AFGL-TR-89-0073

AD-A209 981

Siting Survey and Configuration Optimization of a New Regional Array in the Federal Republic of Germany

H.-P. Harjes

Ruhr Universitat Bochum
Fakultat fur Geowissenschaften
D-4630 Bochum
Federal Republic of Germany

15 February 1989

Scientific Report No. 1

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AIR FORCE BASE, MASSACHUSETTS 01731-5000

Sponsored by: Defense Advanced Research Projects Agency
Nuclear Monitoring Research Office

DARPA Order No. 5307
Monitored by: Air Force Geophysics Laboratory
Contract No. F49620-88-C-0045

The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Defense Advanced Research Projects Agency or the US Government.

This technical report has been reviewed and is approved for publication.

JAMES F. LEWKOWICZ
Contract Manager
Solid Earth Geophysics Branch
Earth Sciences Division

JAMES C. BATTIS
Acting Chief
Solid Earth Geophysics Branch
Earth Sciences Division

FOR THE COMMANDER

DONALD H. ECKHARDT, Director
Earth Sciences Division

This report has been reviewed by the ESD Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualified requestors may obtain additional copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

If your address has changed, or if you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify AFGL/DAA, Hanscom AFB, MA 01731-5000. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document requires that it be returned.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; Distribution unlimited
2b DECLASSIFICATION DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) RUB-89-100	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFGL-TR-89-0073
6a NAME OF PERFORMING ORGANIZATION Ruhr-University Bochum / 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION Air Force Geophysics Laboratory
6c. ADDRESS (City, State, and ZIP Code) D-4630 Bochum Federal Republic of Germany	7b ADDRESS (City, State, and ZIP Code) Hanscom AFB, MA 01731-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION Defense Advanced Research Projects Agency / 8b OFFICE SYMBOL (If applicable) NMRO	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F49620-88-C-0045
8c ADDRESS (City, State, and ZIP Code) 1400 Wilson Boulevard Arlington, VA 22209-2308	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO 62714E / PROJECT NO 8A10 / TASK NO. DA / WORK UNIT ACCESSION NO. AF

11 TITLE (Include Security Classification)
Siting Survey and Configuration Optimization of a New Regional Array in the Federal Republic of Germany

12 PERSONAL AUTHOR(S)
H.-P. Harjes

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Scientific No. 1	FROM 15.12.87 TO 15.12.88	1989/02/15	94

16 SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	NORESS, underground nuclear explosions, teleseismic, seismic noise, regional array

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The project is aiming at a siting survey for an advanced seismic array in the Federal Republic of Germany which could be used in a multi-array network jointly with arrays in Scandinavia to detect and identify seismic events especially at regional distances. In order to assess the eventual capabilities of a new high-frequency array in the FRG, it was necessary to conduct a noise survey and to evaluate signal characteristics, both in the high-frequency band up to 50 Hz.
It was found that the Bavarian Forest (BF) in the southeastern part of the FRG at the border to Austria and Czechoslovakia is principally suited for such an array installation.
Continuous field work has been carried out in this area from April 4 to July 9 1988. This time period covered winter conditions with heavy snow
(continued)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL James F. Lewkowicz	22b. TELEPHONE (Include Area Code) 617-377-3028 / 22c. OFFICE SYMBOL AFGL/LWH

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

in April to summer conditions including farming activities. A portable digital data acquisition system recorded more than 500 seismic events, about half of them occured at local or regional distances.

Representative noise power spectra were calculated for 10 sites in the BF-area. The most favourable ones show values slightly lower than 1 nm**2/Hz at 1 Hz and a smooth decay proportional to f**-4 per decade up to 40 Hz, leading to a value of 10**-4 nm**2/Hz at 10 Hz and 10**-5 nm**2/Hz at 20 Hz.
For comparison a noise sample was taken at NORESS and analyzed with the same procedure. The NORESS power spectrum at 1 Hz is about 10 nm**2/Hz and shows a steep slope proportional to f**-5 at low frequences due to the influence of microseisms. It crosses the BF-spectra at 2 Hz. At frequences above 5 Hz the NORESS spectrum also follows the f**-4 slope with absolute values about a decade lower than the BF-sites (5*10**-5 nm**2/Hz at 10 Hz and 3*10**-6 nm**2/Hz at 20 Hz).
Regional seismograms exhibit the typical phases for continental source-receiver paths. The first arriving Pn-waves constitute the highest frequency waves (5-20 Hz) whereas Lg-wave amplitudes (1-10 Hz) dominate the regional seismogram.
In concluding phase I of the project, one of the quietest BF-sites near the village of Bischofsreut was selected for the establishment of a provisional 9-element array. Data from this installation will be used in phase II to find the correlation properties of signals and noise. The results will lead to a proposal for the configuration of a small NORESS-type array adapted to the local site conditions in the Bavarian Forest.

