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MX SITING INVESTIGATION. GRAVITY SURVEY - SOUTHERN SNAKE VALLEY--ETC(U)
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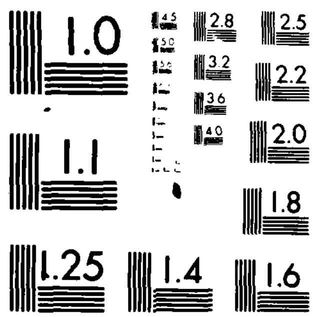

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MX SITING INVESTIGATION

GRAVITY SURVEY - SOUTHERN SNAKE VALLEY (FERGUSON DESERT)

UTAH

Prepared for:

U.S. Department of the Air Force
Ballistics Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

28 March 1980

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REPORT DOCUMENTATION PAGE

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3. RECIPIENT'S CATALOG NUMBER	
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20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

Results of a gravity survey in the southern Snake Valley of west central Utah shows the Ferguson Desert area to be a Basin-and-Range structural valley with a maximum thickness of alluvium of about 3000 feet. There are six inferred normal faults. Of these, the two most notable are north-south range-boundary faults on the east side of the valley.

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FOREWORD

Methodology and Characterization studies during fiscal years 1977 and 1978 included gravity surveys in ten valleys in Arizona (five), Nevada (two), New Mexico (two), and California (one). The gravity data were obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. There was also the possibility of detecting shallow rock in areas between boring locations. Generalized interpretations from these surveys were included in Fugro National's Characterization Reports (FN-TR-26a through e).

During the FY 77 surveys, measurements were made to form an approximate one-mile grid over the study areas and contour maps showing interpreted depth to bedrock were made. In FY 79, the decision was made to concentrate on verifying and refining suitable area boundaries. This decision resulted in a reduction in the gravity program. Instead of obtaining gravity data on a grid, the reduced program consisted of obtaining gravity measurements along profiles across the valleys where Verification Studies were also performed.

The Defense Mapping Agency (DMA), St. Louis was requested to provide gravity data from their library to supplement the gravity profiles. For Big Smoky, Reveille and Railroad valleys, a sufficient density of library data is available to permit construction of interpreted contour maps instead of just two-dimensional cross sections.

In late summer of FY 79, supplementary funds became available to begin data reduction. At that time inner zone terrain corrections were begun on the library data and the profiles from Big Smoky Valley, Nevada, and Butler and La Posa valleys, Arizona. The profile data from Whirlwind, Hamlin, Snake East, White River and Garden Coal valleys, Nevada became available from the field in early October, 1979.

A continuation of gravity interpretations has been incorporated into the FY 80 program and the results are being summarized in a series of valley reports. In reports covering Nevada-Utah gravity studies will be numbered, "FN-TR-33-", followed by the abbreviation for the subject valley. In addition, more detailed reports of the results of FY 77 surveys in Dry Lake and Ralston valleys, Nevada are being prepared. Verification studies are continuing in FY 80 and gravity studies are included in the program. DMA will continue to obtain the field measurements and it is planned to return to the grid pattern. The interpretation of the grid data will allow the production of contour maps which will be valuable in the deep basin structural analysis needed for computer modeling in the water resources program. The gravity interpretations will also be useful in Nuclear Hardness and Survivability (NH&S) evaluations.

The basic decisions governing the gravity program are made by BMO following consultation with TRW Inc., Fugro National and the DMA. Conduct of the gravity studies is a joint effort between DMA and Fugro National. The field work, including planning, logistics, surveying, and meter operation is done by the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC), headquartered in Cheyenne, Wyoming. DMAHTC reduces the data to Simple Bouguer Anomaly (see Section A1.4, Appendix A1.0). The Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, calculates outer zone terrain corrections.

Fugro National provides DMA with schedules showing the valleys with the highest priorities. Fugro National also recommended locations for the profiles in the FY 79 studies within the constraints that they should follow existing roads or trails. Any required inner zone terrain corrections are calculated by Fugro National prior to making geologic interpretations.

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1.0 INTRODUCTION

1.1 OBJECTIVE

Gravity measurements were made in Southern Snake Valley for the purpose of estimating the overall shape of the structural basin, the thickness of alluvial fill, and the location of concealed faults. The estimates will be useful in modeling the dynamic response of the basin to explosion- or earthquake-generated ground motion and in evaluating ground-water resources.

1.2 LOCATION

The study area is the Ferguson Desert part of Snake Valley. It is located in western Millard County, Utah near the Nevada border, approximately 80 miles (130 km) from both Ely, Nevada and Delta, Utah on U.S. Highway 6/50 (Figure 1).

The area is bounded on the north and east by the Conger and Confusion ranges, and on the southwest by the Burbank Hills (Figure 2).

1.3 SCOPE OF STUDY

The Defense Mapping Agency Hydrographic-Topographic Center/ Geodetic Survey Squadron (DMAHTC/GSS) made the 224 gravity measurements for the nine profiles used in this study (Appendix A2.0). Data from the DMA gravity library was also used to establish the gravity contours.

Profile locations are shown in Figure 2. The names of several profiles are composite, like SE-7,8 -- to indicate the linking of profiles SE-7 and SE-8. (SE stands for Snake East - an

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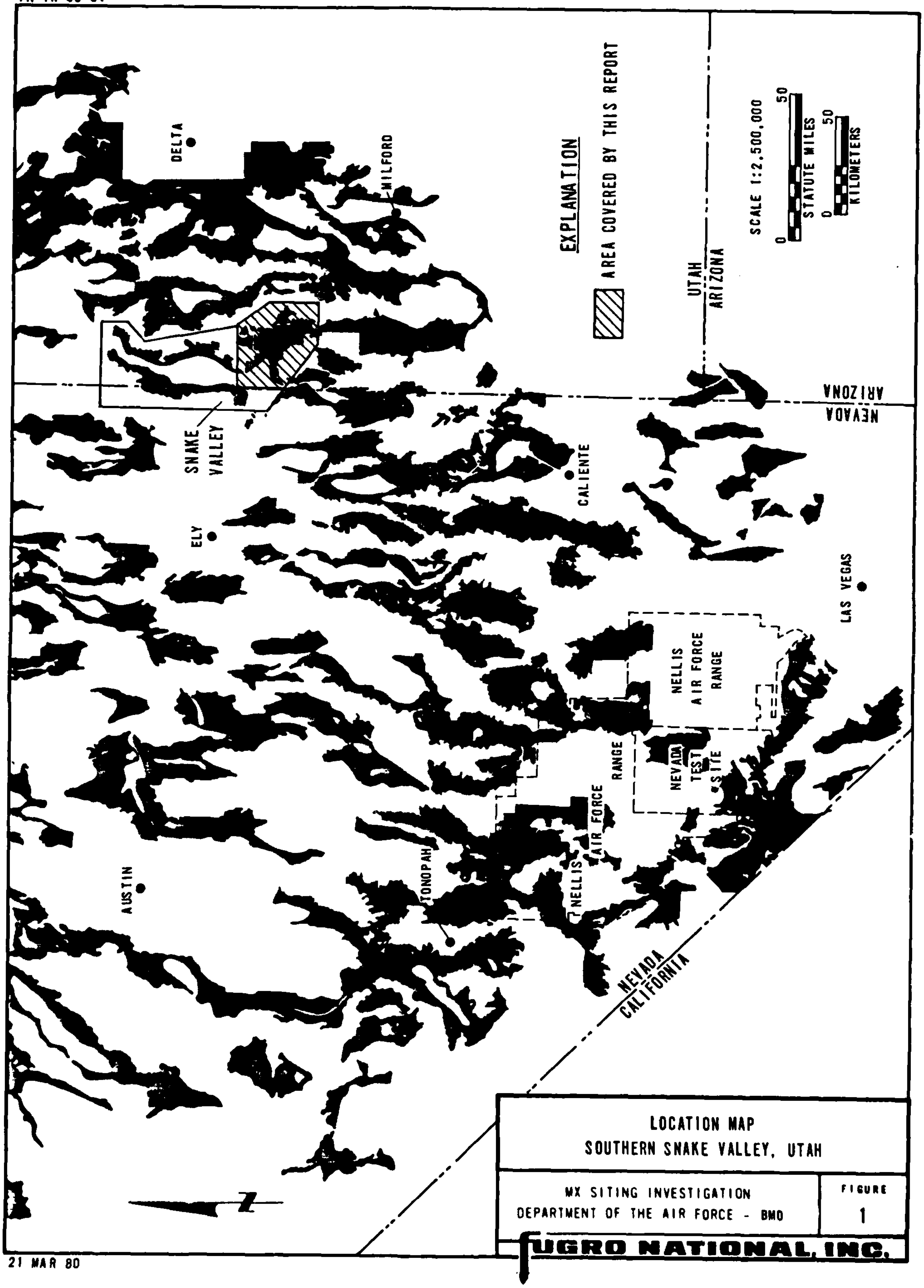

LOCATION MAP
SOUTHERN SNAKE VALLEY, UTAH

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FIGURE 1

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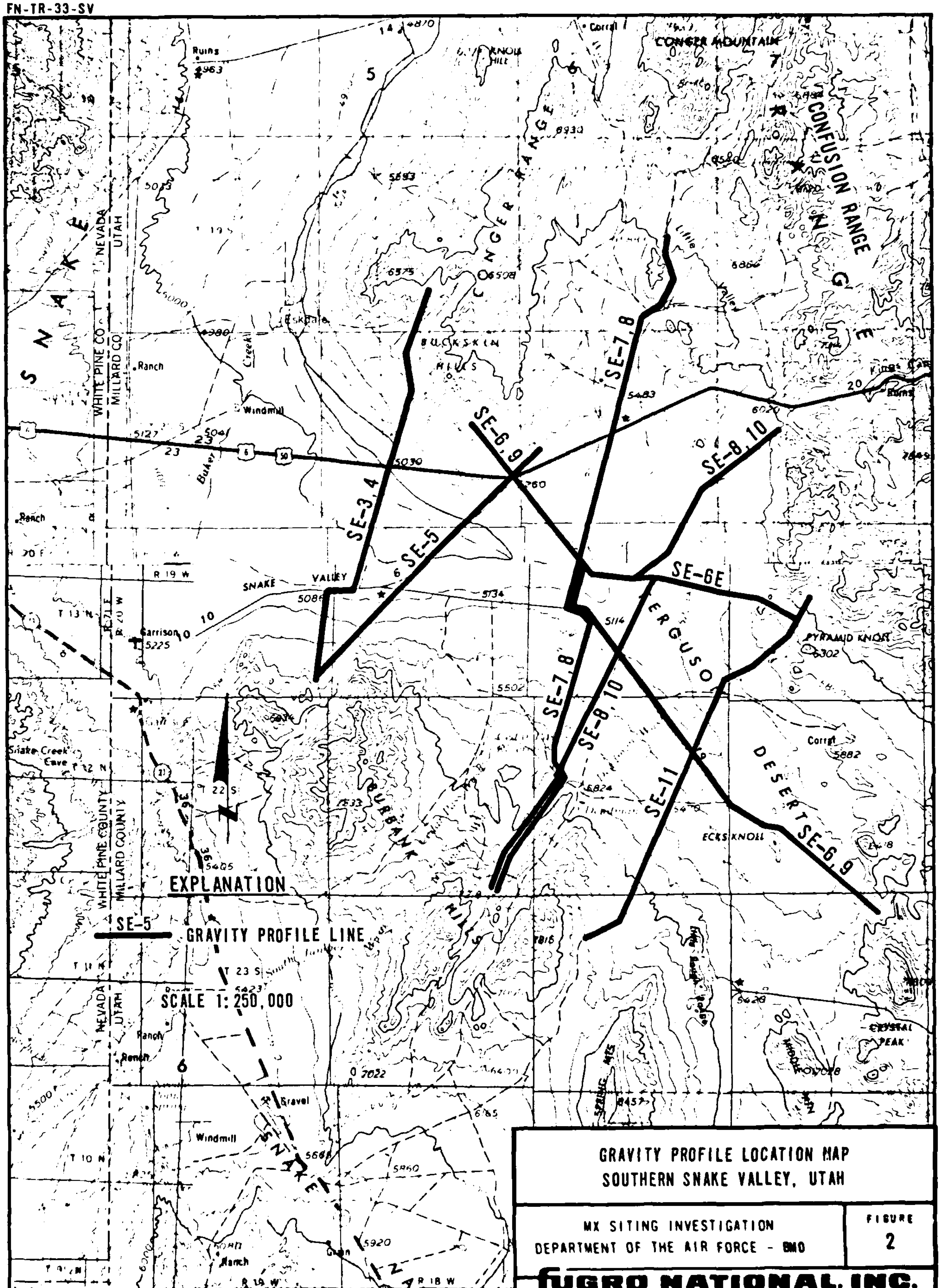

GRAVITY PROFILE LOCATION MAP
SOUTHERN SNAKE VALLEY, UTAH

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FIGURE 2

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obsolete designation which is retained for compatibility with the original data set.) The profile lengths range between 7 miles (11 km) and 18 miles (29 km), crossing from bedrock to bedrock over the valley fill. The sampling interval is approximately 1-mile (1.6 km) over the central valley and 1/4-mile (0.4 km) near the valley margins. The denser sampling was used near the valley margins to define any steep gravity gradients which could indicate the presence of boundary faults, and to resolve short-wavelength anomalies caused by shallow bedrock.

The tolerance for establishing station elevations was 5 feet (1.5 m). This tolerance for elevation control limits the gravity precision to 0.3 milligals.

2.0 GRAVITY DATA REDUCTION

DMAHTC/GSS obtained the basic observations and reduced them to Simple Bouguer Anomalies (SBA) for each station as described in Appendix A1.0. Up to three levels of terrain corrections were applied to convert the SBA to the Complete Bouguer Anomaly (CBA). First, the Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, used its library of digitized terrain data and a computer program to calculate corrections out to 104 miles (167 km) from each station. When the program could not calculate the terrain effects near a station, a ring template was used to estimate the effect of terrain within approximately 3000 feet (914 m) of the station. The third level of terrain corrections was applied to those stations where 10 feet (3 m) or more of relief was observed within 130 feet (40 m). In these cases, the elevation differences were measured in the field at a distance of 130 feet along six directions from the stations. These data were used to calculate the effect of the very near relief.

3.0 GEOLOGIC SUMMARY

The structural geologic setting, major rock types, and depositional regime of the valley-fill material are important considerations in the interpretation of gravity data.

Ferguson Desert is an alluvial basin with dimensions of roughly 10 miles by 20 miles (16 km by 32 km). The surrounding mountains exhibit a strong northeast structural grain, primarily a product of Laramide deformation. Thrust faulting and west-dipping homoclinal beds are prevalent in the carbonate rocks of the Confusion Range. Basin and Range block faulting is not generally observed in the surface geology, but Hintze (1963) indicates basin-margin faults, concealed by alluvium, along the east side of the site. No active faults were observed in the Verification Studies (FY 79, FN-TR-1A), and deeply embayed canyon reentrants with numerous outliers suggest tectonic stability.

The major rock types in the Conger and Confusion Ranges and Burbank Hills are Paleozoic limestones and dolomites with interbedded shales and sandstones. Localized Tertiary age basalts are located along the north side of the Burbank Hills.

Basin-fill sediments are derived chiefly from the Confusion Range on the east, and from the Conger Range and Burbank Hills on the west. The sediments are primarily alluvial fan and lacustrine deposits. About 1/2 of the area consists of alluvial fan deposits composed of weakly cemented sands -- ranging from gravelly sand near the mountain fronts to silty sand toward the basin center. About 1/4 of the area is composed of older lacustrine deposits which consist of isolated sandy and gravelly shoreline deposits; and sandy to fine-grained lake deposits of former Lake Bonneville. These deposits occur along the valley's axis and western side below elevation 5200 feet. The remaining 1/4 of the area is covered by active eolian deposits, young alluvial fan deposits, and playa deposits -- all overlying the older fan and lake deposits. These deposits are composed of sands, gravels, silts, and clays.

Much of the present alluvial morphology below elevation 5200 feet (1585 m) was modified by the presence of the former Lake Bonneville during late-Pleistocene time. An exploratory oil well located west of the study area (T.20S, R.19W, sec. 19cd) penetrated 4200 feet (1250 m) of basin-fill sediments (Hood and Rush, 1965).

4.0 INTERPRETATION

A valley filled with alluvium which has low-density relative to the surrounding bedrock creates a negative gravity anomaly. Thus gravity profiles across such valleys are typically U-shaped, low in the middle of the valley where the fill is thickest and high on the ends where the fill thins and bedrock emerges. The basis for the interpretation is the Complete Bouguer Anomaly (CBA), which is contoured in Figure 3. The CBA is defined in Appendix A1.4. The data for this report are listed in Appendix A2.0 and are also shown as profile cross-sections in the top part of Figures 4 through 10.

4.1 REGIONAL-RESIDUAL SEPARATION

A fundamental part of the gravity interpretation is the separation of regional effects from the local effects of the valley and its fill. The CBA contains long-wavelength components from deep and broad geologic structures extending far beyond the valley. These long-wavelength components, called the regional gravity, have been approximated by linear interpolation between CBA values at bedrock stations on opposite ends of the profiles. They are shown as straight lines in the top part of Figures 4 through 10. The regional gravity was subtracted from the CBA and the resulting residual gravity anomaly profiles were used to model the valley. The residual gravity anomaly (interpolated at evenly spaced points) is shown by the crosses (x) in the center portion of Figures 4 through 10.

4.2 DENSITY SELECTION

To construct a geologic model from the residual gravity anomaly, it is necessary to obtain values of density for the basin fill and the underlying rock. Only generalized density information exists, so the geologic models are necessarily approximate.

The density selected to represent the bedrock was 2.8 g/cm^3. This value is at the upper end of the range for limestones and dolomites (Clark, 1966). It was chosen because the Paleozoic age carbonate rocks of Nevada are generally reported to be of high density, on the order of 2.8 g/cm^3.

The density selected to represent the valley fill was 2.3 g/cm^3. This value was obtained from measurements of in situ densities from eight 160-foot boreholes drilled during the Verification Studies (FY 79, FN-TR-27-III). A value at the high end of the density range, rather than the average value, was selected to account for compaction with depth (compaction with depth and age is discussed by Woollard, 1962).

The selected density contrast of 0.5 g/cm^3 (i.e., 2.8 minus 2.3) will cause an underestimate of the depth of fill if the effective bedrock density is less than 2.8 g/cm^3 or that of the fill greater than 2.3 g/cm^3. This is because the calculated depth of fill is inversely proportional to the density contrast.

4.3 MODELING

The profile lines covered the study area well enough to justify contouring the CBA (Figure 3). Wider contouring using DMA gravity library data showed that just west of the Ferguson Desert, the Bouguer gravity has a steep negative trend to the west. This is also seen in a published (Smith and Eaton, 1978) regional gravity profile which crosses the study area at 39°N latitude. This gross feature however, is due to structure on a much larger scale than this small valley and it does not affect our model.

An iterative computer program that calculates the gravity field for two-dimensional models was used to approximate the depth of fill beneath each profile. The two-dimensional model used for computation appears in cross-section as a set of half-km-wide blocks whose tops are at surface elevation and whose bottoms represent the alluvium-bedrock boundary. The elevations of tne bottoms of the blocks were adjusted by iterative computation until the computed gravity anomaly differed by less than a half-milligal from the observed residual gravity anomaly. The computed gravity anomaly from the final model is shown as a continuous segmented line in the center portion of Figures 4 through 10. The resulting geologic-cross-section models are shown in the bottom sections of Figures 4 through 10. There is a vertical exaggeration of 125/24 (5.2) times so that all slopes appear about five times steeper than actual.

The shape of the basin floor derived from the model profiles indicates that fill depths exceed 3000 feet in the deepest parts of the central valley. The gross shape of the basin is shown by the contoured thickness of alluvium in Figure 11.

The geologic map of southwestern Utah (Hintze, 1963) is used as a base for Figures 3 and 11. This map shows a north-south fault concealed beneath the alluvium crossing the eastern side of the Ferguson Desert. The gravity expression just west of Eck's Knoll on Profile SE-6,9 (Figure 6) provides good support for the existence of this fault. The gravity expression corresponding to this feature is much weaker on profiles SE-6E, SE-8,10, and SE-11 (Figures 7, 9, and 10). The intersection of this published fault with these profiles is marked on each of the figures.

