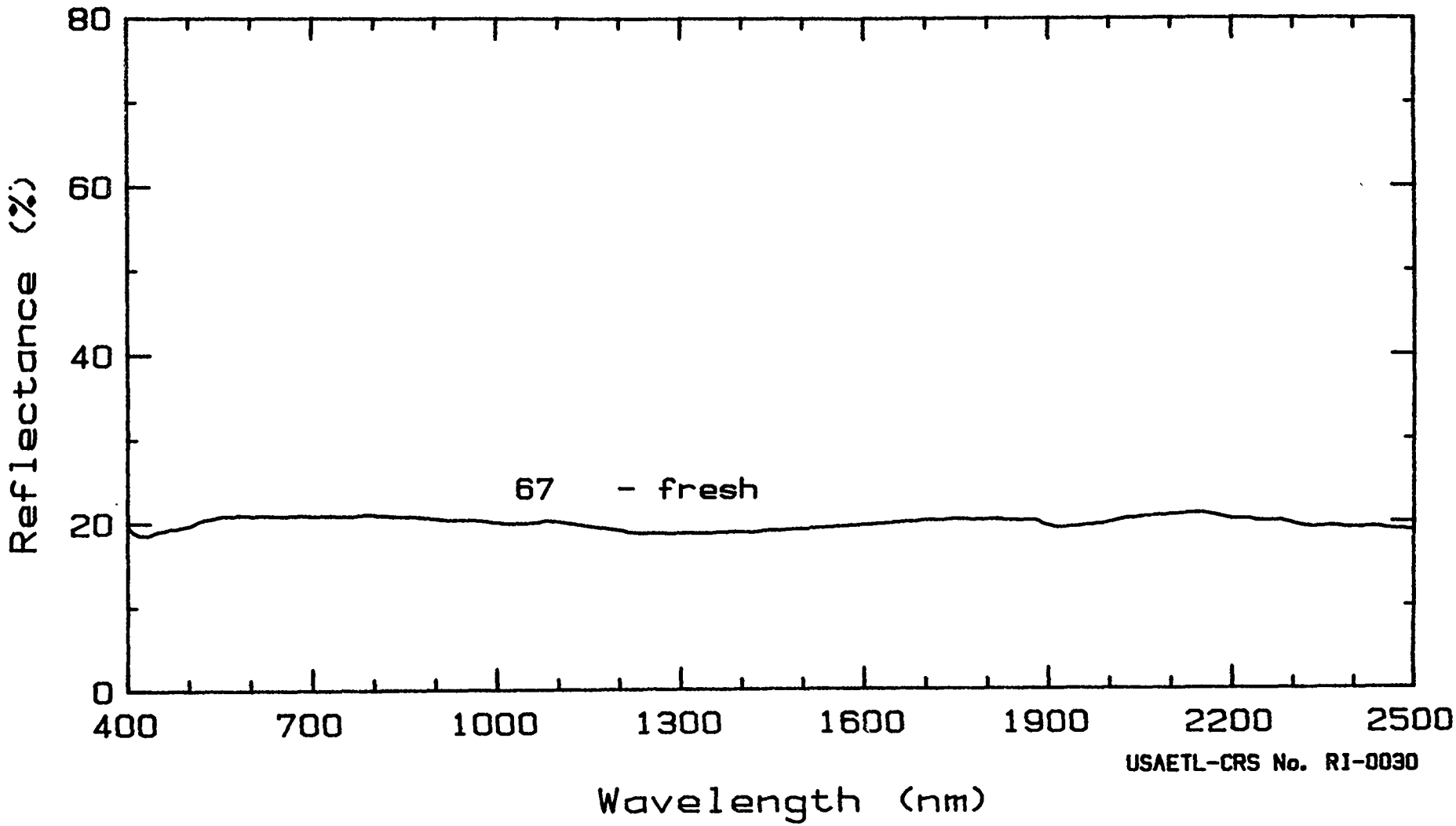
Ref: 1/. Ehlen and Zen, 1985. J. Geol. 94:575-584.
2/. Ehlen and Zen, 1990. USGS Open File Report 90-48.

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
67	19.6	20.8	20.9	20.8	20.0	20.3

Compiled by: J. Ponder Henley.
USAETL-RI-RSD.

Sheet No.: RI-0030.



Reflectance Spectra of Tonalite.
Pioneer Mtn., Beaverhead Co., MT; June 1988.

Laboratory Reflectance Spectra of Vegetation

Plant Name: Sweet gum Date Collected: May to Sep 1987
Specific Name: Liquidamber styraciflua L.
Spectrum No.: G-GUM.MEN

Site Location: Ft. Belvoir, Fairfax Co., VA, USA.
38.8 deg. N Latitude; 77.1 deg. W Longitude.

Procedures:

Spectrophotometric: Perkin-Elmer spectrophotometer, model 330, spectral range 400-1900 nm, 3 nm waveband centered at 5 nm increments; 6 cm diameter integrating sphere coated with barium sulfate, barium sulfate reference standard.