Table of Contents

1. *Introduction*

Since the establishment of the Graefenberg (GRF) array in 1980, considerable efforts have been made in the Federal Republic of Germany to use array data for seismic monitoring of underground nuclear explosions. Research was focused on discrimination studies using the broadband characteristic of seismic signals. From the very beginning it became obvious that for detection purposes this installation - built for general seismological research - should be amended by a special short-period array. The broadband instruments with a high-cut filter at 5 Hz are not optimal for detection of weak events, especially at regional distances. High frequency signals which seem to be extremely important for the identification of small underground explosions at regional distances are not detectable on records of the broadband array. On the other hand, initial results from a small-size (3 km diameter) 25-element short-period array in Norway (NORESS) have been very encouraging, as the array has proven capable of taking advantage of the very efficient propagation of high-frequency seismic phases in Eurasia. Together with a similar recently installed array in Northern Norway (ARCESS), the proposed array in Southern Germany (tentatively named GERESS = German Experimental Seismic System) would built a tripartite array network with a side length of a triangle being roughly 1000 km. This configuration is particularly relevant in view of a possible deployment of "in-country" seismic systems.

Unlike NORESS it is not possible to collocate the new short-period array with an existing GRF subarray because the latter is built on a sedimentary column which strongly attenuates high frequencies.

The Bavarian Forest at the southeast border of the FRG to Austria and Czechoslovakia represents the largest outcropping crystalline complex - as part of the Bohemian Massif - in Central Europe. This region is principally suited for an array installation of the proposed kind as has been demonstrated by the excellent detection capabilities of conventional seismic stations in the CSSR and Austria. But in the FRG the environment has to be carefully investigated due to human and industrial noise sources. Apart from these local noise conditions, sufficient seismic signals from various azimuths should be recorded and evaluated to assess the propagation of high-frequency signals, especially across geological boundaries like the one between the Russian Platform and Western Europe or the influence of the Alps on signals originating from the Mediterranean earthquake region.

After describing the field work in the next chapter, a noise analysis will be evaluated in chapter 3. Besides a comparison of the 10 test sites which were measured during a 3 months campaign, an additional noise sample was taken at NORESS. This power spectrum will serve as a reference to judge on the spectral noise conditions at the proposed new array site in Southern Germany.

A low noise profile is only one condition for a reasonable seismometer site. Equally important is the transfer function of the receiver crust which determines the signal characteristics and the signal-to-noise ratio. Having operated the seismic data acquisition system in a detector mode we were able to analyze more than 500 signals. In chapter 4 the general detection capability will be discussed for a site in the Bavarian Forest area, then we shall focus on recordings of regional events and finally a collection of seismograms from presumed underground nuclear explosions will be shown with special emphasis on the two events included in the US-USSR Joint Verification Experiment.

In a concluding chapter 5 an outlook on future work will be given which has to be done in phase II of the project. This phase will concentrate on correlation studies for noise and signals after the most promising site has been selected for the provisional installation of a 9-element small array.

2. *Field Work*

During phase I of the project the siting survey was completed and final results of the noise analysis are now available. Measurements have been carried out initially in October 1987 and from April 5 to July 9 1988 continuously. Some additional data have been collected later in 1988 to prove the long-term variability of noise conditions and to calibrate the results with data from well-defined events (e.g. JVE-experiment).

The measurements concentrated on an area in the Bavarian Forest (Bayerischer Wald) in the southeastern edge of the FRG (figure 2a). The advantage of this area is its geological setting (crystalline outcropping rocks from the Bohemian Massif) and the low population density. The landscape is mostly mountainous up to 1200 m elevation. Nearly all sites were situated in extensive forest areas to minimize cultural noise and instruments were installed on granite or gneiss rocks to record high frequencies, especially from events at regional distances. By this temporary surface installation the seismometers were quite sensitive to wind noise but for technical and financial reasons no other arrangement was feasible. Detection capabilities derived from noise estimates of these data should represent conservative values.

For survey purposes three portacorders with direct recording were used. In case of favourable places one of three digital data acquisition systems was installed for a time period of several weeks. The digital systems were PCM recording instruments of Lennartz 5800 type with the following specifications :

ADC	66 dB resolution
gain ranging	126 dB dynamic range
sampling frequency	250 Hz
lowcut filter	44 Hz, 6 pole Bessel

Each PCM system was equipped with three vertical short-period seismometers (1 Hz Geotech S-13) which were installed at distances between 100 m and 300 m to avoid false alarms by coincidence triggering.

The survey concentrated on three areas within the Bavarian Forest (figure 2b) :

a. the southern region (south of the city of Hauzenberg)
b. the northern region (northeast and southwest of Frauenau)
c. the central region (east of the city of Freyung).

Station coordinates and station codes are summarized in table 1. A brief description of the recording sites is as follows :

In the southern area stations were installed near Kleinrathberg (KLRB), Sonnen (SONN) and Steinbuechl (STEI). KLRB began its operation already in early April when the whole region was covered with snow. The other two stations recorded under summer conditions. All southern stations were based on solid granite. At night these sites were very quiet as could be seen on the portacorder. However during day times not only farming activities but also some large quarries in the vicinity increased the noise level significantly.

In the northern area, at first the station Buchenau (BUCH) was set up. It operated simultaneously to KLRB in the south under the same weather conditions (snow). The other station, Dreikoegelriegel (DRKR) was situated southwest of Frauenau at a distance of approximately 10 km from BUCH. Both stations were placed on gneiss. Although the geological conditions looked quite promising the general noise level was influenced by traffic and tourism. Additionally small industries seemed to contribute some background noise.