We have inferred additional faults where closely-spaced data showed steep gravity gradients. One such inferred fault is marked at kilometer 5 on profile SE-6E (Figure 7) and near kilometer 18 on profile SE-8,10 (Figure 9); it is shown in Figure 11 as a north-south trending dashed line 2 miles west of the Hintze fault. A pair of inferred valley-margin faults are shown running southeast from the valley's west entrance.

Profile SE-6,9, which runs along the valley axis (Figure 6), does not have the optimum orientation for using a two-dimensional modeling algorithm designed for modeling cross-sections of theoretically infinitely-long valleys. Some of the gravity anomaly in Figure 6 may be caused by floor topography which is not directly beneath the profile. The topography at kilometers 14 through 18 in Figure 6, for example, may well be due to a buried ridge of the Burbank Hills.

5.0 CONCLUSIONS

Based on gravity data, the Ferguson Desert area of Snake Valley, Utah is interpreted to be a Basin-and-Range structural valley with a maximum thickness of alluvium of about 3000 feet. There are six inferred bedrock faults (Figure 11). Of these, the two most notable are north-south range-bounding faults on the east side of the valley. They probably represent a zone of faulting which corresponds to the concealed fault interpreted in Hintze (1963).

The interpreted depth-to-bedrock map (Figure 11) shows some closed contours in the deepest areas. The indicated basin shape may have some implications for ground water investigations.

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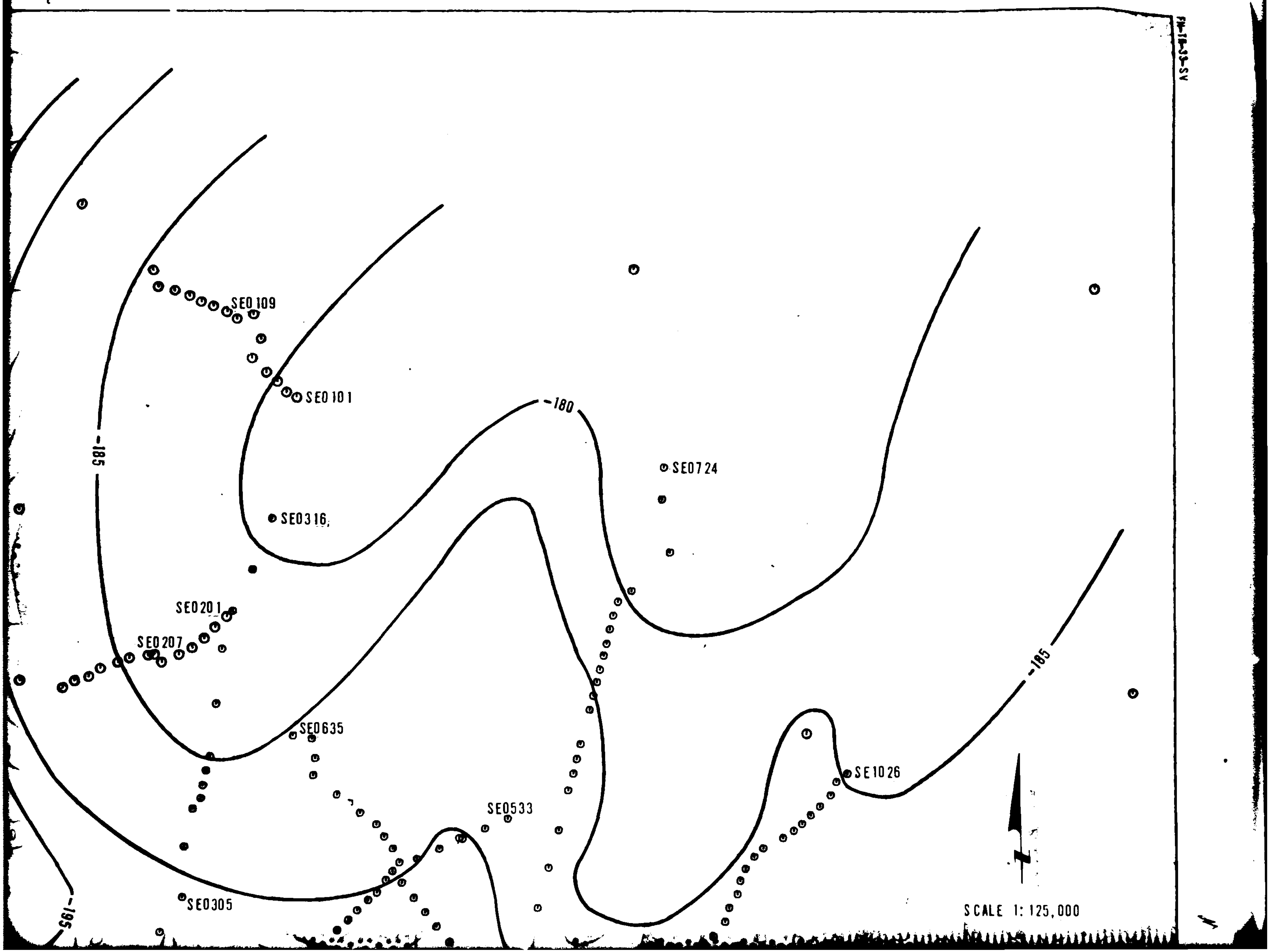
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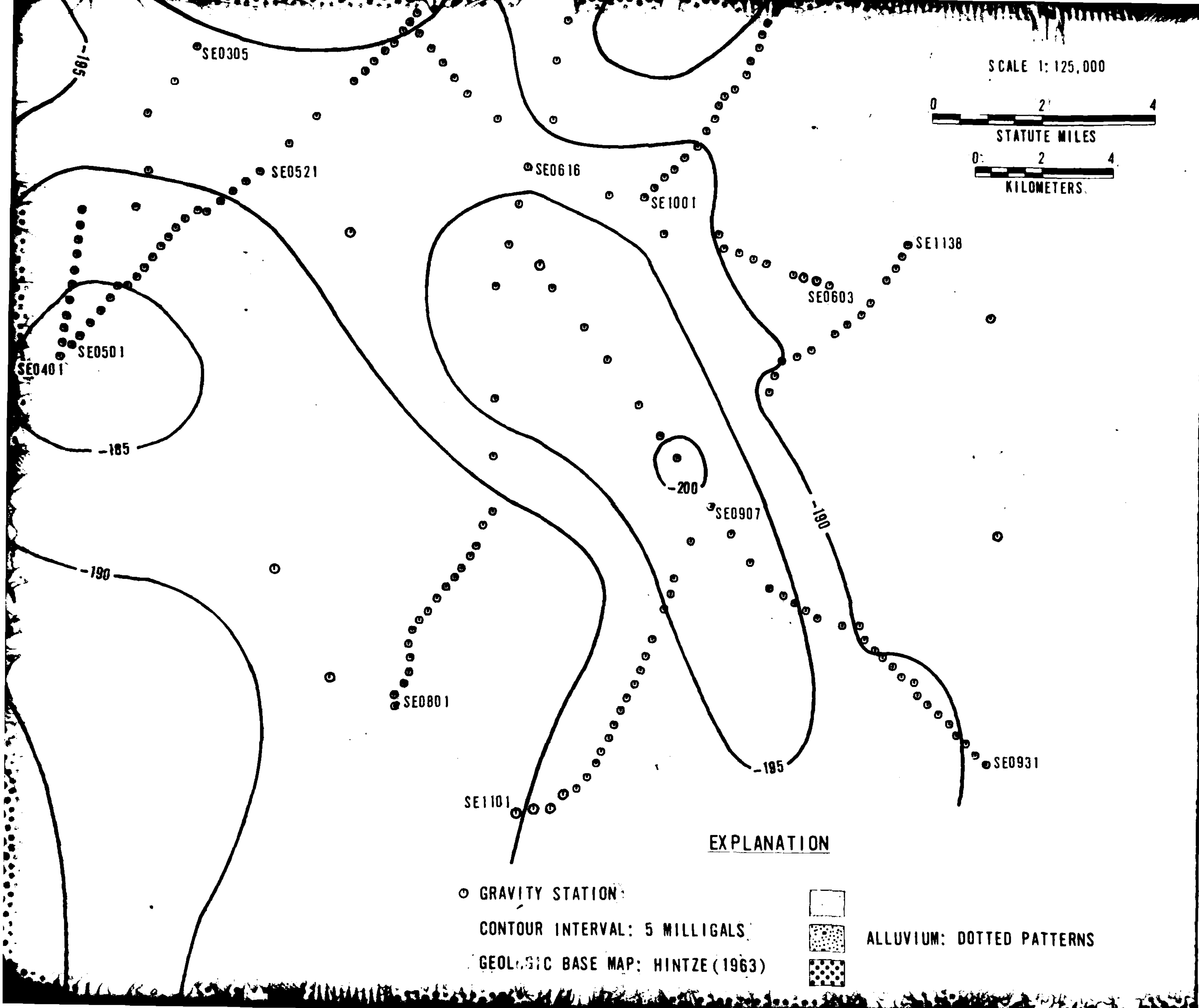
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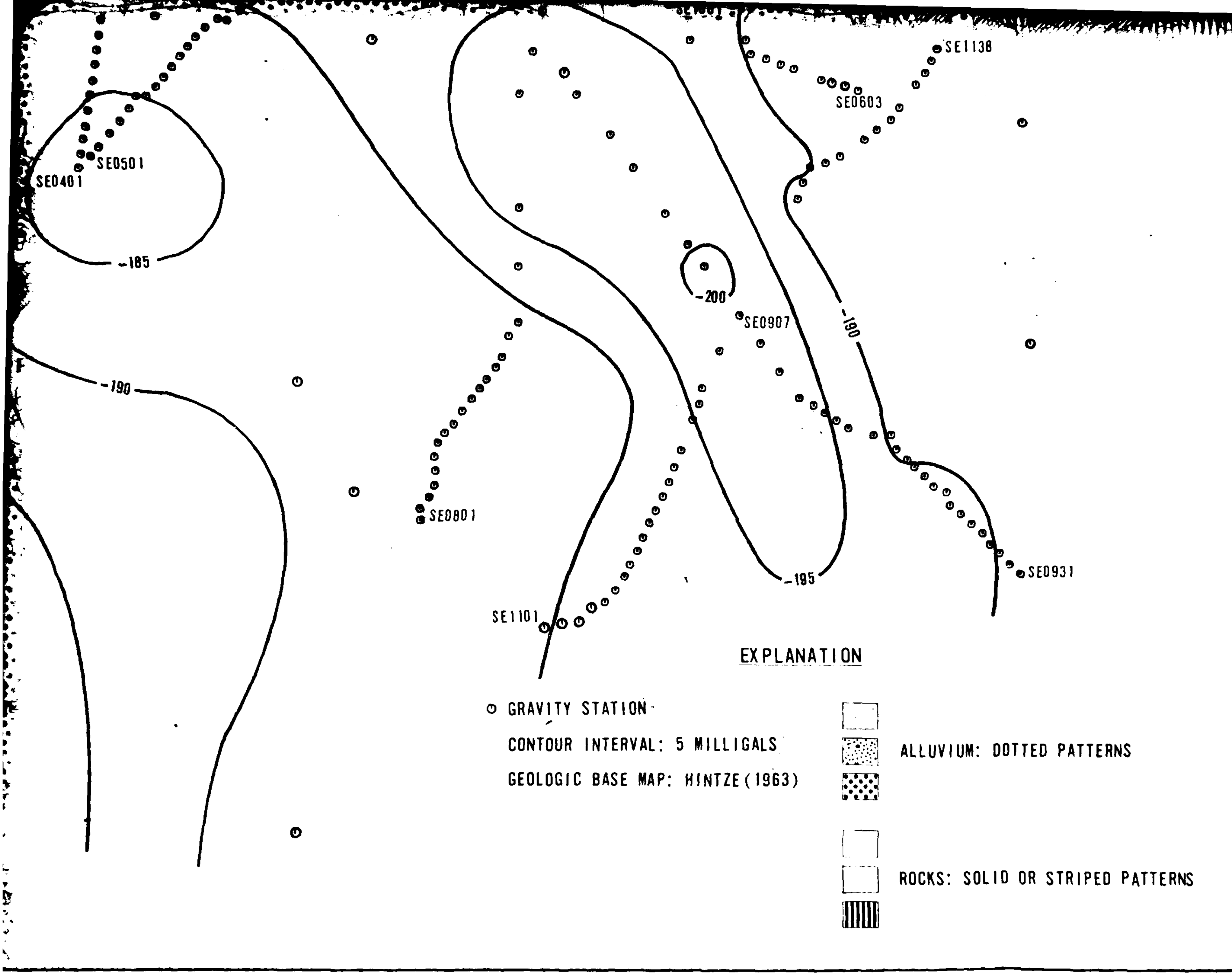
ALLUVIUM: DOTTED PATTERNS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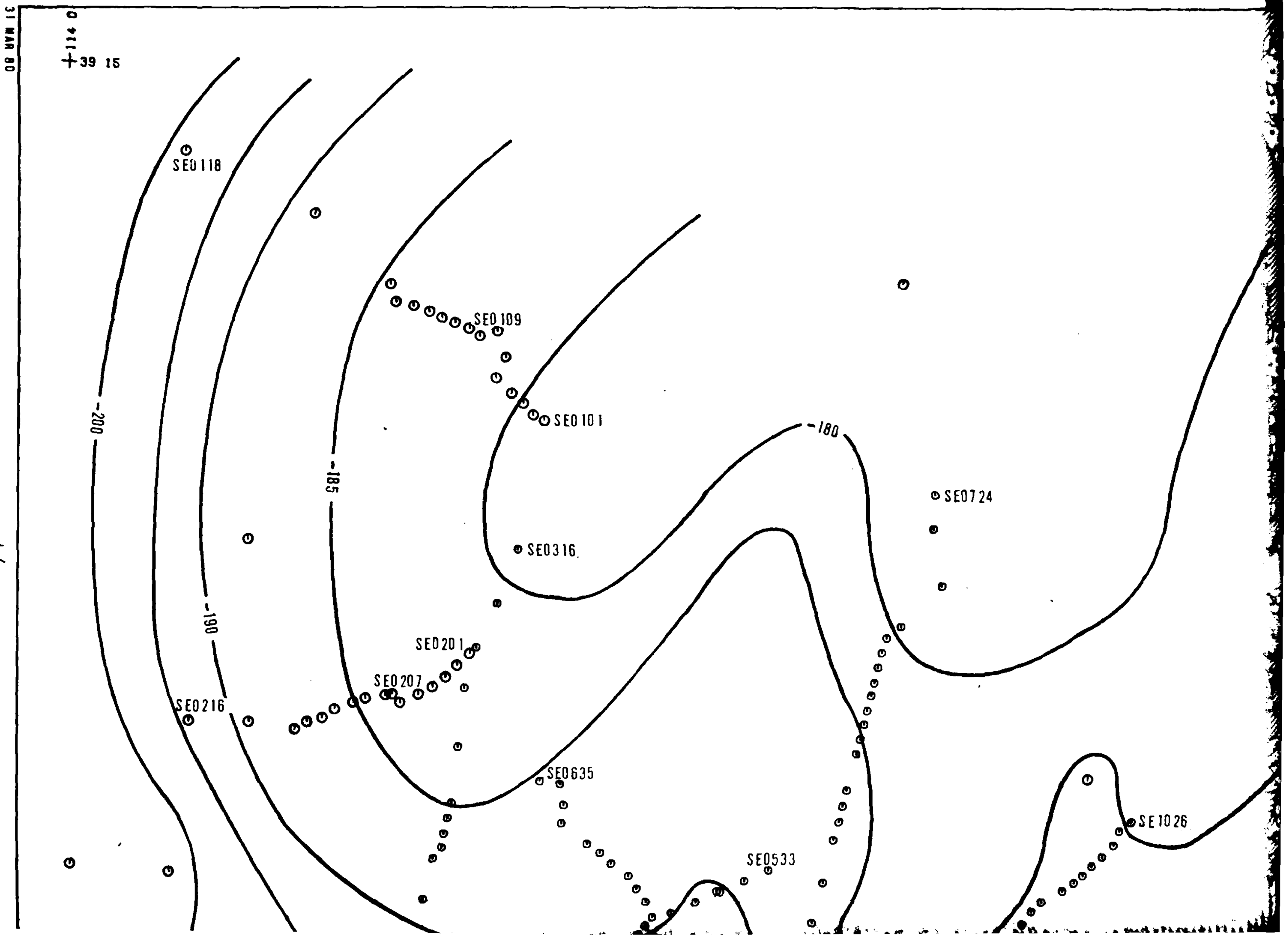