Sample: Mature, green "sun" leaves were taken periodically from the same sweet gum tree canopy. All leaves had been exposed to direct sunlight most of the day. They were placed into a plastic bag to minimize water loss. The lower 1/3 of the leaf blade was measured but the leaf's midrib was not part of the sampled surface. The spectra of the sixteen leaves were not statistically different from the group's mean spectra at the 95% confidence level. The mean curve (#1) and those reprepresenting one standard deviation (#2, #3) of the mean curve are shown.

Physical & Chemical Properties:

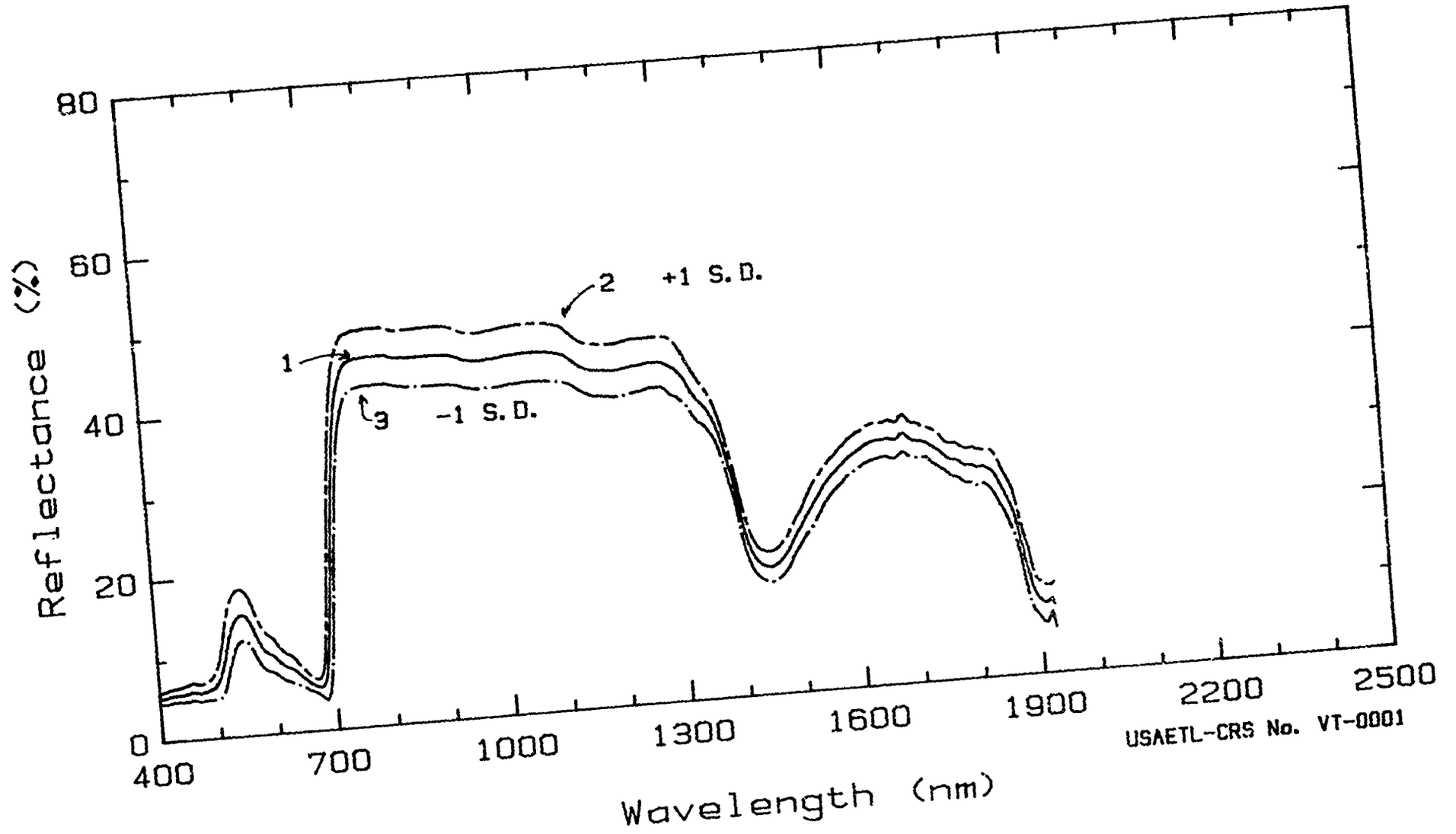
Phenological stage: vegetative, actively growing.
Sample cover in the FOV: 100%
Plant height: 10 m Crown diameter: 8 m

Mean Reflectance (%) in Landsat 4 Thematic Mapper Bands.

Curve Index No.	Band 1 450-520 nm	Band 2 520-600 nm	Band 3 630-690 nm	Band 4 760-900 nm	Band 5 1550-1750 nm	Band 7 2080-2350 nm
1	6.8	12.6	6.5	45.7	29.5	
2	8.4	15.5	8.1	49.2	31.7	
3	5.1	9.6	5.0	42.2	27.4	

Compiled by: Melvin B. Satterwhite
USAETL-RI-RSD

Sheet No. VT-0001.



Spectra of Sweet Gum Leaves.
Ft. Belvoir, Fairfax Co., VA; May-Sep., 1987.