Very soon the site survey concentrated on the central area which is closest to the CSSR border. Very few roads, low population density, and extensive woodland offered adequate pre-conditions for seismic installations. The first station near Haidmuehle (HAID) was established in April. It was placed on weathered granite. Later, two other stations at Gross-Lichtenberg (GRLB) and Kiesberg (KIBG) were established on gneiss. During the JVE-experiment an additional station was installed at Sulzberg (SULZ). Portacorder records showed a generally low noise background and especially a small day-to-night variation. The only obvious disadvantage appeared to be some saw-mills which generated monochromatic seismic noise during working hours.

A summary of the recording times of field stations in the Bavarian Forest is given in table 2.

For comparison some noise samples have been taken at the Graefenberg array (station B5) which confirmed earlier measurements showing relatively high cultural noise levels.

Finally during a short trip to Norway in October 1988, some recordings were made at NORESS to get a direct comparison of noise values by using the same data acquisition system and - more important - the same processing procedure as for data from the area under investigation in Germany.

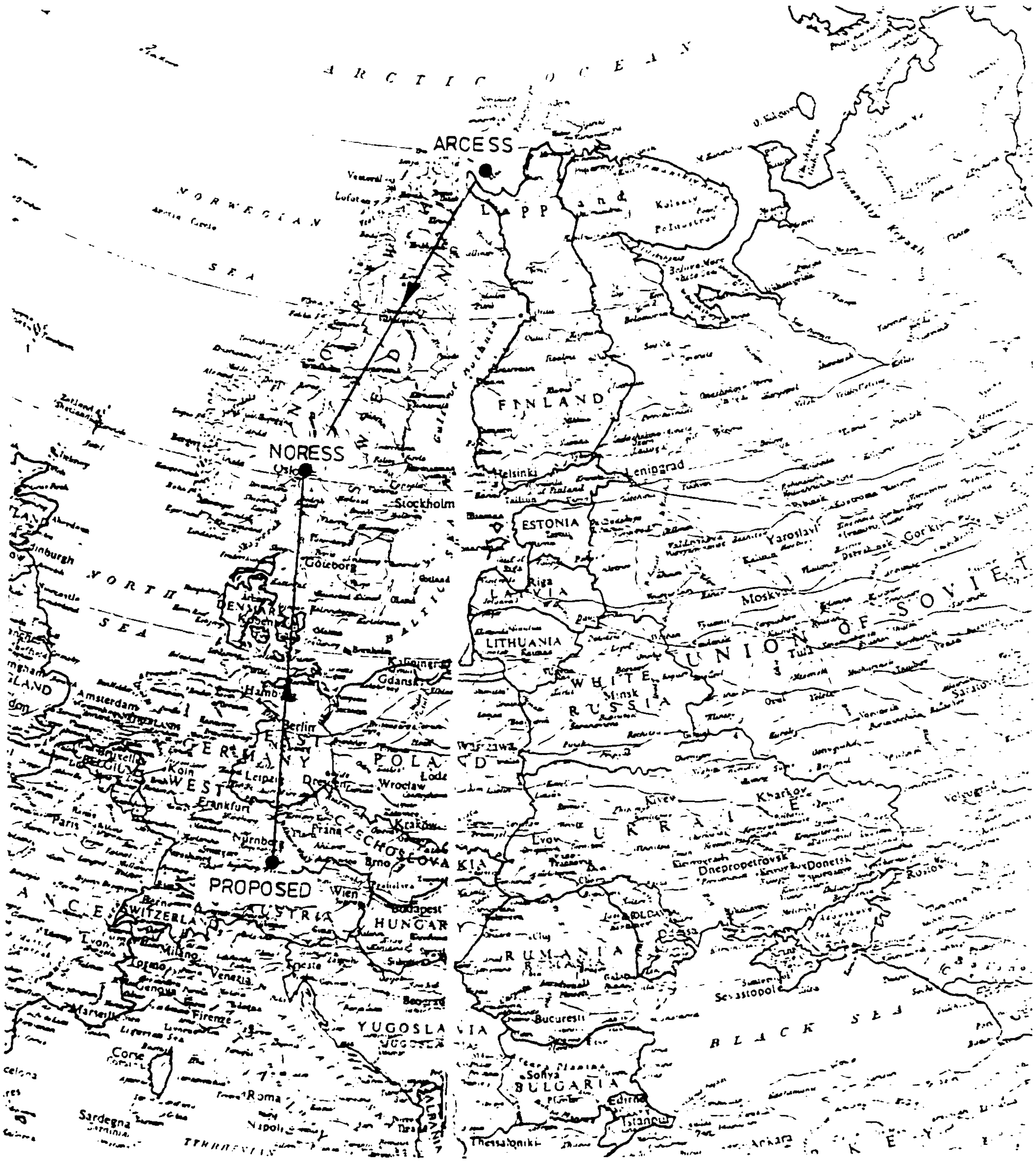


Fig. 2a : Geographical Location of the Proposed German Array (GERESS) in Relation to Existing Scandinavian Arrays.