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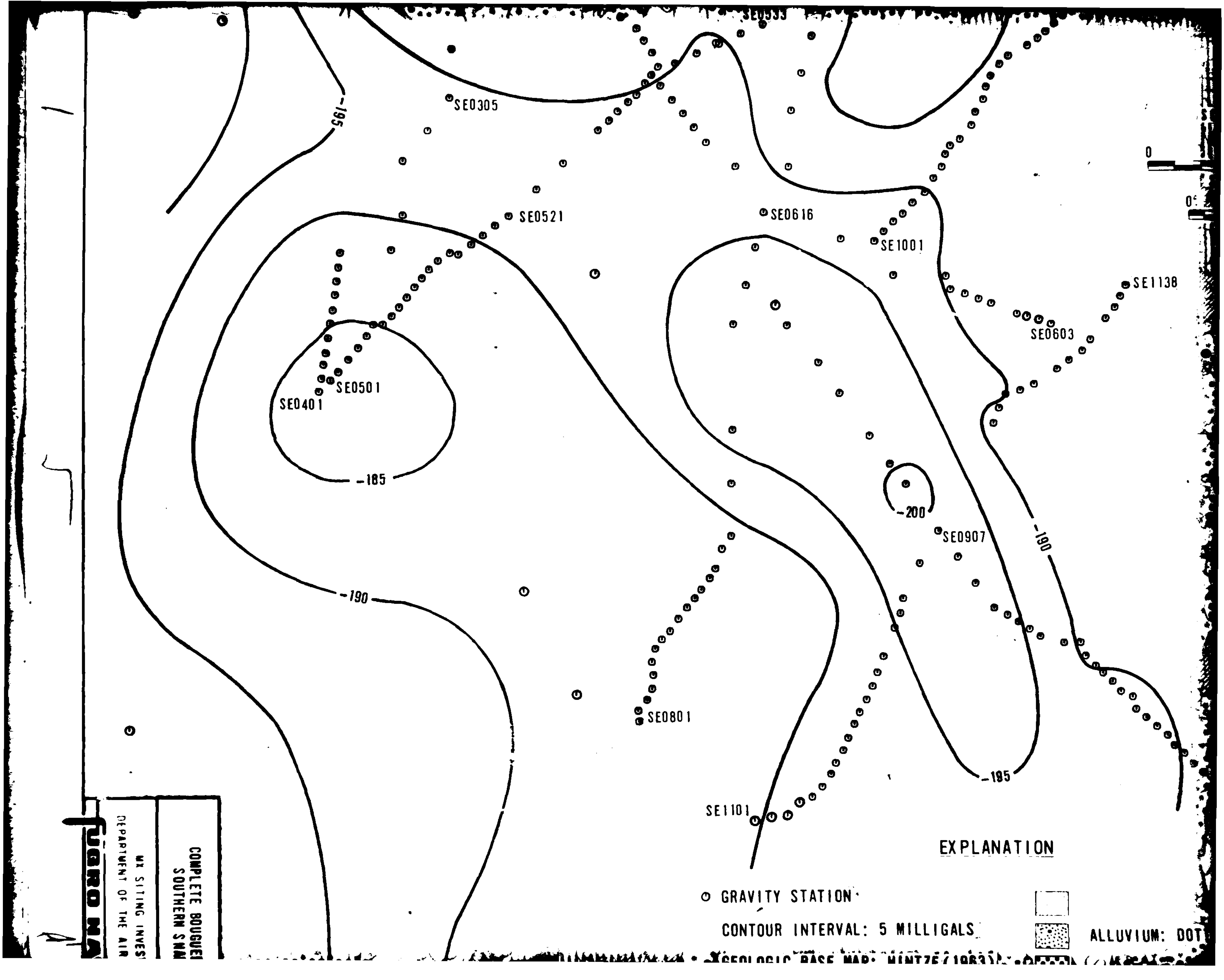
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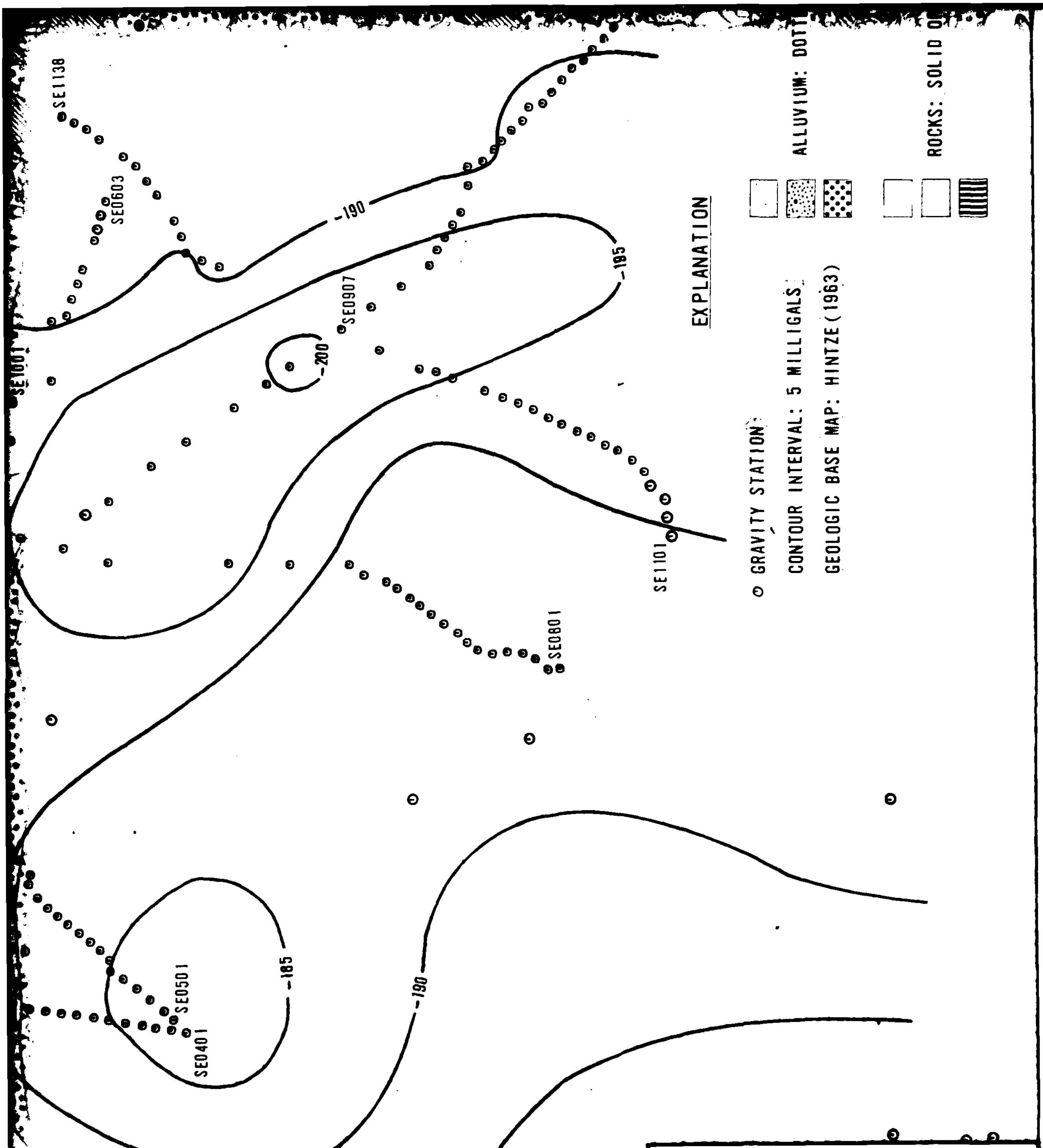

COMPLETE BOUGUER ANOMALY CONTOURS
SOUTHERN SNAKE VALLEY, UTAH

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FIGURE 3

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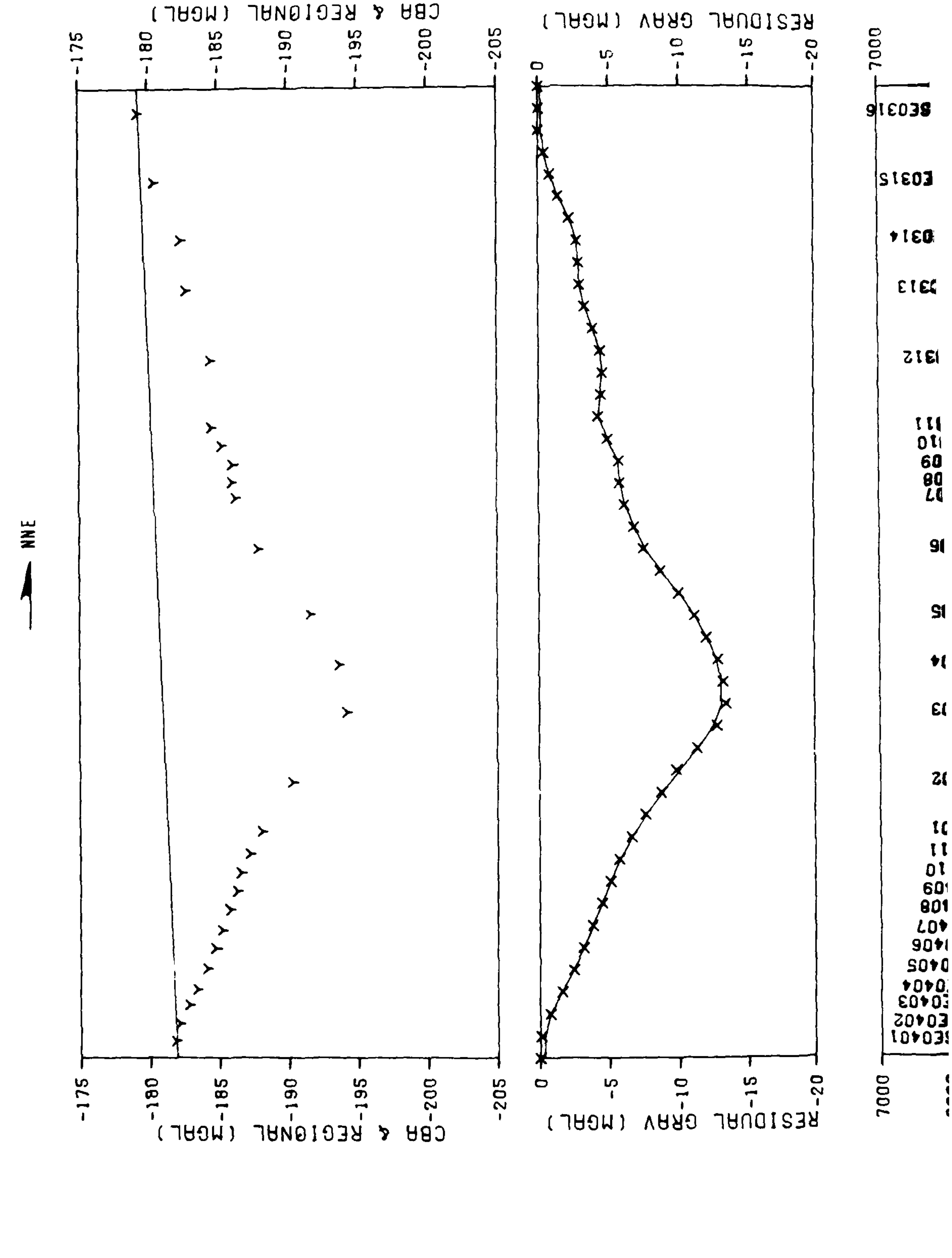
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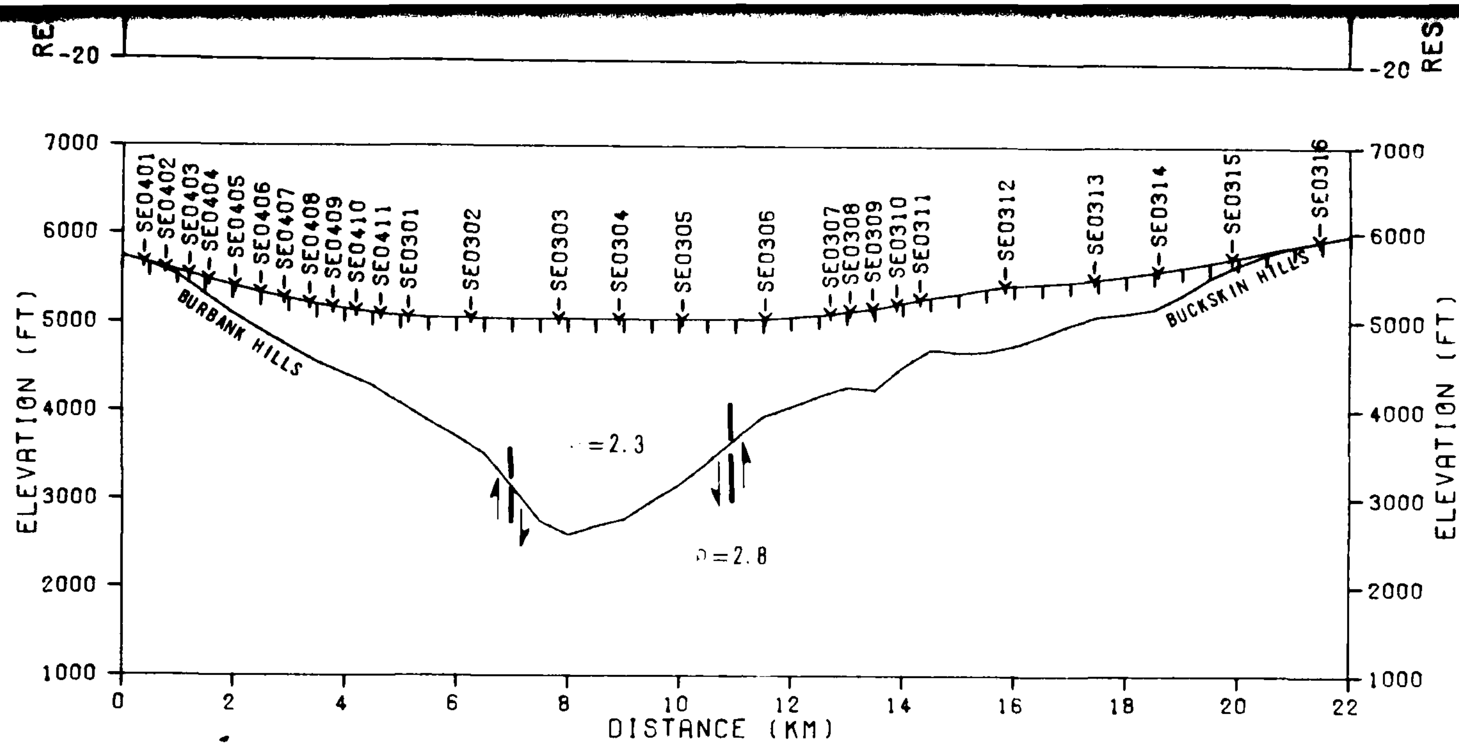

EXPLANATION

TOP	CBA (Y) & REGIONAL ( )
MIDDLE	RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
	CALCULATED FROM MODEL ( )
BOTTOM	ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
	INTERPOLATED SURFACE ELEVATIONS ( )
	MODEL OF BEDROCK SURFACE ( )
	DENSITY VALUES (ρ=2.3) g/cm^3
	DISTANCE SCALE 1:125,000
	GRAVITY INTERPRETED FAULT LOCATION

INTERPRETED GRAVITY PROFILE SE-3,4
SNAKE VALLEY, UTAH

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FIGURE 4

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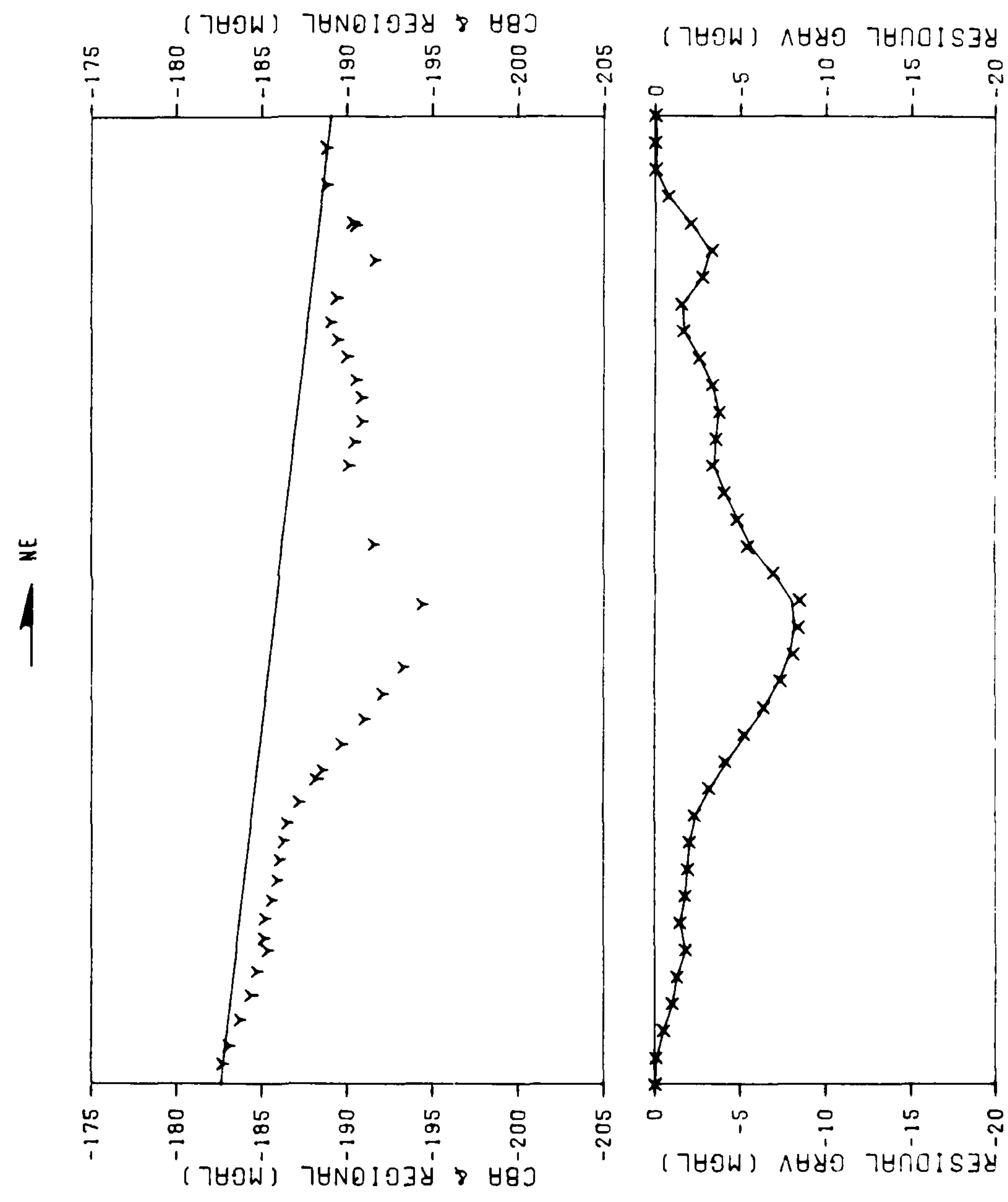
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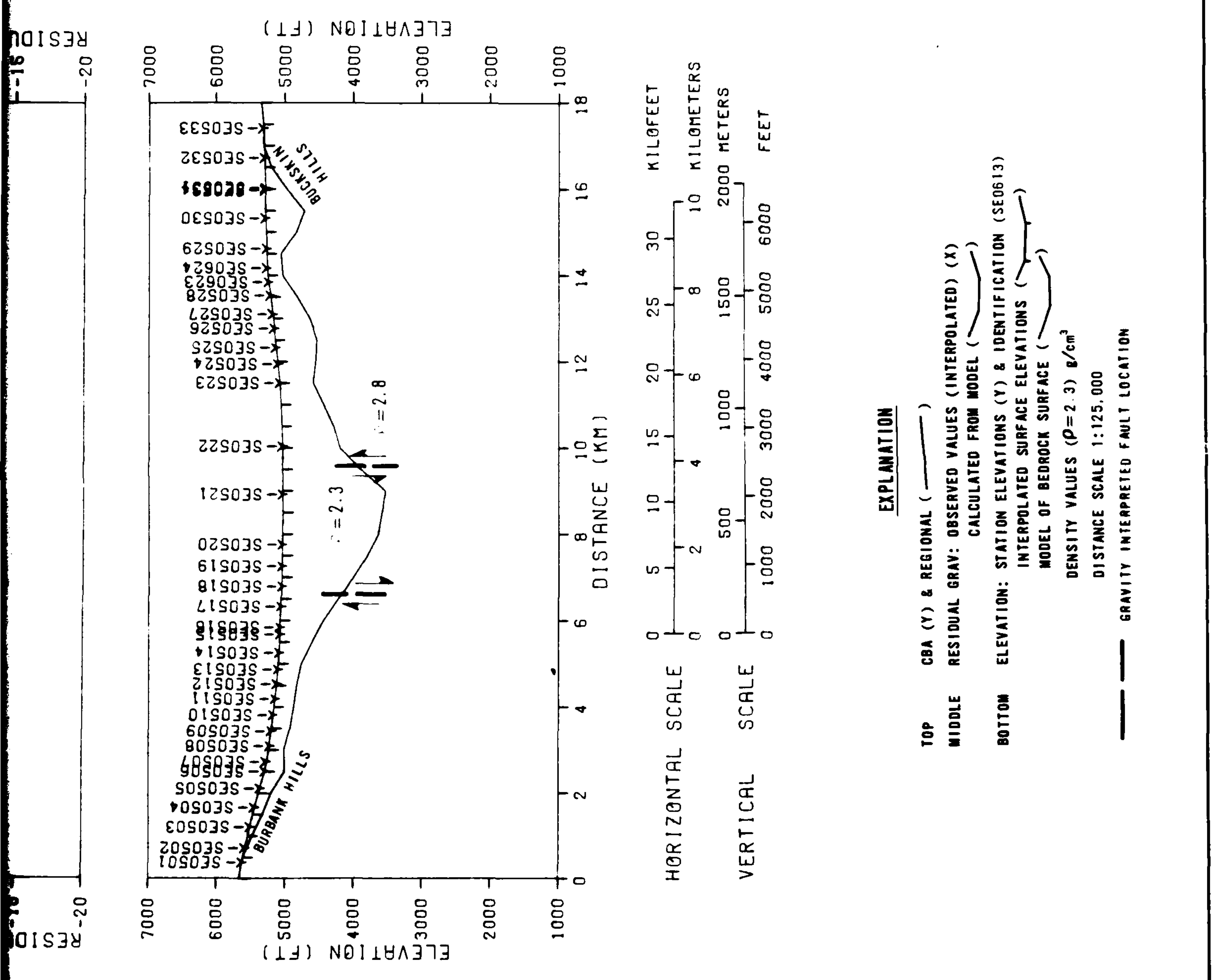

INTERPRETED GRAVITY PROFILE SE-5
SNAKE VALLEY, UTAH

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FIGURE 5

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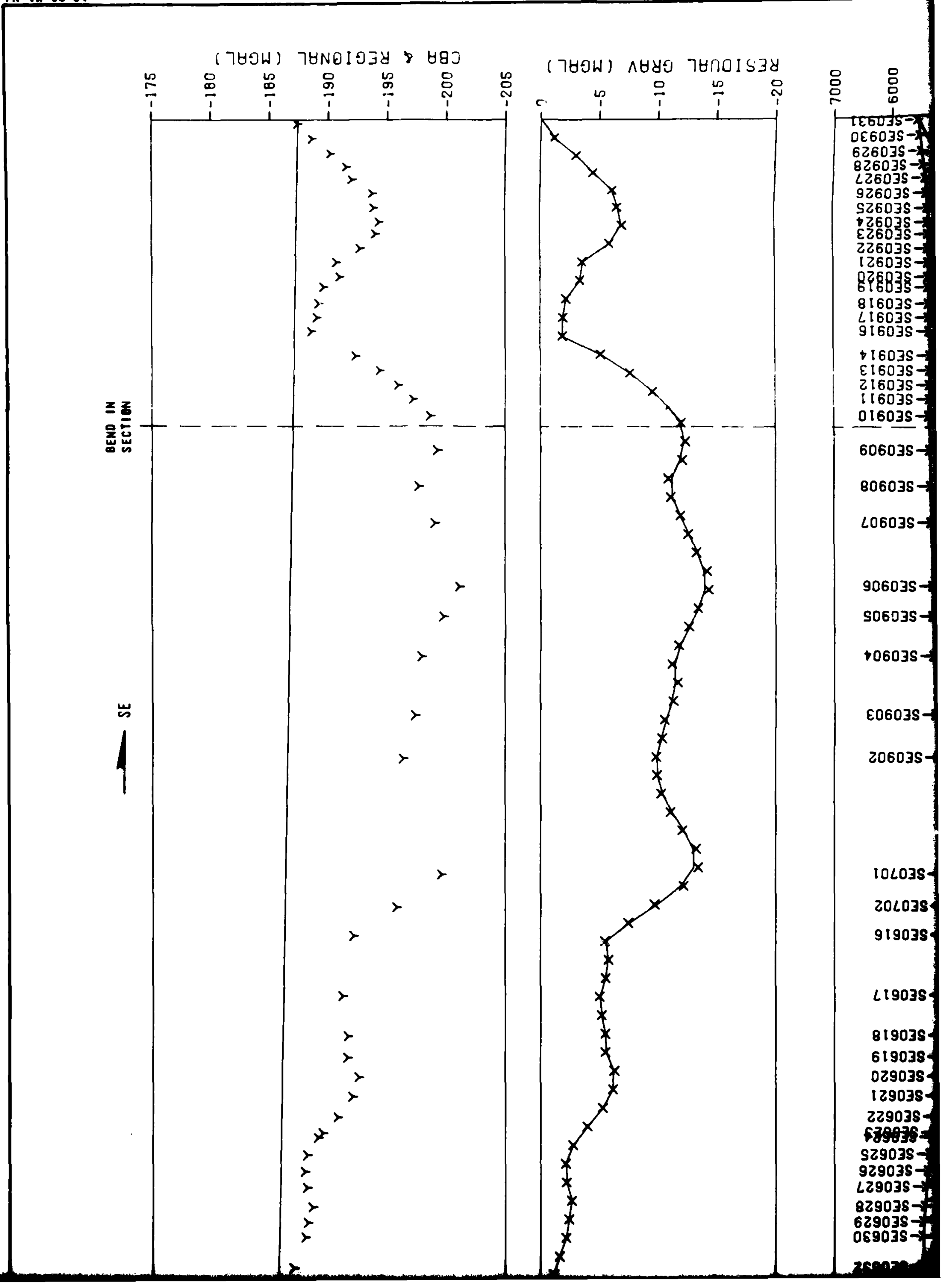

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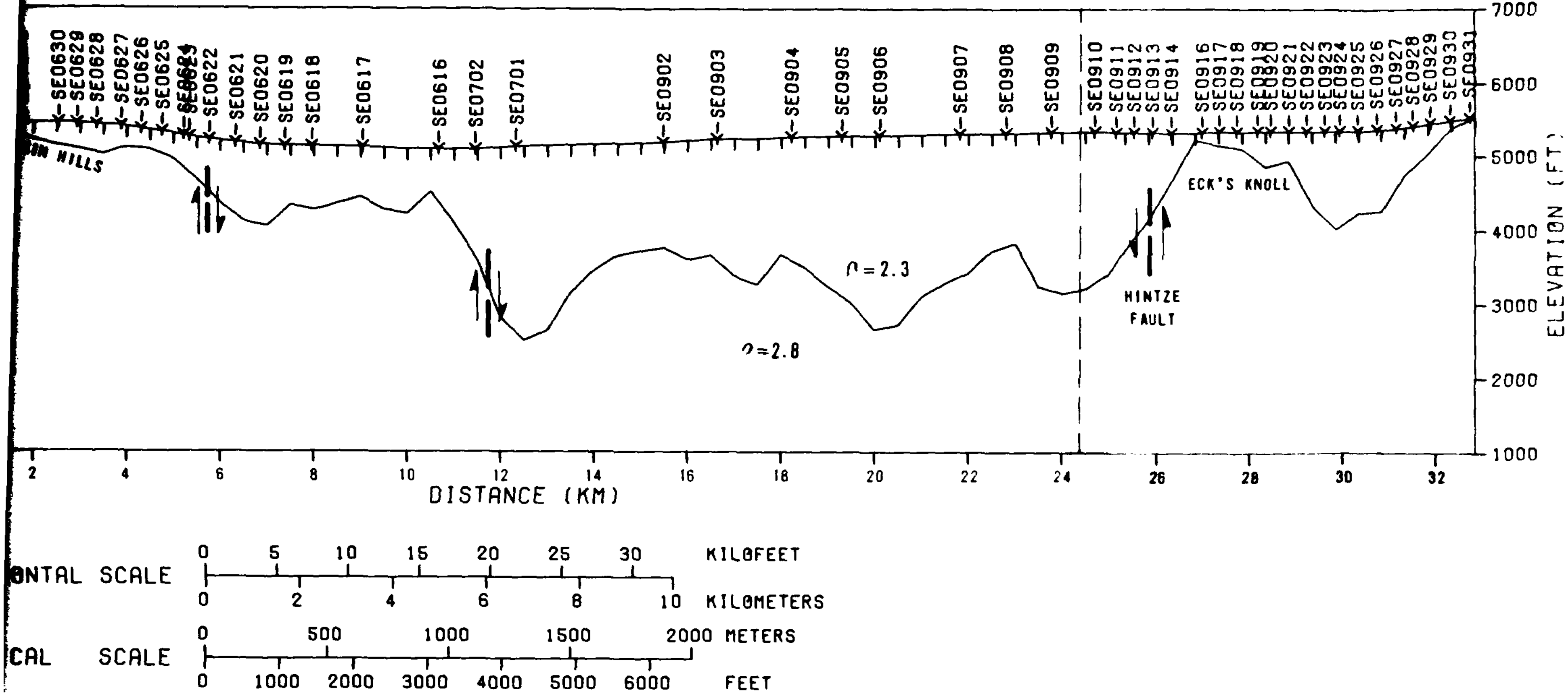


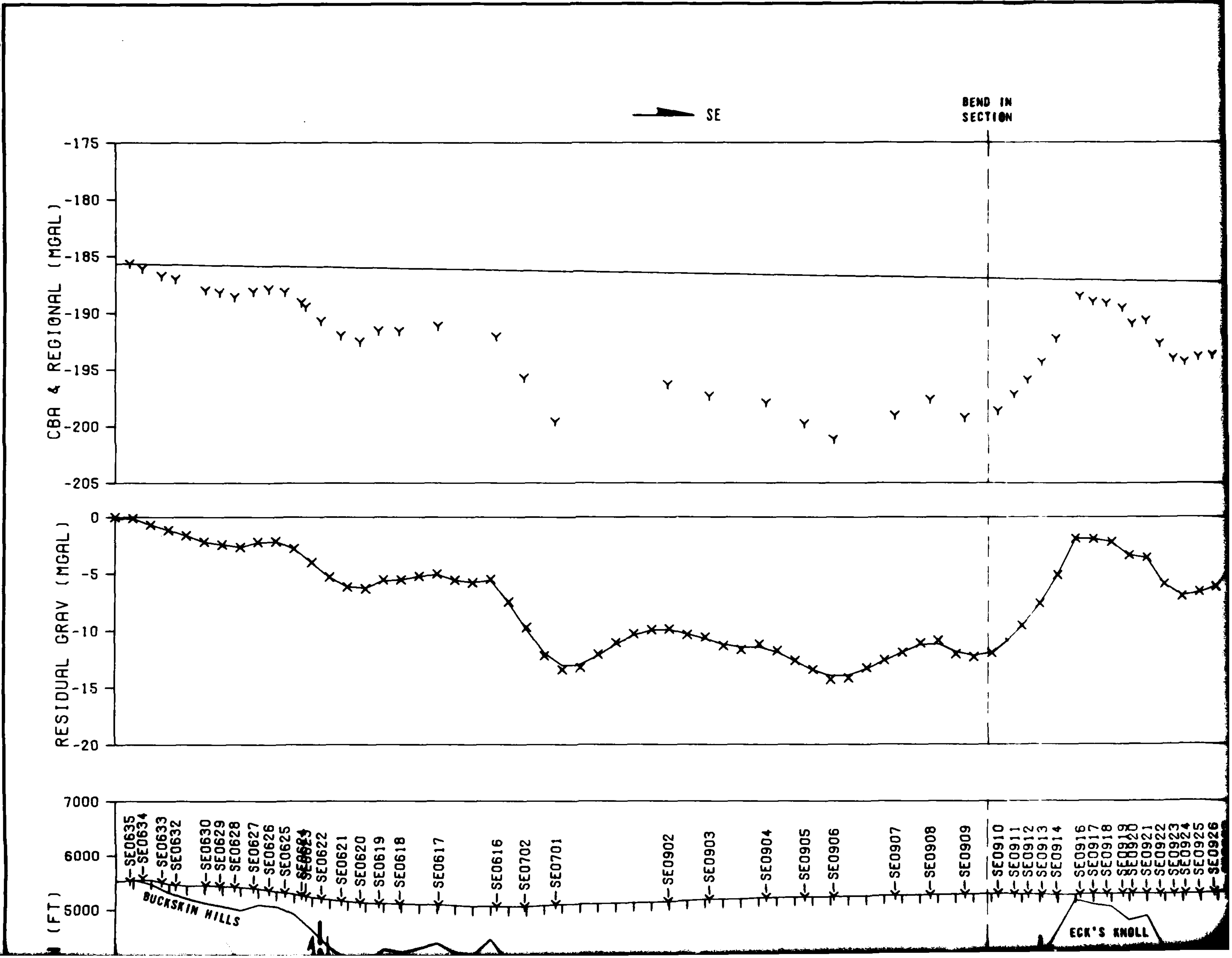
EXPLANATION

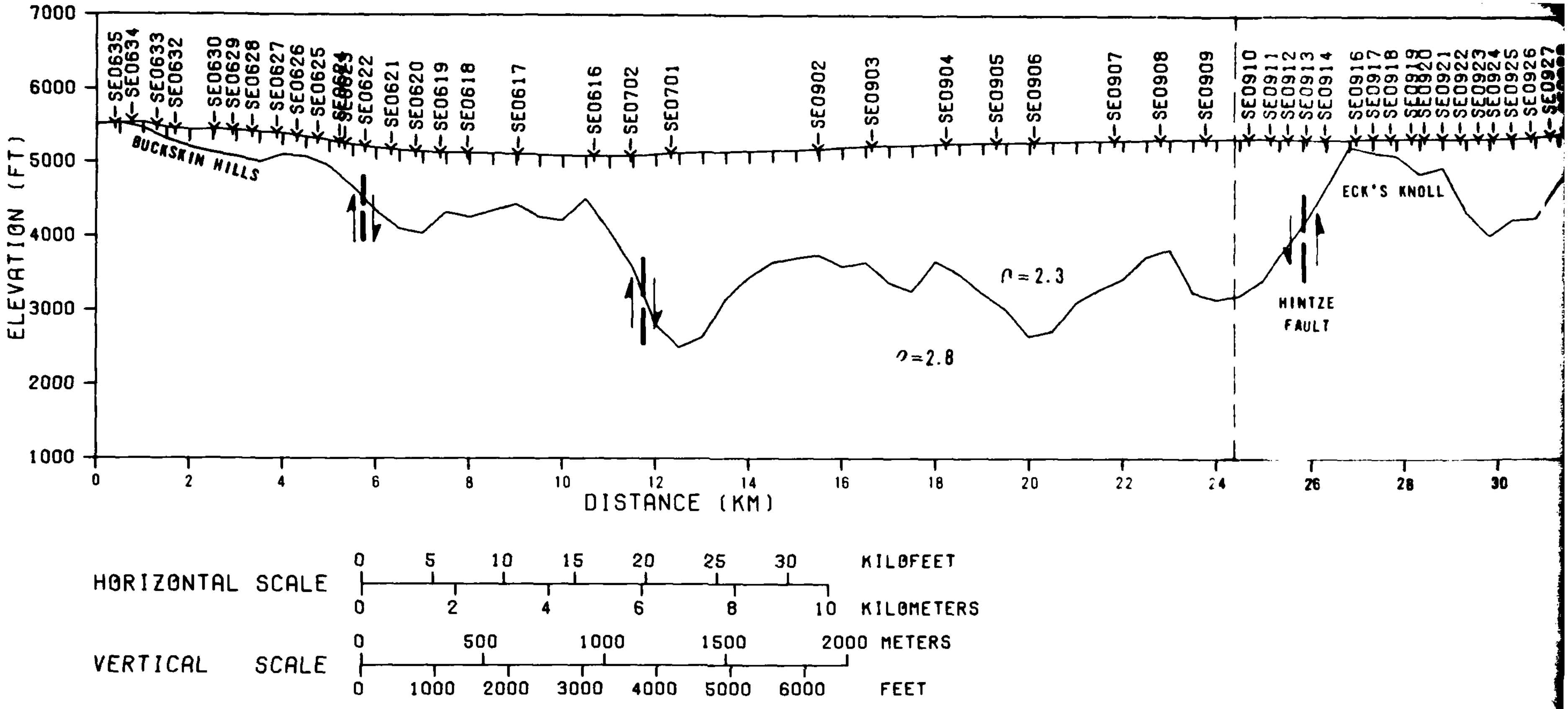
TOP CBA (Y) & REGIONAL (———)

MIDDLE RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (———)

BOTTOM ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS (———)
MODEL OF BEDROCK SURFACE (———)
DENSITY VALUES ($\rho = 2.3$) g/cm^3
DISTANCE SCALE 1:125,000

— — GRAVITY INTERPRETED FAULT LOCATION


SE
BEND IN SECTION
CBA & REGIONAL (MGAL)
-175
-180
-185
-190
-195
-200
-205
RESIDUAL GRAV (MGAL)
0
-5
-10
-15
-20
(FT)
7000
6000
5000
SE0635
SE0634
SE0633
SE0632
SE0630
SE0629
SE0628
SE0627
SE0626
SE0625
SE0622
SE0621
SE0620
SE0619
SE0618
SE0617
SE0616
SE0702
SE0701
SE0902
SE0903
SE0904
SE0905
SE0906
SE0907
SE0908
SE0909
SE0910
SE0911
SE0912
SE0913
SE0914
SE0916
SE0917
SE0918
SE0921
SE0922
SE0923
SE0924
SE0925
SE0926
BUCKSKIN HILLS
ECK'S KNOLL



EXPLANATION

TOP — CBA (Y) & REGIONAL (———)

MIDDLE — RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (———)

BOTTOM — ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS (———)
MODEL OF BEDROCK SURFACE (———)
DENSITY VALUES ($\rho = 2.3$) g/cm^3
DISTANCE SCALE 1:125,000