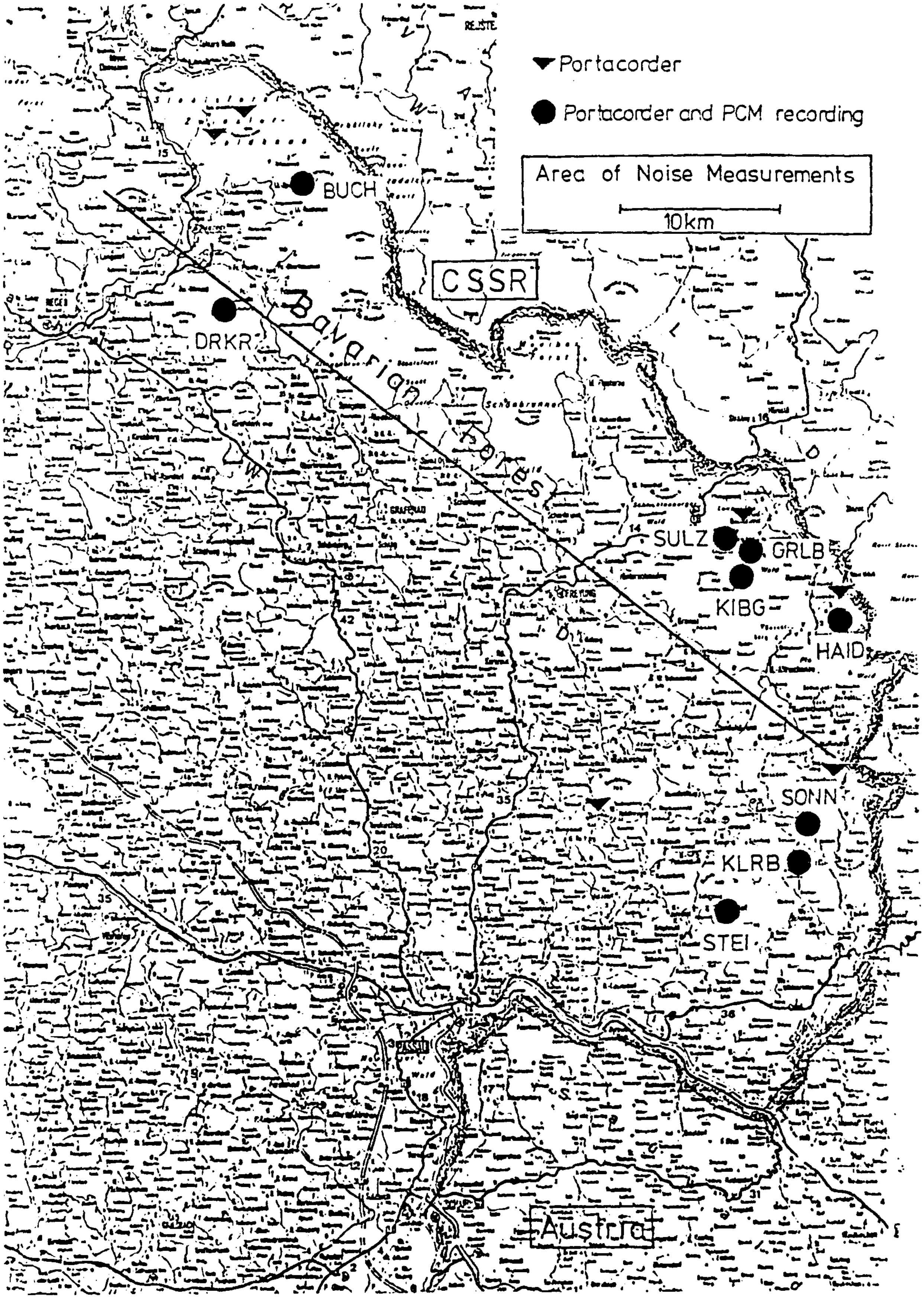


Fig. 2b : Location of Field Sites for Noise Measurements

station name	code	area*	lat	long
Buchenau	BUCH	n	49.051 N	13.333 E
Dreikoegelriegel	DRKR	n	48.967 N	13.26[illegible] E
Gross-Lichtenberg	GRLB	c	48.838 N	13.720 E
Haidmuehle	HAID	c	48.800 N	13.786 E
Kiesberg	KIBG	c	48.820 N	13.704 E
Kleinrathberg	KLRB	s	48.641 N	13.748 E
Sonnen	SONN	s	48.679 N	13.778 E
Steinbuechl	STEI	s	48.622 N	13.698 E
Sulzberg	SULZ	c	48.845 N	13.700 E