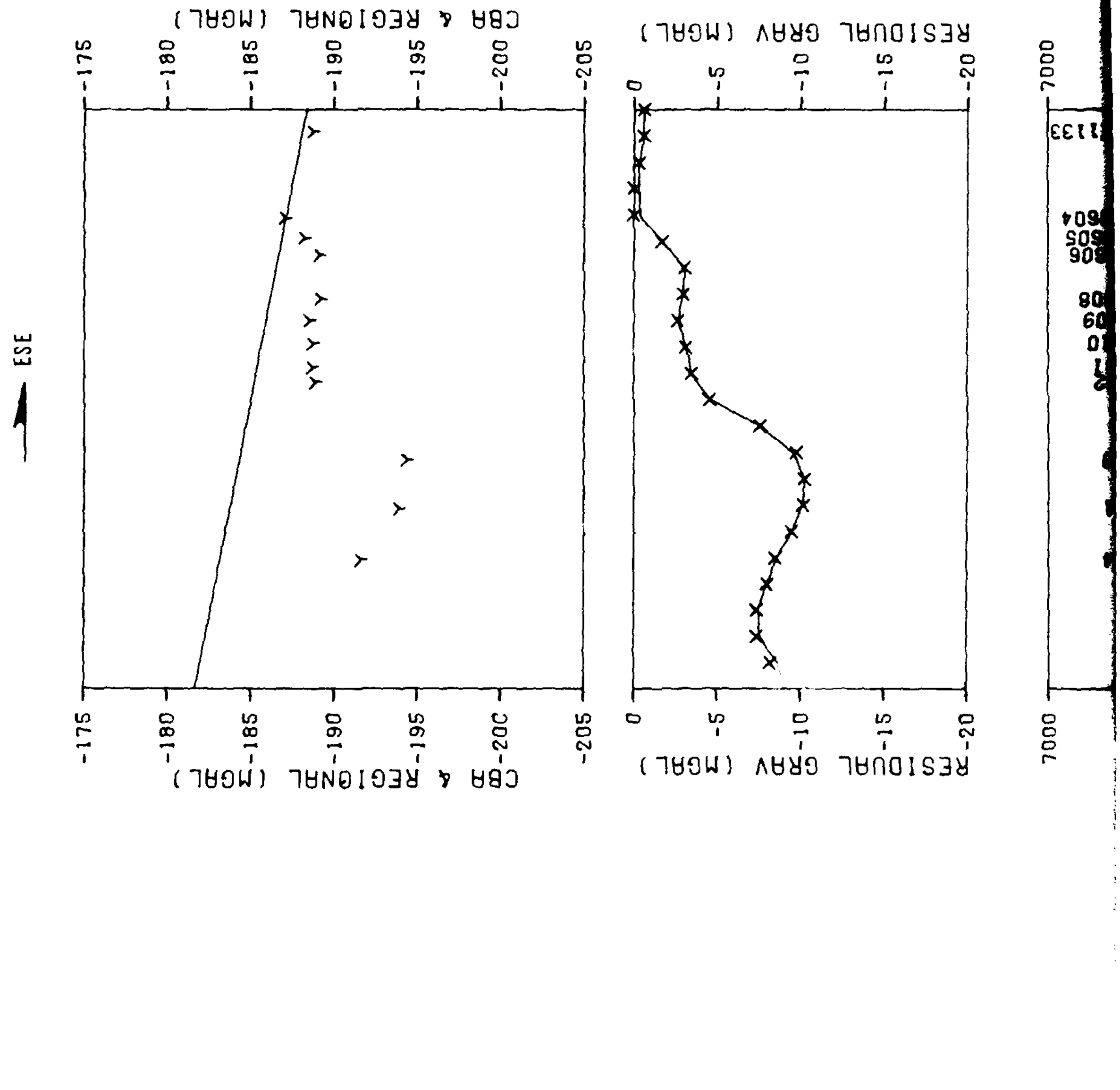
— — GRAVITY INTERPRETED FAULT LOCATION

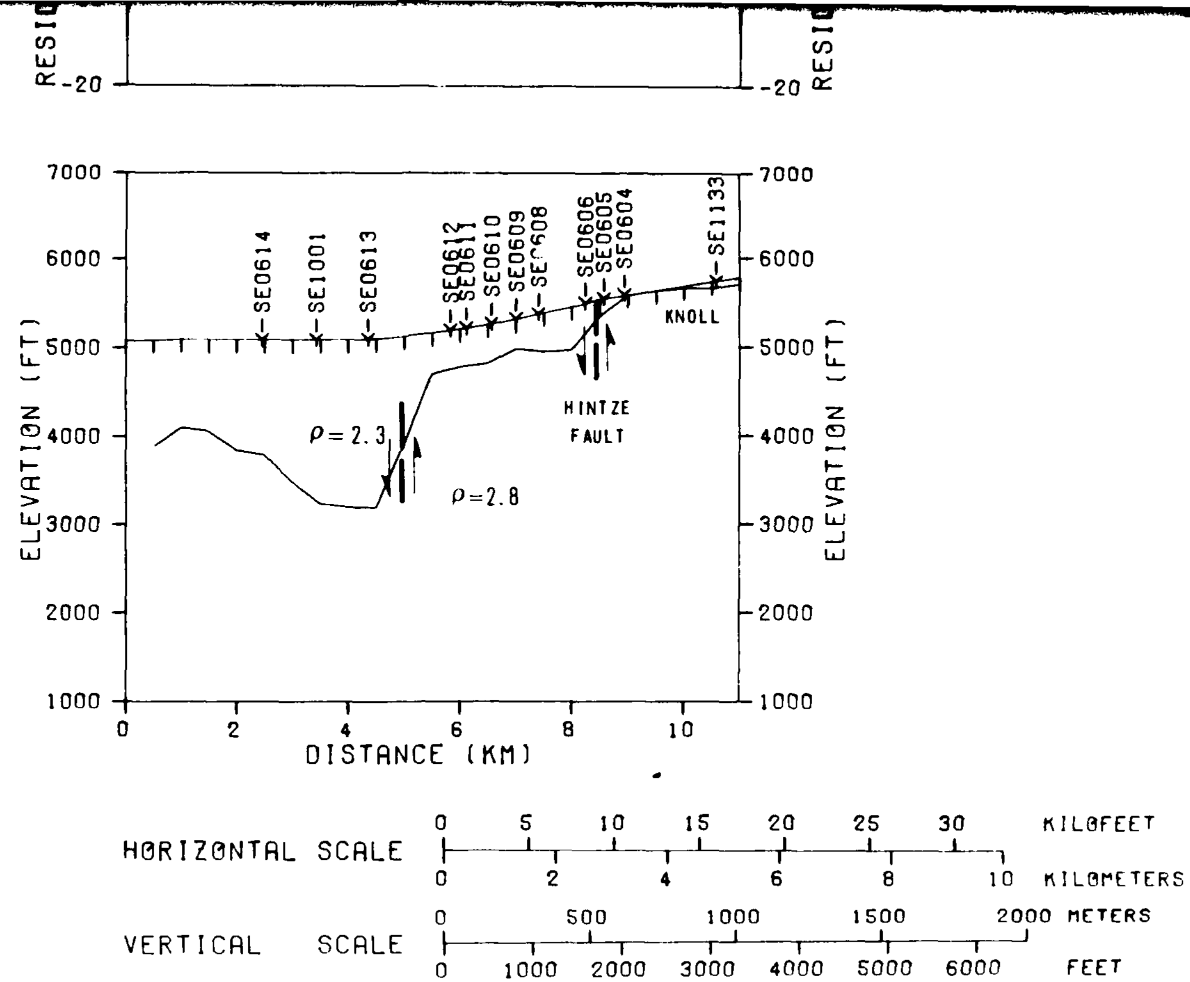
INTERPRETED GRAVITY PROFILE SE-6,9
SNAKE VALLEY, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 6

FUGRO NATIONAL, INC.


CBA & REGIONAL (MGAL)
-175 -180 -185 -190 -195 -200 -205
RESIDUAL GRAV (MGAL)
0 -5 -10 -15 -20
7000
ESE



EXPLANATION

TOP — CBA (Y) & REGIONAL (———)

MIDDLE — RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (———)

BOTTOM — ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS (———)
MODEL OF BEDROCK SURFACE (———)
DENSITY VALUES ($\rho = 2.3$) g/cm^3
DISTANCE SCALE 1:125,000

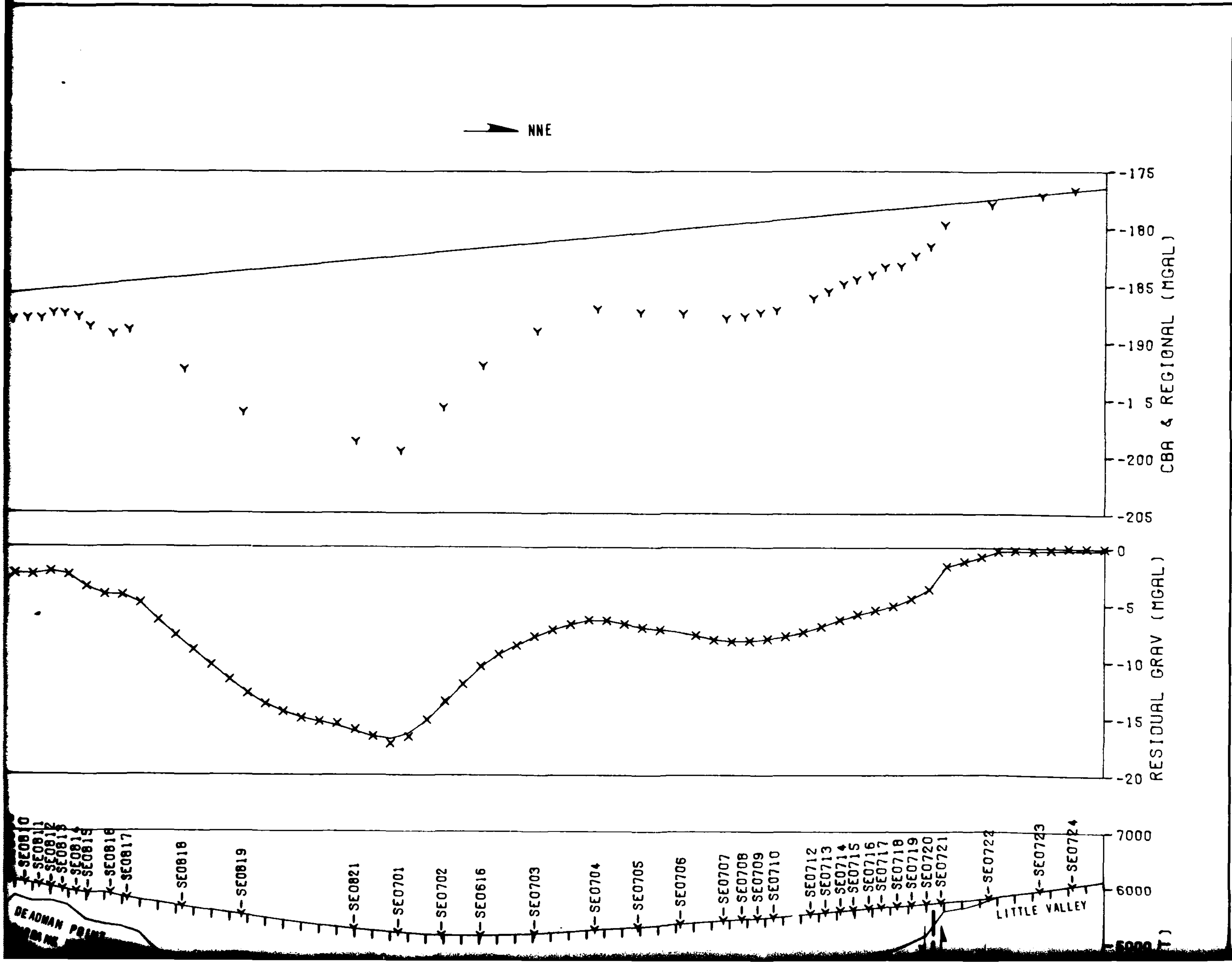
— — GRAVITY INTERPRETED FAULT LOCATION

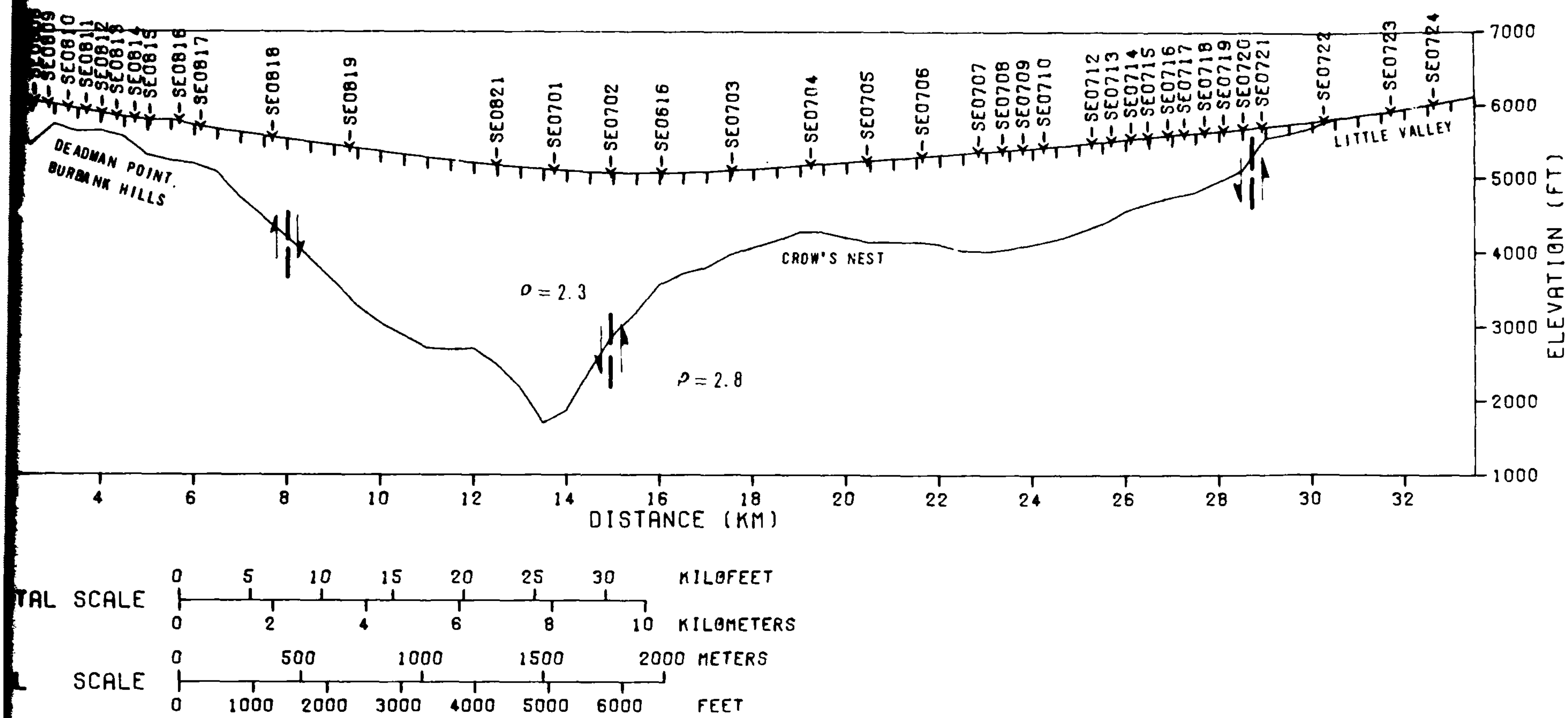
INTERPRETED GRAVITY PROFILE SE-6E
SNAKE VALLEY, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 7

FUGRO NATIONAL, INC.


FN TR 33 SV
NNE
CBA & REGIONAL (MGAL)
-175
-180
-185
-190
-1 5
-200
-205
RESIDUAL GRAV (MGAL)
0
-5
-10
-15
-20
7000
6000
5000
SE0810
SE0811
SE0812
SE0813
SE0814
SE0815
SE0816
SE0817
SE0818
SE0819
SE0821
SE0701
SE0702
SE0616
SE0703
SE0704
SE0705
SE0706
SE0707
SE0708
SE0709
SE0710
SE0712
SE0713
SE0714
SE0715
SE0716
SE0717
SE0718
SE0719
SE0720
SE0721
SE0722
SE0723
SE0724
LITTLE VALLEY
DEADMAN POINT



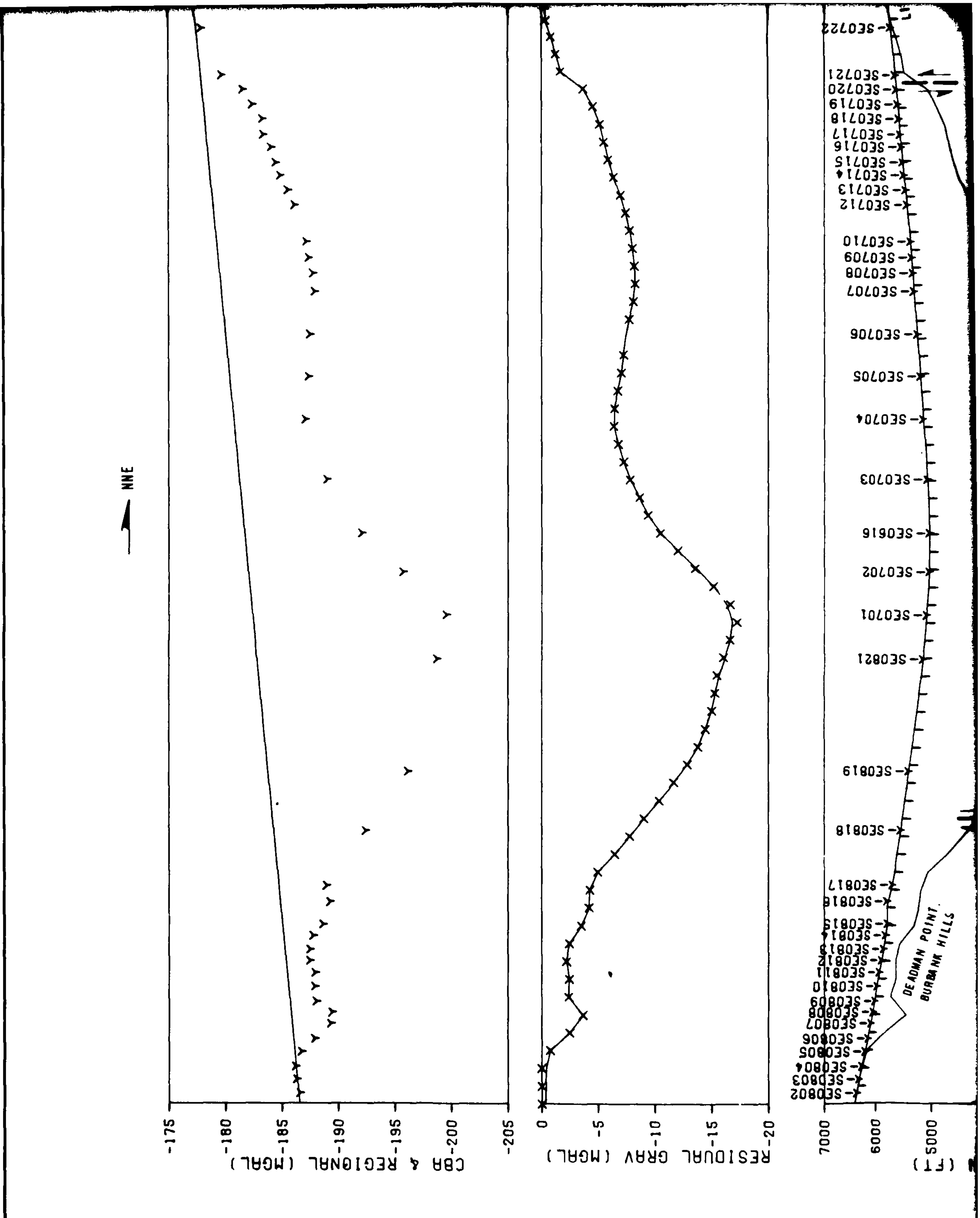
EXPLANATION

TOP CBA (Y) & REGIONAL (———)

MIDDLE RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (⌣)

BOTTOM ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS ( )
MODEL OF BEDROCK SURFACE ( )
DENSITY VALUES ($\rho = 2.3$) g/cm^3
DISTANCE SCALE 1:125,000

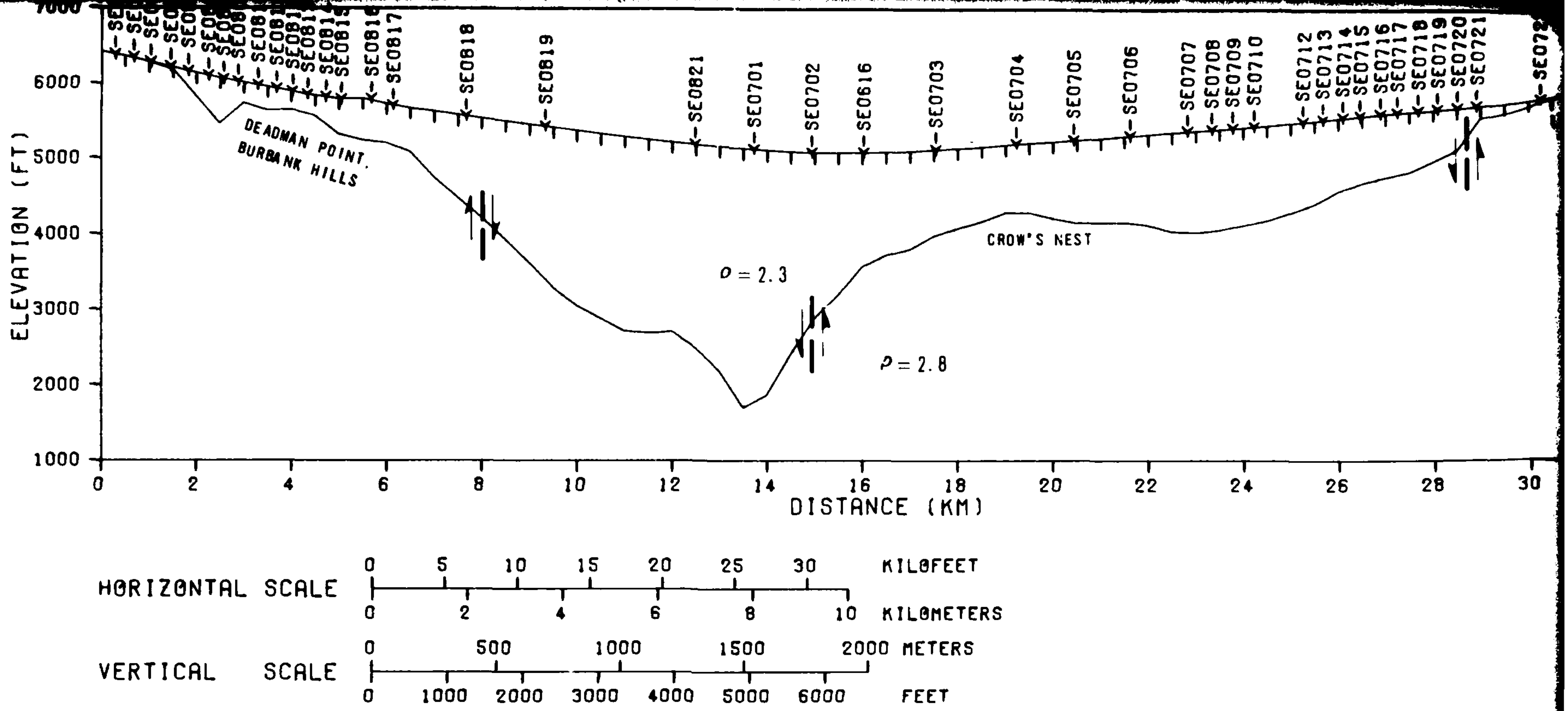
GRAVITY INTERPRETED FAULT LOCATION



NNE
CBA & REGIONAL (MGAL)
-175 -180 -185 -190 -195 -200 -205
RESIDUAL GRAV (MGAL)
0 -5 -10 -15 -20
(FT)
7000 6000 5000
DEADMAN POINT
BURBANK HILLS
SE0722
SE0721
SE0720
SE0719
SE0718
SE0717
SE0716
SE0715
SE0714
SE0713
SE0712
SE0710
SE0709
SE0708
SE0707
SE0706
SE0705
SE0704
SE0703
SE0616
SE0702
SE0701
SE0821
SE0819
SE0818
SE0817
SE0816
SE0815
SE0814
SE0813
SE0812
SE0811
SE0810
SE0809
SE0808
SE0807
SE0806
SE0805
SE0804
SE0803
SE0802

31 MAR 80

3



EXPLANATION

TOP — CBA (Y) & REGIONAL (———)

MIDDLE — RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (⌣)

BOTTOM — ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS (⌣)
MODEL OF BEDROCK SURFACE (⌣)
DENSITY VALUES ($\rho = 2.3$) g/cm^3
DISTANCE SCALE 1:125,000

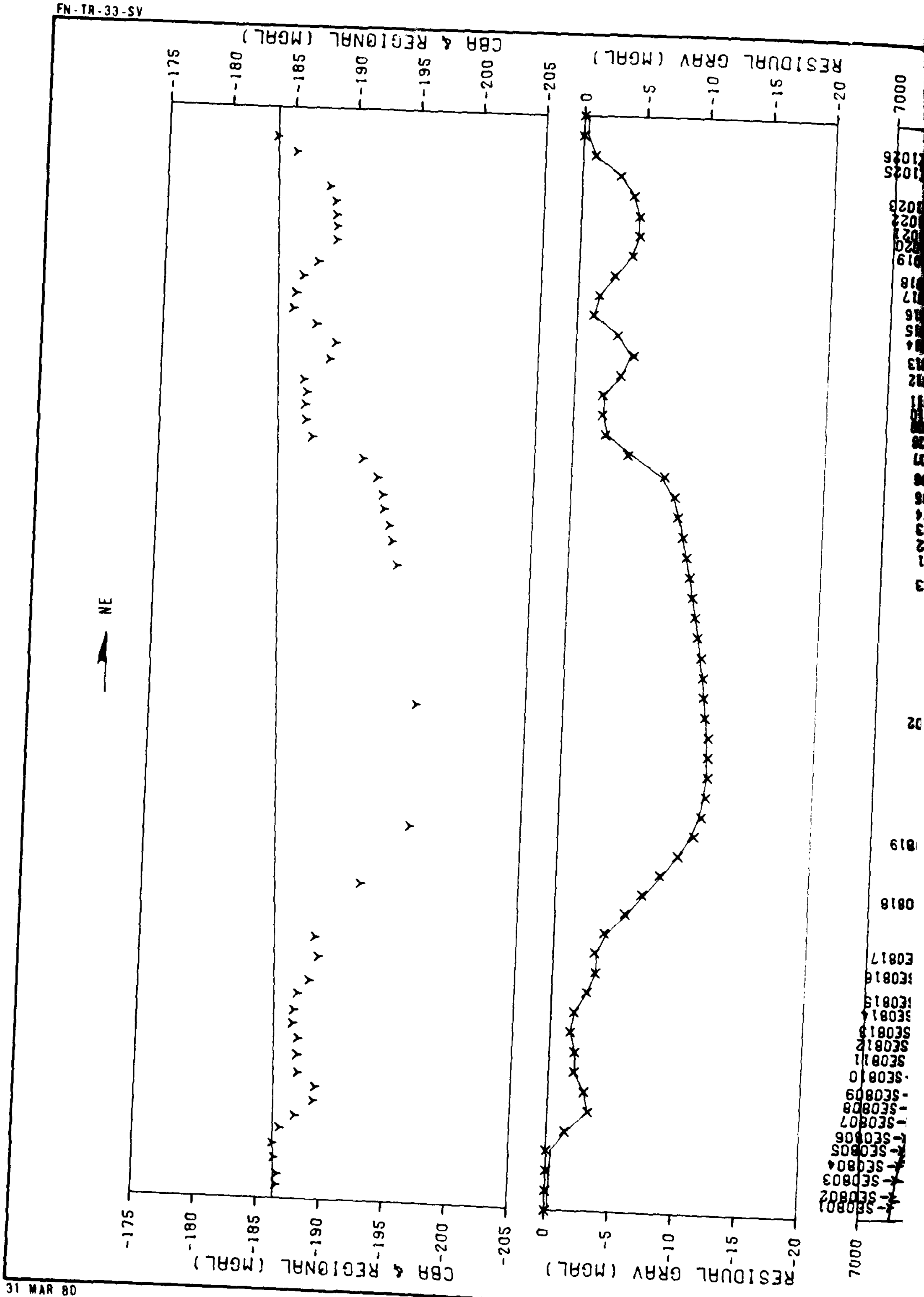
▬ ▬ GRAVITY INTERPRETED FAULT LOCATION

INTERPRETED GRAVITY PROFILE SE-7,8
SNAKE VALLEY, UTAH

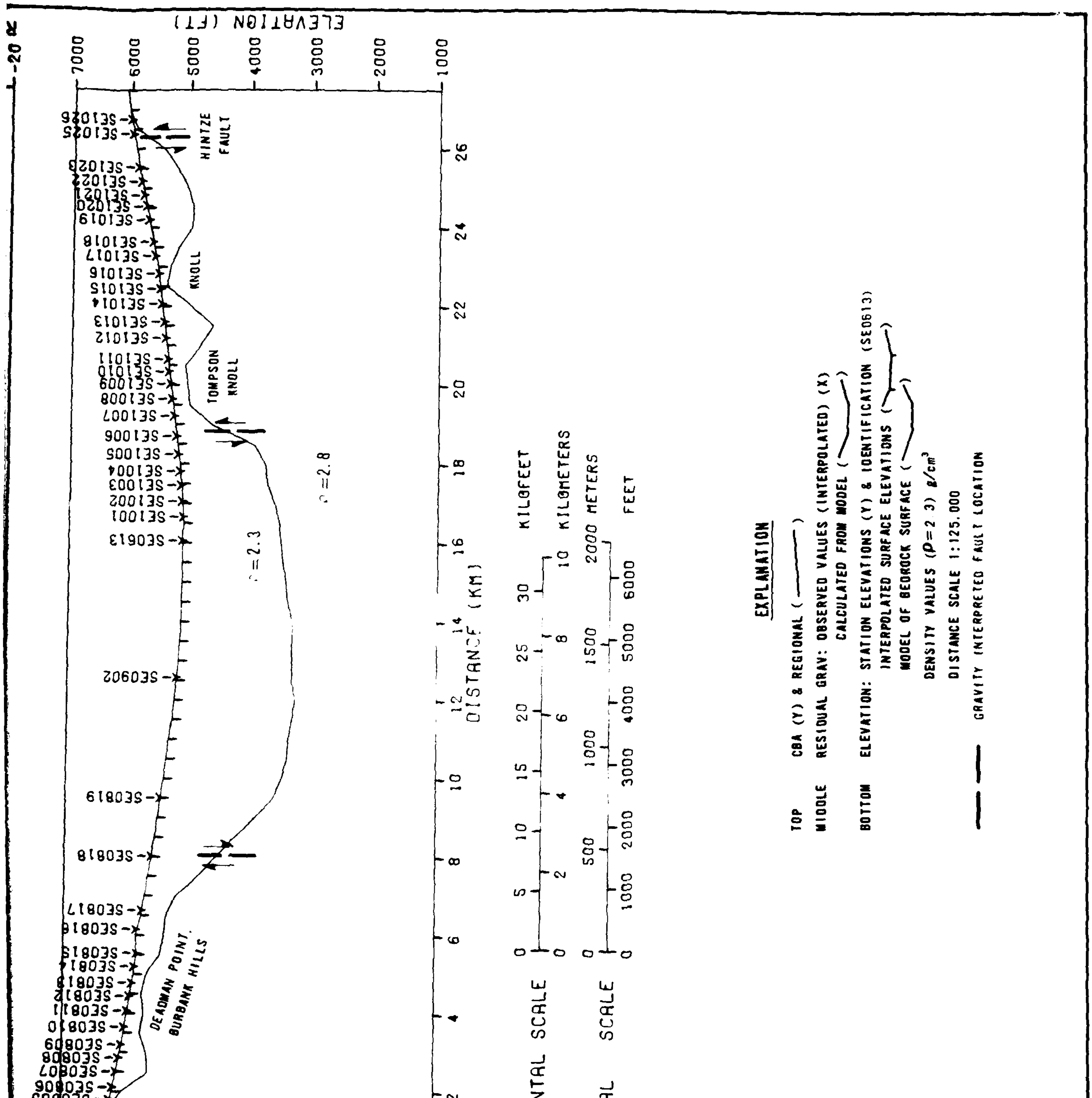
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 8

FUGRO NATIONAL, INC.



FN-TR-33-SV
CBA & REGIONAL (MGAL)
RESIDUAL GRAV (MGAL)
NE
31 MAR 80

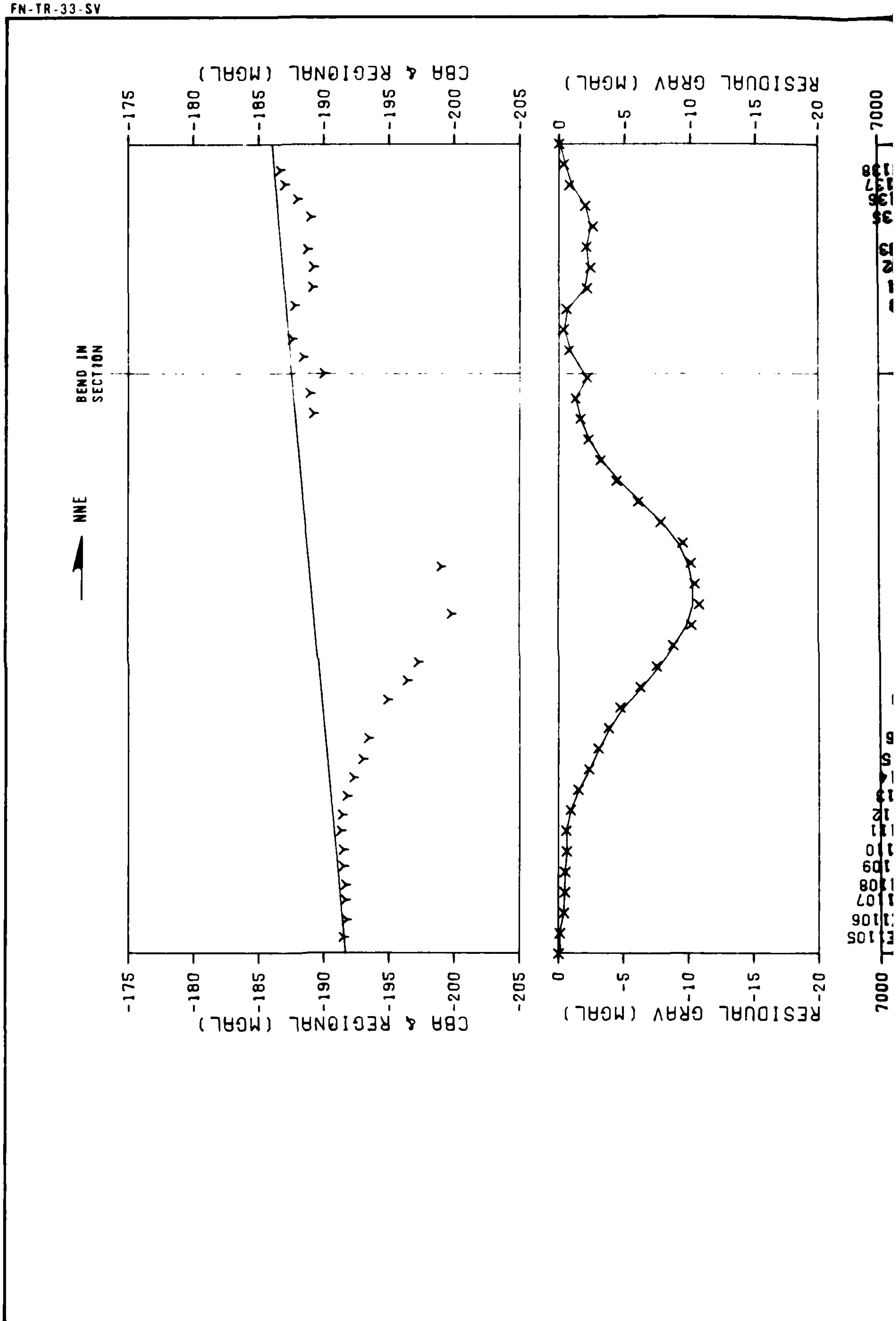


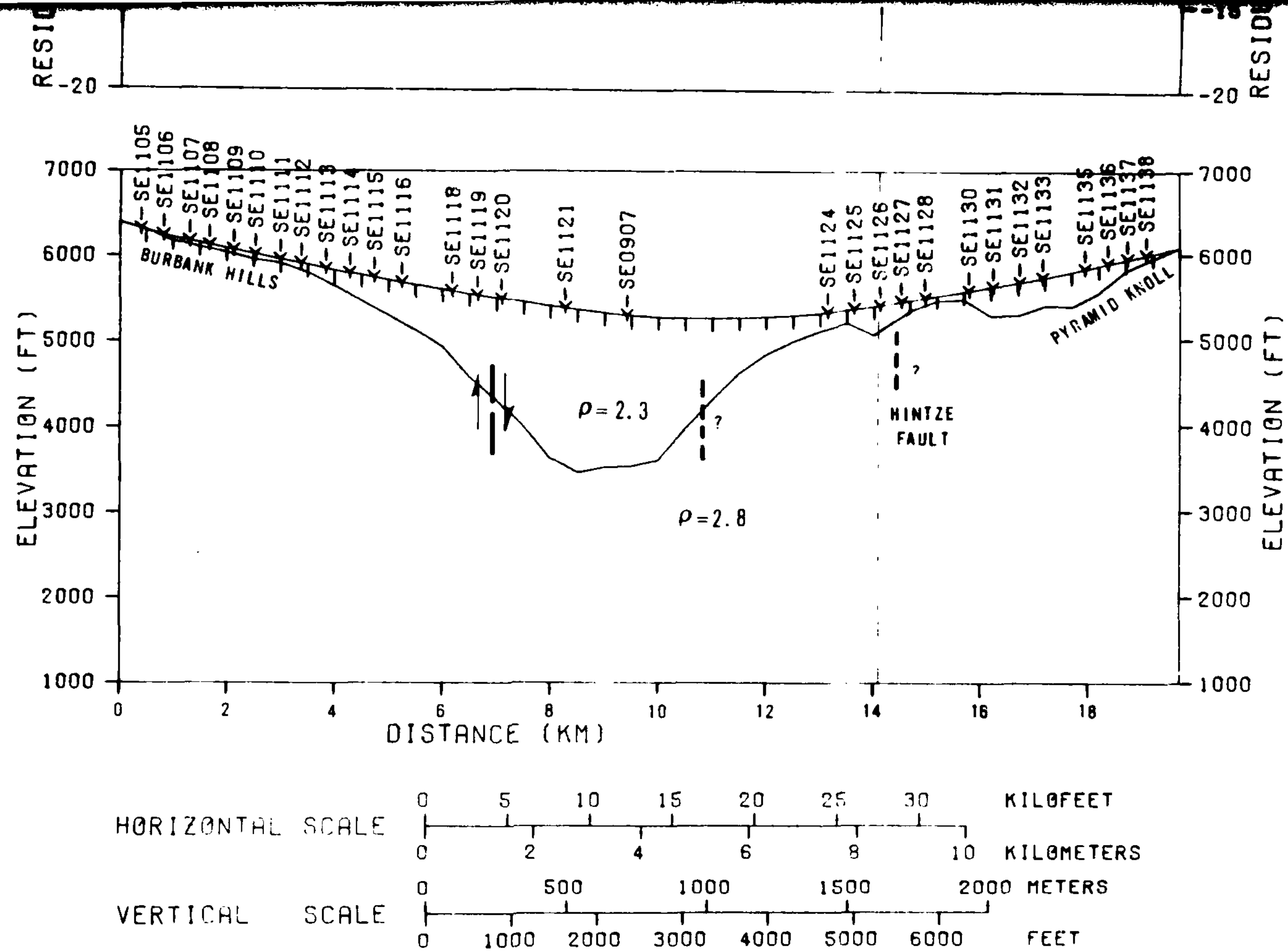
INTERPRETED GRAVITY PROFILE SE-8, 10
SNAKE VALLEY, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 9

FUGRO NATIONAL, INC.


CBA & REGIONAL (MGAL)
RESIDUAL GRAV (MGAL)
BEND IN SECTION
NNE
-175
-180
-185
-190
-195
-200
-205
0
-5
-10
-15
-20
7000



EXPLANATION

TOP — CBA (Y) & REGIONAL (———)

MIDDLE — RESIDUAL GRAV: OBSERVED VALUES (INTERPOLATED) (X)
CALCULATED FROM MODEL (———)

BOTTOM — ELEVATION: STATION ELEVATIONS (Y) & IDENTIFICATION (SE0613)
INTERPOLATED SURFACE ELEVATIONS (———)
MODEL OF BEDROCK SURFACE (———)

DENSITY VALUES ($\rho = 2.3$) g/cm^3

DISTANCE SCALE 1:125,000

— — GRAVITY INTERPRETED FAULT LOCATION

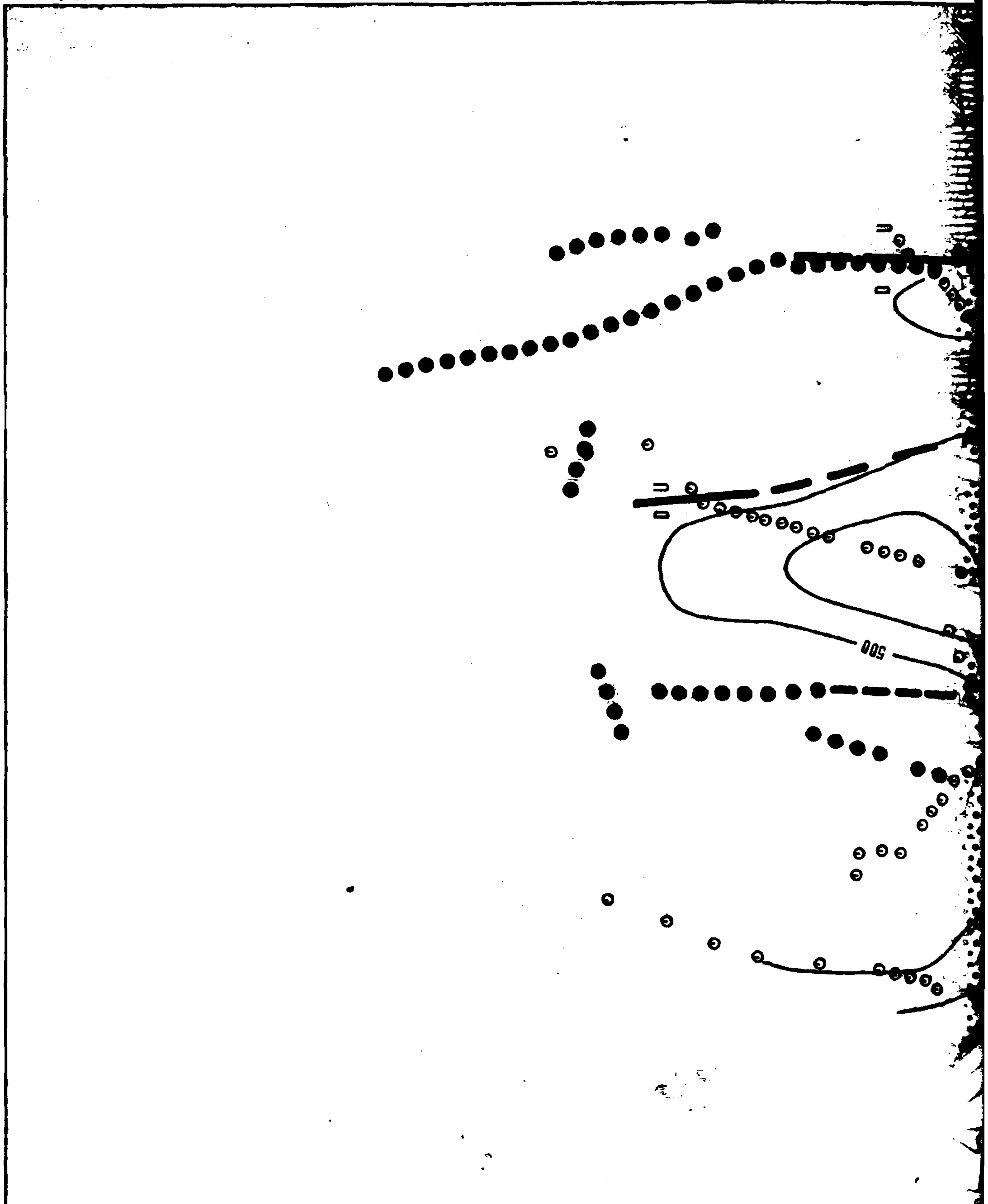
INTERPRETED GRAVITY PROFILE SE-11
SNAKE VALLEY, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