*area : n = northern area
c = central area
s = southern area

Table 1 : Site Coordinates

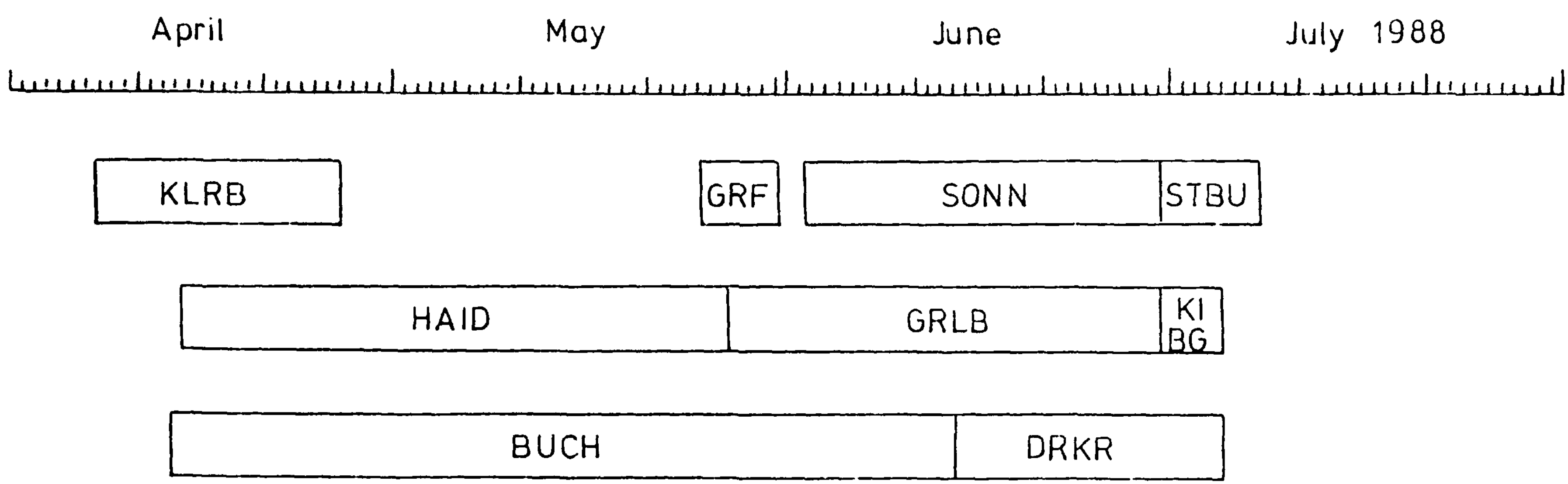


Table 2 : Recording Times of Field Stations

3. *Noise Analysis*

The processing of field data included several steps. At the beginning the PCM field tapes had to be converted to standard 9-track IBM-compatible format. Then an appropriate file system was established on the SUN computing system of the Institute of Geophysics in Bochum. The CSS-format was used for this and also for the waveform data file. In this way the data could also easily be transferred to DARPA's analysis centre in Washington.

Having recorded the field data in event mode the pre-event window can be used for noise evaluation. There are many well-established methods to estimate the power spectral density of stationary time series (e.g. Oppenheim and Schafer, 1975; Welch, 1967). In this report the following procedure was applied :

Altogether 20 seconds of the pre-event window were divided into 19 blocks of 2 seconds length each with an overlap of one second. Each data block was padded with zeros to get a transformation length of 2^{10} for FFT reminding that the original sampling frequency of the field data was 250 Hz. The 19 raw Fourier spectra were averaged to lower the variance without affecting stationary noise peaks. The final step includes an average of 12 noise spectra from each station and a plot of the mean values and their standard deviation.

The noise spectra (figure 3a-k) are calculated separately for day and night. They cover the whole time period during which the corresponding station was operating. By that procedure, working hours, weekends, and different weather conditions are included in the noise estimate.

The noise power spectral density of each station will be discussed in the same order as the station sites in the previous chapter.

In the southern area, Kleinrathberg (KLRB) showed the highest noise level we measured in the Bavarian Forest (figure 3a). Typical for this site is a broad maximum with values about 10^{-3} nm^2/Hz between 10 Hz and 20 Hz. This plateau is dominated by a noise peak at 11 Hz which can be observed at all southern stations KLRB, SONN, and STEI. Another maximum can be seen at 2 Hz, especially during night times. Whereas the 11 Hz peak presumably originates from a local source, the 2 Hz maximum can be found on most European recordings. At working hours this peak is masked by a generally higher noise level but it can still be identified. The relatively high noise level between 5 Hz and 20 Hz in the southern area is caused by farming activities, small industries, traffic and quarries. Additionally this area is more densely populated than the other investigated regions. The station at Sonnen (figure 3b) shows a low noise level for frequencies above 20 Hz. Besides the already known maxima at 2 Hz and 11 Hz, we find a sharp noise peak at 16.67 Hz (railroad ?). The third site in the southern region, STEI, was placed in an abandoned quarry. During night times it shows low noise values over the whole observed frequency range (figure 3c). The installation of the seismometer on the ground of the quarry about 50 m below surface level gives an excellent opportunity for comparison with the surface installations in this area. Although the improvement, i.e. noise decrease is remarkable at night, the local noise at day times is still present.

In the northern area the spectra generally show a much smoother behavior. Up to 20 Hz the spectrum of the station at Buchenau (BUCH) in figure 3d exhibits a continuous decay but for higher frequencies several maxima appear, especially in the range between 20 Hz and 30 Hz. The spectrum of the second station in this region, DRKR, shows a similar shape, except for a higher variance during working hours (figure 3e). This may be caused by larger villages around the site. In general, the noise level is somewhat lower than at BUCH but it is still high compared to the most favorable sites which were found in the central region of the survey.