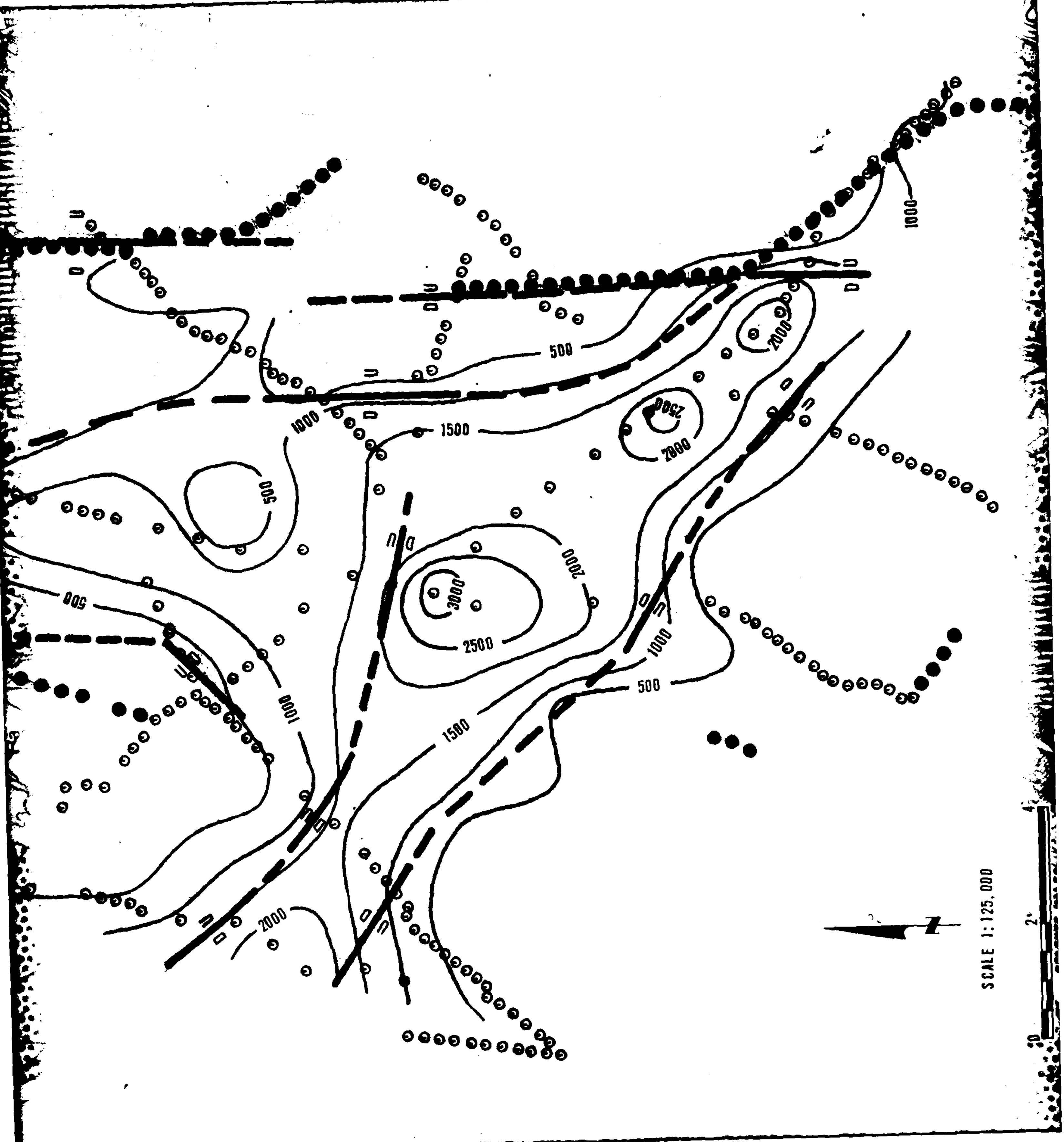
FIGURE 10

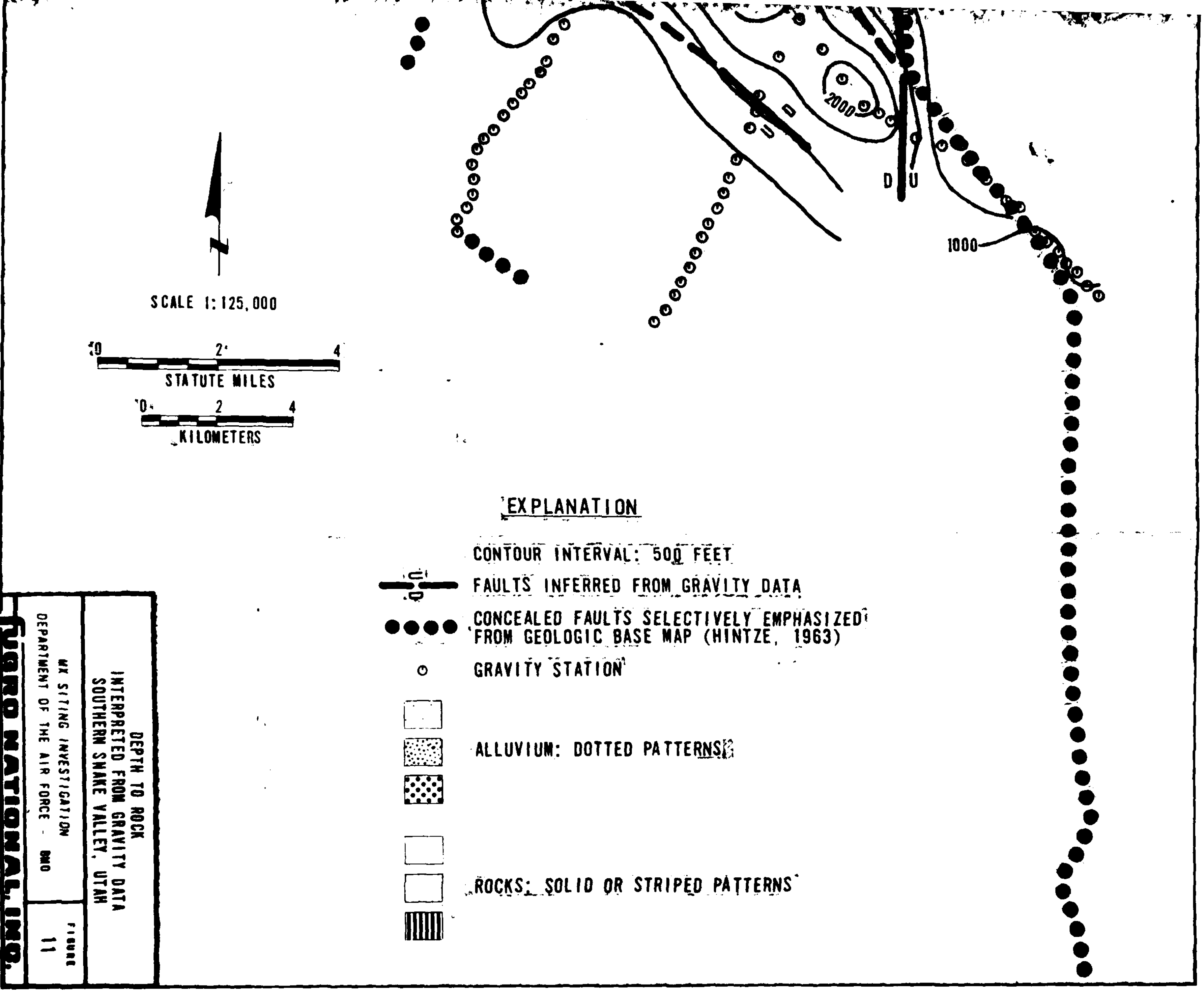
FUGRO NATIONAL, INC.

FN-TR-33-SV



31 MAR 80


500
1000
1500
2000
2500
3000
SCALE 1:125,000
0
2
4



DEPTH TO ROCK
INTERPRETED FROM GRAVITY DATA
SOUTHERN SNAKE VALLEY, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 11

FUGRO NATIONAL, INC.

3

APPENDIX A1.0

GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.0 GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.1 GENERAL

A gravity survey involves measurement of differences in the gravitational field between various points on the earth's surface. The gravitational field values being measured are the same as those influencing all objects on the surface of the earth. They are generally associated with the force which causes a 1 gm mass to b accelerated at 980 cm/sec^2. This force is normally referred to as a 1 g force.

Even though in many applications the gravitational field at the earth's surface is assumed to be constant, small but distinguishable differences in gravity occur from point to point. In a gravity survey, the variations are measured in terms of milligals. A milligal is equal to 0.001 cm/second^2 or 0.00000102 g. The differences in gravity are caused by geometrical effects, such as differences in elevation and latitude, and by lateral variations in density within the earth. The lateral density variations are a result of changes in geologic conditions. For measurements at the surface of the earth, the largest factor influencing the pull of gravity is the density of all materials between the center of the earth and the point of measurement.

To detect changes produced by differing geological conditions, it is necessary to detect differences in the gravitational field as small as a few milligals. To recognize changes due to geological conditions, the measurements are "corrected" to account for changes due to differences in elevation and latitude.

Given this background, the basic concept of the gravitational exploration method, the anomaly, can be introduced. If, instead of being an oblate spheroid characterized by complex density variations, the earth were made up of concentric, homogeneous shells, the gravitational field would be the same at all points on the surface of the earth. The complexities in the earth's shape and material distribution are the reason that the pull of gravity is not the same from place to place. A difference in gravity between two points which is not caused by the effects of known geometrical differences, such as in elevation, latitude, and surrounding terrain, is referred to as an "anomaly."

An anomaly reflects lateral differences in material densities. The gravitational attraction is smaller at a place underlain by relatively low density material than it is at a place underlain by a relatively high density material. The term "negative gravity anomaly" describes a situation in which the pull of gravity within a prescribed area is small compared to the area surrounding it. Low-density alluvial deposits in basins such as those in the Nevada-Utah region produce negative gravity anomalies in relation to the gravity values in the surrounding mountains which are formed by more dense rocks.

The objective of gravity exploration is to deduce the variations in geologic conditions that produce the gravity anomalies identified during a gravity survey.

A1.2 INSTRUMENTS

The sensing element of a LaCoste and Romberg gravimeter is a mass suspended by a zero-length spring. Deflections of the mass from a null position are proportional to changes in gravitational attraction. These instruments are sealed and compensated for atmospheric pressure changes. They are maintained at a constant temperature by an internal heater element and thermostat. The absolute value of gravity is not measured directly by a gravimeter. It measures relative values of gravity between one point and the next. Gravitational differences as small as 0.01 milligal can be measured.

A1.3 FIELD PROCEDURES

The gravimeter readings were calibrated in terms of absolute gravity by taking readings twice daily at nearby USGS gravity base stations. Gravimeter readings fluctuate because of small time-related deviations due to the effect of earth tides and instrument drift. Field readings were corrected to account for these deviations. The magnitude of the tidal correction was calculated using an equation suggested by Goguel (1954):

$$C = P + N\cos\phi\,(\cos\phi + \sin\phi) + S\cos\phi\,(\cos\phi - \sin\phi)$$

where C is the tidal correction factor, P, N, and S are time-related variables, and ϕ is the latitude of the observation point. Tables giving the values of P, N, and S are published annually by the European Association of Exploration Geophysicists.

The meter drift correction was based on readings taken at a designated base station at the start and end of each day. Any difference between these two readings after they were corrected for tidal effects was considered to have been the result of instrumental drift. It was assumed that this drift occurred at a uniform rate between the two readings. Corrections for drift were typically only a few hundredths of a milligal. Readings corrected for tidal effects and instrumental drift represented the observed gravity at each station. The observed gravity values represent the total gravitational pull of the entire earth at the measurement stations.

A1.4 DATA REDUCTION

Several corrections or reductions are made to the observed gravity to isolate the portion of the gravitational pull which is due to the crustal and near-surface materials. The gravity remaining after these reductions is called the "Bouguer Anomaly." Bouguer Anomaly values are the basis for geologic interpretation. To obtain the Bouguer Anomaly, the observed gravity is adjusted to the value it would have had if it had been measured at the geoid, a theoretically defined surface which approximates the surface of mean sea level. The difference between the "adjusted" observed gravity and the gravity at the geoid calculated for a theoretically homogeneous earth is the Bouguer Anomaly.

Four separate reductions, to account for four geometrical effects, are made to the observed gravity at each station to arrive at its Bouguer Anomaly value.

a. Free-Air Effect: Gravitational attraction varies inversely as the square of the distance from the center of the earth. Thus corrections must be applied for elevation. Observed gravity levels are corrected for elevation using the normal vertical gradient of:

$$FA = -0.09406 \text{ mg/ft } (-0.3086 \text{ milligals/meter})$$

where FA is the free-air effect (the rate of change of gravity with distance from the center of the earth). The free-air correction is positive in sign since the correction is opposite the effect.

b. Bouguer Effect: Like the free-air effect, the Bouguer effect is a function of the elevation of the station, but it considers the influence of a slab of earth materials between the observation point on the surface of the earth and the corresponding point on the geoid (sea level). Normal practice, which is to assume that the density of the slab is 2.67 grams per cubic centimeter was followed in these studies. The Bouguer correction (B_c), which is opposite in sign to the free-air correction, was defined according to the following formula.

$$B_c = 0.01276 \ (2.67) \ h_f \text{ (milligals per foot)}$$

$$B_c = 0.04185 \ (2.67) \ h_m \text{ (milligals per meter)}$$

where h_f is the height above sea level in feet and h_m is the height in meters.

c. Latitude Effect: Points at different latitudes will have different "gravities" for two reasons. The earth (and the geoid) is spheroidal, or flattened at the poles. Since points at higher latitudes are closer to the center of the earth than points near the equator, the gravity at the higher latitudes is larger. As the earth spins, the centrifugal acceleration causes a slight decrease in gravity. At the higher latitudes where the earth's radii are smaller, the centrifugal acceleration diminishes. The gravity formula for the Geodetic Reference System, 1967, gives the theoretical value of gravity at the geoid as a function of latitude. It is:

$$g = 978.0381\ (1 + 0.0053204 \sin^2 \phi - 0.0000058 \sin^2 2\phi) \text{ gals}$$

where g is the theoretical acceleration of gravity and ϕ is the latitude in degrees. The positive term accounts for the spheroidal shape of the earth. The negative term adjusts for the centrifugal acceleration.

The previous two corrections (free air and Bouguer) have adjusted the observed gravity to the value it would have had at the geoid (sea level). The theoretical value at the geoid for the latitude of the station is then subtracted from the adjusted observed gravity. The remainder is called the Simple Bouguer Anomaly (SBA). Most of this gravity represents the effect of material beneath the station, but part of it may be due to irregularities in terrain (upper part of the Bouguer slab) away from the station.

d. Terrain Effect: Topographic relief around the station has a negative effect on the gravitational force at the station. A nearby hill has upward gravitational pull and a nearby valley contributes less downward attraction than a nearby material would have. Therefore, the corrections are always positive. Corrections are made to the SBA when the terrain effects were 0.1 milligal or larger. Terrain corrected Bouguer values are called the Complete Bouguer Anomaly (CBA). When the CBA is obtained, the reduction of gravity at individual measurement points (stations) is complete.

A1.5 INTERPRETATION

The first step in interpretation is to separate the portion of the CBA that might be caused by the lightweight, basin-fill material overlying the heavier bedrock material which forms the surrounding mountains and presumably the basin floor. Since the valley-fill sediments are absent at the stations read in the mountains, the CBA values at these bedrock stations are used as the basis for constructing a regional field over the valley. A regional field is an estimation of the values the CBA would have had if the light weight sediments (the anomaly) had not been there.

The difference between the CBA and the regional field is called the "residual" field or residual anomaly. The residual field is the interpreter's estimation of the gravitational effect of the geologic anomaly. The zero value of the residual anomaly is not exactly at the rock outcrop line but at some distance on the "rock" side of the contact. The reason for this is found in the explanation of the terrain effect. There is a component of gravitational attraction from material which is not directly beneath a point.

If the "regional" is well chosen, the magnitude of the residual anomaly is a function of the thickness of the anomalous (fill) material and the density contrast. The density contrast is the difference in density between the alluvial and bedrock material. If this contrast were known, an accurate calculation of the thickness could be made. In most cases, the densities are not well known and they also vary within the study area. In these cases, it is necessary to use typical densities for materials similar to those in the study area.

If the selected average density contrast is smaller than the actual density contrast, the computed depth to bedrock will be greater than the actual depth and vice-versa. The computed depth is inversely proportional to the density contrast. A ten percent error in density contrast produces a ten percent error in computed depth. An iterative computer program is used to calculate a subsurface model which will yield a gravitational field to match (approximately) the residual gravity anomaly.