In the central area Haidmuehle (HAID) was the station which was installed at the beginning of the survey. Its noise estimate (figure 3f) includes data from times when the ground was covered with snow and also from summer times. In the individual spectra no significant difference could be observed. The spectrum shows a continuous slope with a small variance and even the 2 Hz peak can only be recognized during night times. The day spectrum is dominated by a noise maximum at 4-5 Hz which is supposed to originate from a saw mill at a distance of a few kilometers in the village of Haidmuehle.

The spectra of the second station in that region, GRLB, show the smallest day/night variation we observed (figure 3g). The only difference remains the influence of the already mentioned saw mill. Its distance from GRLB and HAID is about the same. Apart from this peak, the noise spectrum at GRLB shows a smooth decay proportional to f^{-4} from 1 Hz to 30 Hz and a small standard deviation. Taking into account that the recording time covered nearly a period of one month, this area seemed to be quite promising as a candidate for an array installation.

To secure this suggestion, two other sites were explored in the vicinity. Indeed, the spectra at Kiesberg (KIBG), situated approximately 2.5 km south of GRLB, look very similar (figure 3h). The only difference can be seen at 2 Hz where we identify the well-known noise peak. Because the data at both stations have been collected at different time periods we have to expect this noise influence at every station during a more permanent operation.

Later in 1988 (September and October), some additional data were collected at Sulzberg (SULZ), approximately 1.5 km northwest of GRLB.

This fourth station (figure 3i) in the central area of the survey confirmed the favorable opinion about the area and provisions were started to establish a multi-element array during phase II of the contract.

To put our noise results from the Bavarian Forest into proper place, additional data were collected at the Graefenberg array and at NORESS. GRF can be regarded as a typical European site whereas NORESS is well known for its excellent noise conditions being situated on the Scandinavian shield.

At day the GRF-spectrum (figure 3j) shows much larger values than any of the BF-spectra. The influence of industry and traffic is especially pronounced in the large variation. The night-spectrum at

GRF looks similar to the BF-spectra between 1 Hz and 8 Hz. For higher frequencies the different geological setting (sediments) causes still higher noise values. From this direct comparison we can conclude that the BF-area exceeds most other places in the FRG - and certainly GRF - as a potential site for an establishment of a high-frequency array.

More interesting is the comparison of the proposed Bavarian area with NORESS. The spectra shown in figure 3k were calculated from a 24 hour noise sample analyzed with the same procedure as described above. There are remarkable differences in the noise spectra. For low frequencies around 1 Hz NORESS clearly suffers from the influence of the coast which results in an order of magnitude higher PSD-values compared to the Bavarian Forest area (10 nm^2/Hz to less than 1 nm^2/Hz). Apparently this high micro seisms lead to a steep slope of the spectrum proportional to f^{-5} up to frequencies of 2-5 Hz. For higher frequencies this slope is flattened and comparable to the f^{-4} fall-off at the BF-area. The absolute noise values at 10 Hz and 20 Hz are certainly lower at NORESS but interestingly some influence of industrial noise between 5 Hz and 8 Hz can be identified in the spectrum at day and at night as well. Whether the sharp noise peak at 30 Hz was only occasional during the short period of data acquisition cannot be decided from this noise sample.

In concluding the comparison between NORESS and the BF-area we found a factor of 10 higher noise values at NORESS for frequencies around 1 Hz and a factor of 2-3 higher noise values at the BF-site for frequencies between 2 Hz and 20 Hz. The consequence of this difference in terms of detection capabilities can only be evaluated in comparison with commonly recorded events.

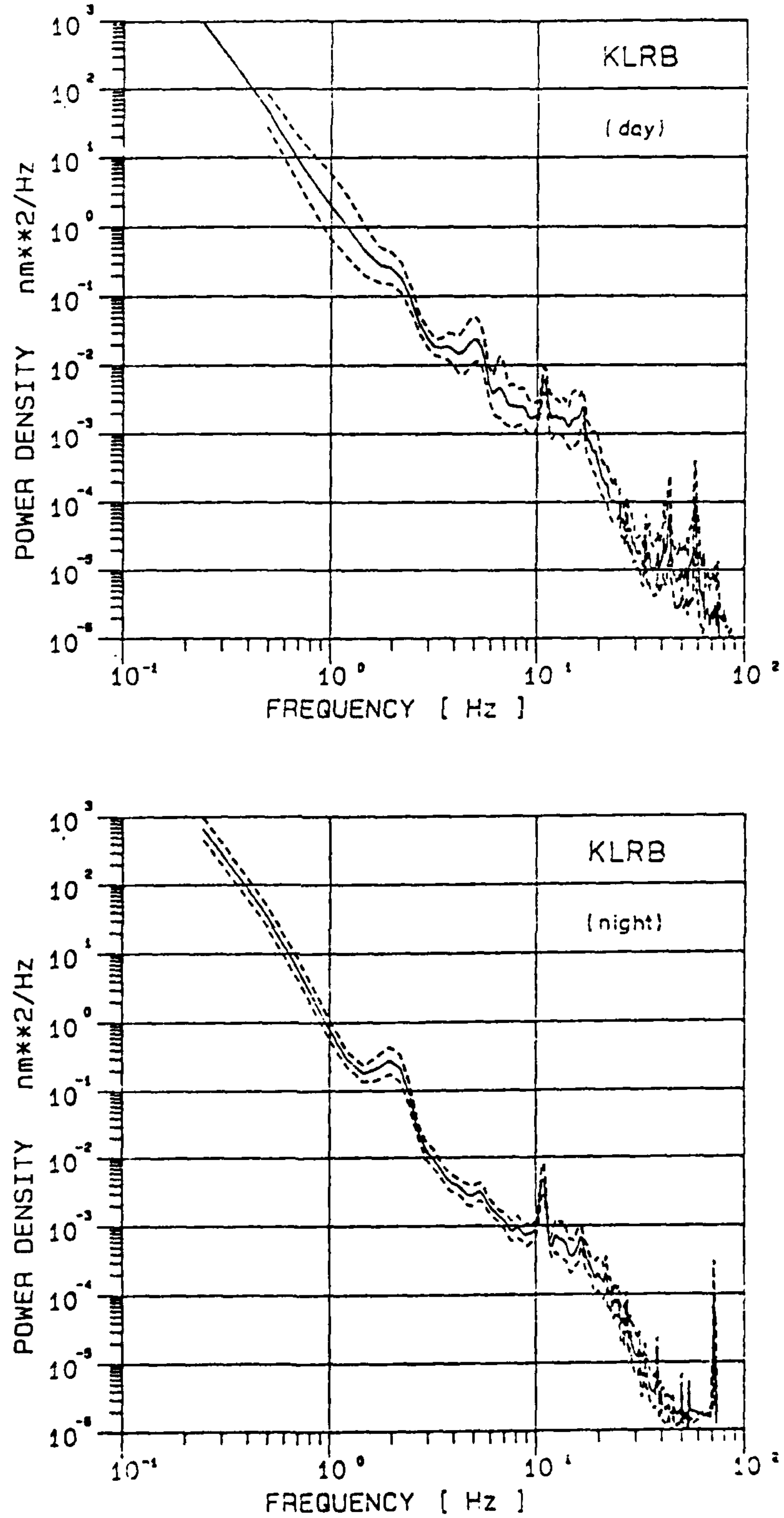
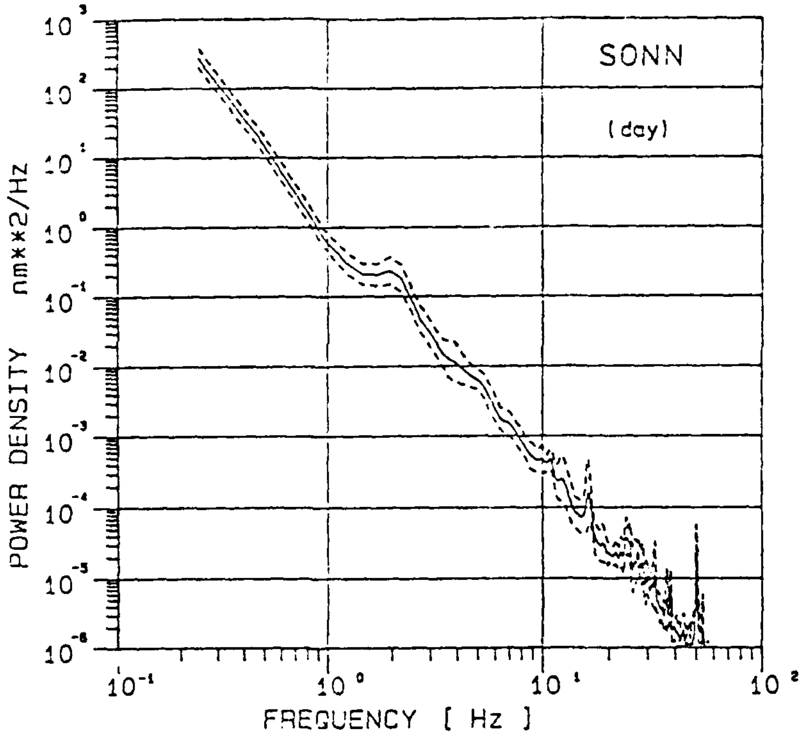


Fig. 3a : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station KLEINRATHBERG