APPENDIX A2.0

SOUTHERN SNAKE VALLEY

GRAVITY DATA

PROFILE 3,4

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
SE0401	385700	1135584	5669Y	1	194431550	76600155179207577	950	81811
SE0402	385721	1135579	5600Y	0	180431589	76606155607207608	702	81782
SE0403	385744	1135575	5532Y	0	175431632	76610155985207642	404	81712
SE0404	385763	1135570	5472Y	0	166431667	76616156322207670	151	81653
SE0405	385788	1135565	5397Y	0	155431714	76622156750207707	-162	81584
SE0406	385813	1135561	5326Y	0	147431760	76626157164207744	-455	81526
SE0407	385835	1135557	5265Y	0	141431801	76631157517207776	-707	81476
SE0408	385860	1135553	5207Y	0	135431848	76635157848207813	-959	81416
SE0409	385882	1135550	5163Y	0	130431889	76638158106207845	-1153	81368
SE0410	385905	1135546	5123Y	0	124431931	76642158353207879	-1317	81335
SE0411	385929	1135543	5086Y	0	120431976	76645158553207915	-1501	81273
SE0301	385935	1135436	5048Y	1	121431992	76799158701207923	-1720	81186
SE0302	385992	1135413	5033S	18	107432099	76829158648208008	-1995	80964
SE0303	39 81	1135415	5029S	0	96432263	76820158440208138	-2371	80572
SE0304	39 131	1135364	5022Y	0	93432358	76891158611208213	-2341	80624
SE0305	39 186	1135319	5020S	0	93432462	76952158910208294	-2141	80830
SE0306	39 268	1135317	5029Y	0	96432614	76950159351208414	-1737	81206
SE0307	39 329	1135298	5083Y	0	100432728	76973159270208505	-1396	81366
SE0308	39 346	1135282	5116Y	0	102432760	76995159122208530	-1261	81392
SE0309	39 367	1135278	5141Y	0	105432799	77000158999208560	-1176	81393
SE0310	39 390	1135271	5192Y	0	109432842	77008158801208595	-936	81466
SE0311	39 412	1135263	5244Y	0	109432883	77018158587208627	-685	81537
SE0312	39 495	1135252	5396Y	0	115433037	77029157806208749	-164	81548
SE0313	39 581	1135241	5468Y	0	125433197	77039157668208876	247	81724
SE0314	39 641	1135220	5565Y	0	135433309	77066157194208965	606	81759
SE0315	39 706	1135180	5713Y	0	148433431	77119156580209060	1288	81950
SE0316	39 786	1135142	5909Y	8	149433581	77169155627209179	2062	82064

END OF LIST

PROFILE 5

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
SE0501	385718	1135560	5623Y	0	190431585	76634155391207604	712	81723
SE0502	385732	1135544	5586Y	0	193431611	76656155596207624	545	81685
SE0503	385753	1135523	5503Y	0	209431651	76685156045207655	182	81621
SE0504	385772	1135502	5441Y	0	196431687	76714156399207683	-79	81559
SE0505	385792	1135484	5359Y	0	182431725	76739156899207713	-377	81526
SE0506	385811	1135470	5288Y	0	172431761	76758157298207741	-674	81461
SE0507	385812	1135450	5275Y	1	177431764	76787157393207742	-704	81482
SE0508	385826	1135432	5216Y	0	177431791	76812157768207763	-912	81476
SE0509	385841	1135417	5196Y	0	156431819	76832157887207785	-1000	81435
SE0510	385857	1135401	5170Y	0	145431850	76854158047207809	-1105	81406
SE0511	385874	1135385	5139Y	0	137431882	76876158251207834	-1216	81392
SE0512	385889	1135370	5119Y	0	130431910	76897158376207855	-1301	81368
SE0513	385903	1135356	5099Y	0	124431937	76917158504207877	-1388	81345
SE0514	385918	1135337	5078Y	0	119431966	76943158584207898	-1522	81276
SE0515	385931	1135312	5065Y	0	116431991	76978158595207917	-1660	81182
SE0516	385929	1135294	5068Y	0	115431988	77004158532207915	-1686	81142
SE0517	385945	1135268	5049Y	0	112432019	77041158561207938	-1866	81027
SE0518	385961	1135244	5040Y	0	107432050	77075158509207962	-2019	80897
SE0519	385977	1135218	5038Y	0	103432081	77111158440207985	-2133	80787
SE0520	385993	1135190	5033Y	0	101432112	77151158379208009	-2267	80668
SE0521	39 37	1135132	5030S	0	95432196	77231158356208073	-2381	80558
SE0522	39 80	1135078	5032Y	0	93432278	77307158688208138	-2093	80837
SE0523	39 136	1135005	5072Y	0	94432385	77408158678208220	-1805	80988
SE0524	39 152	1134983	5097Y	0	93432416	77439158518208243	-1757	80951
SE0525	39 167	1134965	5127Y	0	93432445	77464158316208266	-1700	80906
SE0526	39 183	1134943	5154Y	0	93432476	77495158179208289	-1608	80907
SE0527	39 195	1134926	5176Y	0	94432499	77519158097208307	-1494	80944
SE0528	39 215	1134908	5210Y	0	94432536	77543157979208336	-1328	80996
SE0623	39 229	1134895	5239Y	0	95432563	77561157874208357	-1177	81049
SE0624	39 243	1134881	5262Y	0	98432590	77580157793208377	-1060	81089
SE0529	39 250	1134846	5263Y	0	100432604	77630157763208388	-1097	81053
SE0530	39 267	1134801	5279Y	0	98432638	77694157474208413	-1263	80831
SE0531	39 283	1134754	5287Y	0	96432670	77761157580208437	-1097	80965
SE0532	39 300	1134709	5296Y	0	97432704	77825157701208462	-924	81112
SE0533	39 316	1134663	5313Y	0	97432736	77890157623208485	-864	81113
SE0534	39 284	113476152900T		0	97432672	77751157544208438	-1109	80945

END OF LIST

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM (with TER-COR.)	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
SE0635	39 445	1135096	5508Y	1	121432953	77257156933208678	95	81431
SE0634	39 441	1135058	5561Y	0	127432947	77312156562208670	225	81387
SE0633	39 410	1135051	5494Y	0	119432890	77324156861208623	-57	81323
SE0632	39 383	1135055	5431Y	0	110432840	77320157178208584	-290	81295
SE0630	39 353	1135007	5439Y	0	110432787	77392156992208540	-361	81198
SE0629	39 340	1134982	5426Y	0	108432764	77428157029208520	-423	81177
SE0628	39 324	1134960	5402Y	0	107432736	77461157111208497	-545	81137
SE0627	39 306	1134928	5392Y	0	109432704	77509157192208470	-534	81185
SE0626	39 286	1134912	5348Y	0	101432668	77533157457208441	-655	81205
SE0625	39 267	1134895	5311Y	0	98432633	77559157631208413	-803	81182
SE0624	39 243	1134881	5262Y	0	98432590	77580157793208377	-1060	81089
SE0623	39 229	1134895	5239Y	0	95432563	77561157874208357	-1177	81049
SE0622	39 211	1134876	5202Y	0	94432531	77590157945208330	-1429	80923
SE0621	39 187	1134851	5160Y	0	95432488	77627158038208295	-1699	80797
SE0620	39 165	1134828	5131Y	0	92432448	77662158128208263	-1851	80742
SE0619	39 143	1134805	5119Y	0	90432408	77697158265208230	-1793	80838
SE0618	39 118	1134779	5110Y	0	89432364	77736158278208193	-1827	80834
SE0617	39 79	1134717	5100S	0	89432295	77828158326208136	-1814	80880
SE0616	39 5	1134656	5070Y	0	92432161	77921158296208027	-2014	80785
SE0702	385948	1134672	5069Y	0	92432054	77901157857207943	-2383	80421
SE0701	385884	1134691	5113Y	0	93431935	77878157116207848	-2616	80038
SE0901	385819	1134604	5555S	0	245431819	78008157014207752	1540	82839
SE0902	385757	1134538	5172S	0	97431708	78107156896207661	-2091	80365
SE0903	385706	1134493	52149T	0	95431616	78176156462207586	-2046	80263
SE0904	385636	1134429	5249Y	0	96431490	78273156096207483	-1989	80205
SE0905	385589	1134385	5258Y	0	99431405	78340155788207413	-2147	80020
SE0906	385554	1134351	5270Y	0	99431342	78391155525207362	-2241	79884
SE0907	385478	1134282	5294Y	0	100431205	78496155474207250	-1952	80091
SE0908	385435	1134241	5307Y	0	102431128	78558155471207187	-1770	80231
SE0909	385392	1134203	5322Y	0	99431050	78616155167207123	-1876	80073
SE0910	385352	1134164	5334Y	0	99430978	78675155091207064	-1775	80131
SE0911	385341	1134136	5324Y	0	100430959	78716155277207048	-1666	80275
SE0912	385330	1134113	5321Y	0	101430940	78750155409207032	-1551	80403
SE0913	385318	1134090	5319Y	0	103430919	78784155557207014	-1404	80559
SE0914	385306	1134067	5315Y	0	104430898	78818155767206997	-1211	80766
SE0916	385296	1134018	5324Y	0	102430882	78890156072206982	-804	81139
SE0917	385296	1133983	5338Y	0	101430884	78940155945206982	-805	81091
SE0918	385274	1133973	5338Y	0	101430844	78956155898206949	-819	81077
SE0919	385258	1133952	5347Y	0	102430815	78988155777206926	-830	81036
SE0920	385247	1133937	5348Y	0	104430796	79010155612206909	-963	80899
SE0921	385233	1133917	5347Y	0	105430771	79040155627206889	-940	80927
SE0922	385217	1133900	5347Y	0	107430742	79066155400206866	-1147	80724
SE0923	385208	1133875	5348Y	0	110430727	79103155245206852	-1276	80593
SE0924	385188	1133867	5349Y	0	115430690	79115155173206823	-1306	80563
SE0925	385174	1133847	5350Y	0	118430666	79145155191206802	-1261	80609
SE0926	385159	1133825	5366Y	0	123430639	79178155080206780	-1202	80620
SE0927	385145	1133803	5389Y	0	127430614	79211155088206759	-951	80795
SE0928	385127	1133789	5418Y	0	133430582	79232154929206733	-815	80839
SE0929	385114	1133770	5449Y	0	139430559	79261154853206714	-581	80974
SE0930	385097	1133750	5484Y	0	150430528	79291154769206689	-313	81134
SE0931	385082	1133728	5517Y	0	162430502	79324154659206666	-89	81257

END OF LIST

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SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
SE0616	39 5	1134656	5070Y	0	92432161	779211582962O8027	-2014	80785
SE0614	385963	1134494	5084Y	0	99432091	781571581952O7965	-1925	80834
SE1001	385960	1134424	5082Y	0	107432089	78259157964207960	-2170	80604
SE0613	385904	1134383	5090Y	0	115431988	78322157782207877	-2195	80559
SE0612	385904	1134273	5188S	0	122431994	78480157731207877	-1323	81105
SE0611	385882	1134263	5210Y	0	121431954	78496157589207845	-1228	81124
SE0610	385875	1134233	5258Y	0	122431942	78540157282207835	-1068	81120
SE0609	385867	1134204	5314Y	0	125431929	78582156954207823	-859	81142
SE0608	385860	1134178	5367Y	0	125431917	78620156555207813	-744	81074
SE0606	385843	1134125	5487Y	0	142431889	78698155804207788	-349	81080
SE0605	385838	1134103	5533Y	0	138431881	78730155614207780	-97	81171
SE0604	385834	1134078	5580Y	1	149431874	78767155426207774	170	81287
SE0603	385827	1134053	5958Y	2	286431863	78803155198207764	3507	83474
SE1133	385801	1133971	5729Y	0	152431819	78923154316207726	504	81117

END OF LIST

PROFILE 7,8

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
SE0801	385162	1134907	6422Y	1	202430588	77613149379206784	3039	81338
SE0802	385179	1134909	6381Y	0	196430620	77609149655206809	2904	81335
SE0803	385197	1134890	6345Y	0	188430654	77635149937206836	2816	81364
SE0804	385215	1134880	6281Y	0	193430688	77648150354206863	2604	81375
SE0805	385238	1134878	6221Y	0	190430730	77650150696206896	2354	81324
SE0806	385259	1134881	6162Y	0	165430769	77644150990206927	2057	81205
SE0807	385281	1134874	6102Y	0	153430810	77653151252206960	1725	81064
SE0808	385296	1134860	6057Y	0	149430839	77672151534206982	1562	81051
SE0809	385310	1134843	6021Y	0	150430865	77696151915207002	1579	81194
SE0810	385330	1134826	5973Y	0	143430903	77719152252207032	1436	81206
SE0811	385348	1134808	5929Y	0	136430938	77744152549207059	1289	81203
SE0812	385364	1134792	5889Y	0	133430968	77766152857207082	1203	81249
SE0813	385379	1134778	5850Y	0	147430996	77785153096207104	1052	81245
SE0814	385397	1134760	5819Y	0	129431031	77810153306207130	936	81219
SE0815	385413	1134748	5787Y	0	125431061	77826153435207154	748	81134
SE0816	385445	1134736	5793Y	2	118431121	77842153389207202	706	81068
SE0817	385467	1134716	5700S	0	113431162	77869154017207234	427	81099
SE0818	385553	1134717	5555S	0	103431321	77862154680207360	-401	80755
SE0819	385644	1134716	5418S	0	97431490	77858155267207495	-1238	80380
SE0821	385819	1134716	5178S	0	94431814	77846156710207752	-2312	80121
SE0701	385884	1134691	5113Y	0	93431935	77878157116207848	-2616	80038
SE0702	385948	1134672	5069Y	0	92432054	77901157857207943	-2383	80421
SE0616	39 5	1134656	5070Y	0	92432161	77921158296208027	-2014	80785
SE0703	39 80	1134606	5111S	0	91432302	77988158471208138	-1567	81092
SE0704	39 173	113460251890T		0	90432474	77988158335208274	-1106	81286
SE0705	39 236	1134580	5243Y	0	92432592	78015158072208367	-952	81257
SE0706	39 298	1134560	5304Y	0	97432708	78040157780208459	-759	81246
SE0707	39 362	113454153661T		0	96432827	78063157465208553	-588	81206
SE0708	39 388	1134531	5389Y	0	97432876	78076157378208591	-497	81220
SE0709	39 411	1134524	5408Y	0	98432919	78084157331208625	-398	81255
SE0710	39 435	1134517	5430Y	0	100432963	78093157260208661	-301	81279
SE0712	39 489	1134499	5494Y	0	100433064	78115157058208741	20	81383
SE0713	39 511	1134492	5521Y	0	102433105	78124156985208773	171	81443
SE0714	39 533	1134485	5549Y	0	102433146	78133156914208805	330	81507
SE0715	39 552	1134479	5573Y	0	104433182	78140156837208834	454	81550
SE0716	39 574	1134472	5599Y	0	106433223	78149156755208866	580	81590
SE0717	39 593	1134466	5620Y	0	107433258	78156156720208894	715	81655
SE0718	39 616	1134459	5646Y	0	110433301	78165156607208927	812	81666
SE0719	39 637	1134452	5669Y	0	112433341	78173156584208959	977	81754
SE0720	39 659	1134443	5690Y	0	119433382	78185156565208991	1123	81835
SE0721	39 676	1134416	5718Y	1	118433415	78223156608209016	1407	82023
SE0722	39 736	1134339	5808Y	0	134433530	78330156320209105	1880	82203
SE0723	39 820	1134355	5935Y	0	126433684	78301155768209229	2393	82277
SE0724	39 870	1134352	6028Y	1	139433777	78302155319209302	2748	82328

END OF LIST

PROFILE 8,10

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
SE0801	385162	1134907	6422Y	1	202430588	776131493792206784	3039	81338
SE0802	385179	1134909	6381Y	0	196430620	776091496552206809	2904	81335
SE0803	385197	1134890	6345Y	0	188430654	776351499372206836	2816	81364
SE0804	385215	1134880	6281Y	0	193430688	776481503542206863	2604	81375
SE0805	385238	1134878	6221Y	0	190430730	776501506962206896	2354	81324
SE0806	385259	1134881	6162Y	0	165430769	776441509902206927	2057	81205
SE0807	385281	1134874	6102Y	0	153430810	776531512522206960	1725	81064
SE0808	385296	1134860	6057Y	0	149430839	776721515342206982	1562	81051
SE0809	385310	1134843	6021Y	0	150430865	776961519152207002	1579	81194
SE0810	385330	1134826	5973Y	0	143430903	777191522522207032	1436	81206
SE0811	385348	1134808	5929Y	0	136430938	777441525492207059	1289	81203
SE0812	385364	1134792	5889Y	0	133430968	777661528572207082	1203	81249
SE0813	385379	1134778	5850Y	0	147430996	777851530962207104	1052	81245
SE0814	385397	1134760	5819Y	0	129431031	778101533062207130	936	81219
SE0815	385413	1134748	5787Y	0	125431061	778261534352207154	748	81134
SE0816	385445	1134736	5793Y	2	118431121	778421533892207202	706	81068
SE0817	385467	1134716	5700S	0	113431162	778691540172207234	427	81099
SE0818	385553	1134717	5555S	0	103431321	778621546802207360	-401	80755
SE0819	385644	1134716	5418S	0	97431490	778581552672207495	-1238	80380
SE0902	385757	1134538	5172S	0	97431708	781071568962207661	-2091	80365
SE0613	385904	1134383	5090Y	0	115431988	783221577822207877	-2195	80559
SE1001	385960	1134424	5082Y	0	107432089	782591579642207960	-2170	80604
SE1002	385976	1134404	5103Y	0	107432120	782861578942207984	-2069	80634
SE1003	385992	1134384	5126S	0	108432151	783141578222208008	-1945	80679
SE1004	39 5	1134364	5144Y	0	110432176	783421577482208027	-1872	80694
SE1005	39 23	1134344	5173Y	0	112432210	783701576482208053	-1727	80743
SE1006	39 40	1134318	5205Y	0	115432243	784061575892208078	-1501	80860
SE1007	39 65	1134301	5244Y	0	118432290	784291578052208115	-961	81272
SE1008	39 84	1134284	5280Y	0	123432326	784521576652208143	-790	81325
SE1009	39 105	1134277	5308Y	0	124432365	784611575372208174	-686	81335
SE1010	39 119	1134267	5330Y	0	125432392	784751574152208195	-622	81325
SE1011	39 130	1134247	5353Y	0	131432413	785031573142208211	-516	81356
SE1012	39 153	1134223	5396Y	0	133432457	785361568892208245	-577	81153
SE1013	39 175	1134215	5423Y	0	134432498	785461567132208277	-529	81109
SE1014	39 196	1134198	5466Y	0	140432538	785691566462208309	-225	81273
SE1015	39 217	1134193	5494Y	0	139432577	785751566962208339	60	81461
SE1016	39 236	1134182	5513Y	0	145432613	785891565892208367	104	81446
SE1017	39 256	1134165	5576Y	0	144432651	786131561852208397	266	81392
SE1018	39 271	1134147	5619Y	0	145432679	786381558352208419	295	81276
SE1019	39 288	1134107	5694Y	0	157432713	786941552542208444	397	81134
SE1020	39 300	1134086	5740Y	0	161432736	787241549932208462	551	81135
SE1021	39 311	1134069	5782Y	0	166432757	787471547582208478	698	81143
SE1022	39 325	1134052	5825Y	0	173432784	787711545262208498	846	81153
SE1023	39 339	1134033	5874Y	0	179432811	787971542962208519	1060	81204
SE1024	39 356	1134012	5693Y	0	317432844	788271541262208545	-844	80058
SE1025	39 377	1134000	5973Y	1	192432883	788421540132208575	1653	81474
SE1026	39 390	1133978	6001Y	0	183432908	788731540282208595	1917	81631

END OF LIST

PROFILE 11

SNAKE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT NORTH UTM		EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
SE1105	385036	1134544	6313Y	0	167430374	78146149389206599	2209	80843
SE1106	385054	1134523	6240Y	0	160430408	78175149837206626	1942	80819
SE1107	385076	1134505	6166Y	0	158430450	78200150327206658	1701	80828
SE1108	385095	1134495	6120Y	0	150430485	78213150636206686	1550	80826
SE1109	385116	1134480	6063Y	0	146430525	78233151029206716	1377	80843
SE1110	385136	1134470	6012Y	0	140430563	78247151370206746	1210	80843
SE1111	385159	1134457	5952Y	0	136430606	78260151790206780	1028	80863
SE1112	385178	1134446	5906Y	0	133430642	78279152085206808	862	80851
SE1113	385200	1134431	5844Y	0	127430683	78299152461206841	619	80815
SE1114	385222	1134419	5790Y	0	124430724	78315152767206873	389	80764
SE1115	385245	1134409	5741Y	0	123430767	78328153028206907	156	80696
SE1116	385271	1134396	5680Y	0	117430816	78345153394206945	-91	80652
SE1118	385318	1134373	5578Y	0	108430904	78375153942207014	-579	80505
SE1119	385342	1134361	5526Y	0	106430949	78391154142207050	-902	80357
SE1120	385366	1134355	5487Y	0	106430994	78398154326207085	-1118	80272
SE1121	385424	1134321	5377Y	0	101431103	78443154818207170	-1749	80012
SE0907	385478	1134282	5294Y	0	100431205	78496155474207250	-1952	80091
SE1124	385659	1134170	5330Y	0	104431546	78646156497207516	-853	81071
SE1125	385684	1134159	5370Y	0	106431593	78660156325207553	-690	81100
SE1126	385708	1134145	5405Y	0	109431638	78678156041207589	-679	80994
SE1127	385715	1134115	5449Y	0	112431652	78721155946207599	-373	81154
SE1128	385725	1134086	5496Y	0	115431672	78762155756207614	-134	81236
SE1130	385751	1134040	5577Y	0	125431723	78827155284207652	116	81220
SE1131	385766	1134015	5626Y	0	133431752	78862154863207674	133	81078
SE1132	385782	1133988	5678Y	0	142431783	78900154558207698	295	81072
SE1133	385801	1133971	5729Y	0	152431819	78923154316207726	504	81117
SE1135	385837	1133940	5834Y	0	175431887	78966153688207779	818	81094
SE1136	385855	1133921	5898Y	0	182431922	78998153426207805	1129	81195
SE1137	385874	1133909	5952Y	0	211431957	79008153201207834	1382	81294
SE1138	385892	1133898	6000Y	0	216431991	79023152969207860	1578	81329

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