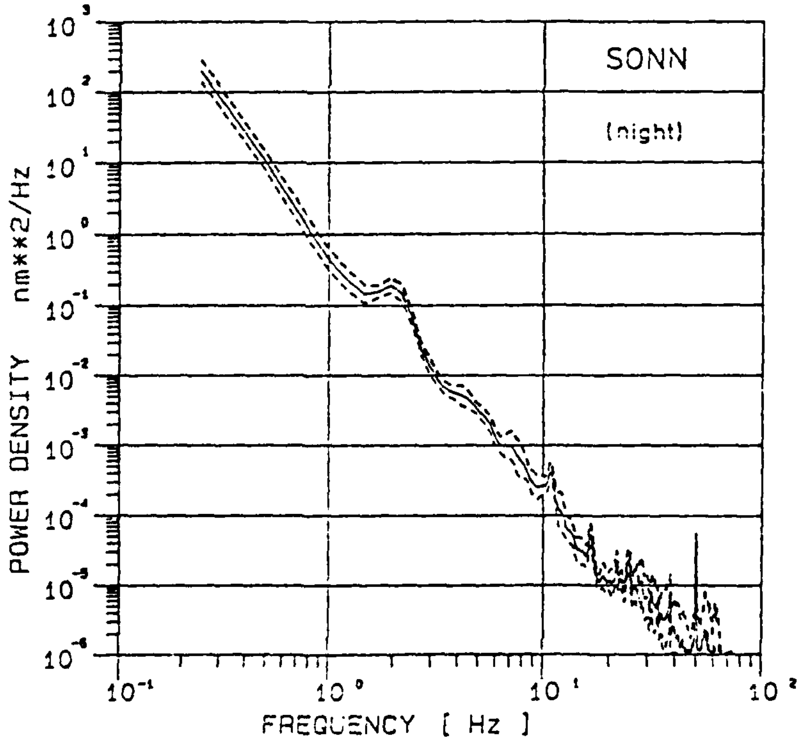


Fig. 3b : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station SONNEN

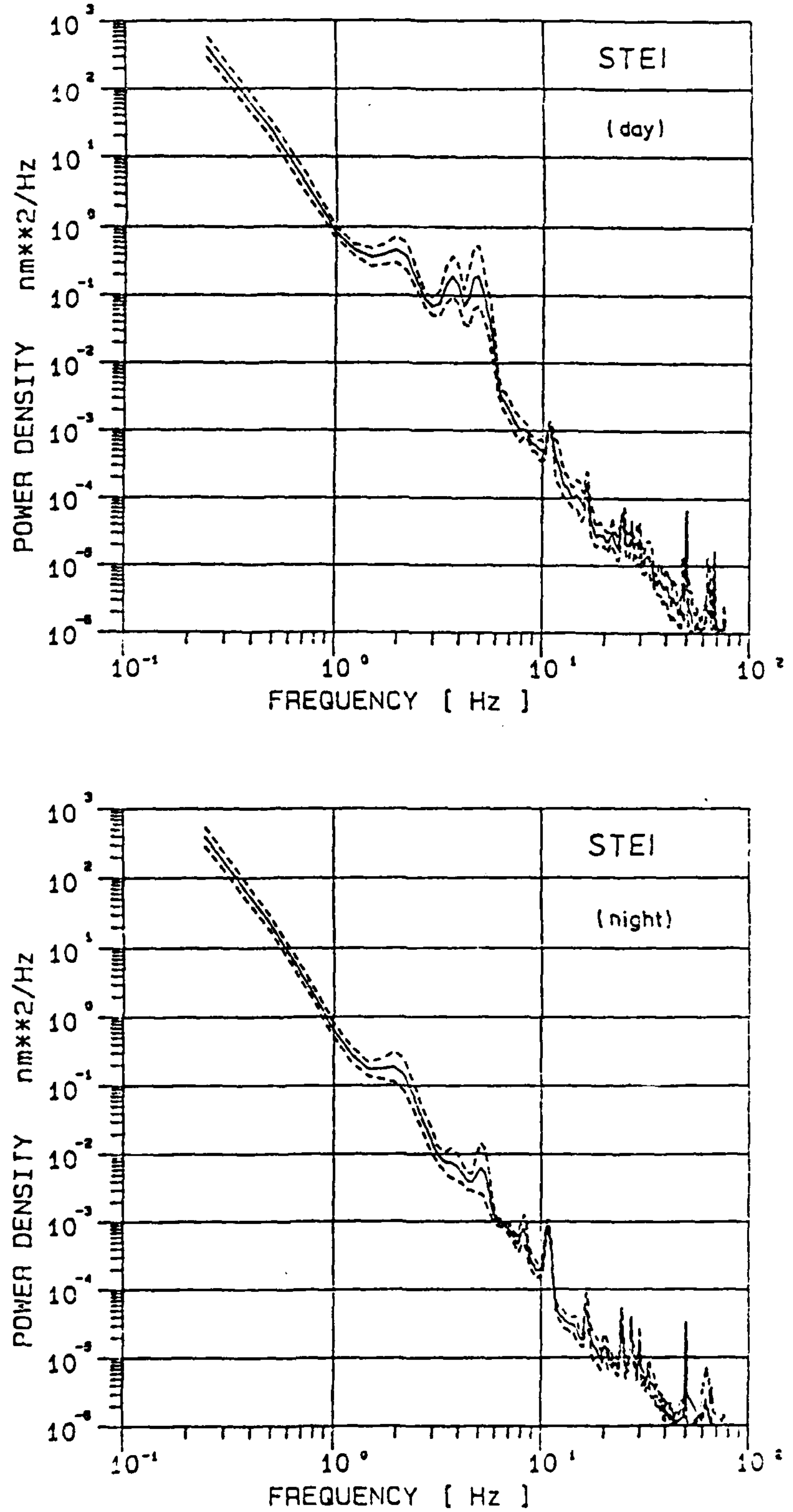


Fig. 3c : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station STEINBUECHL

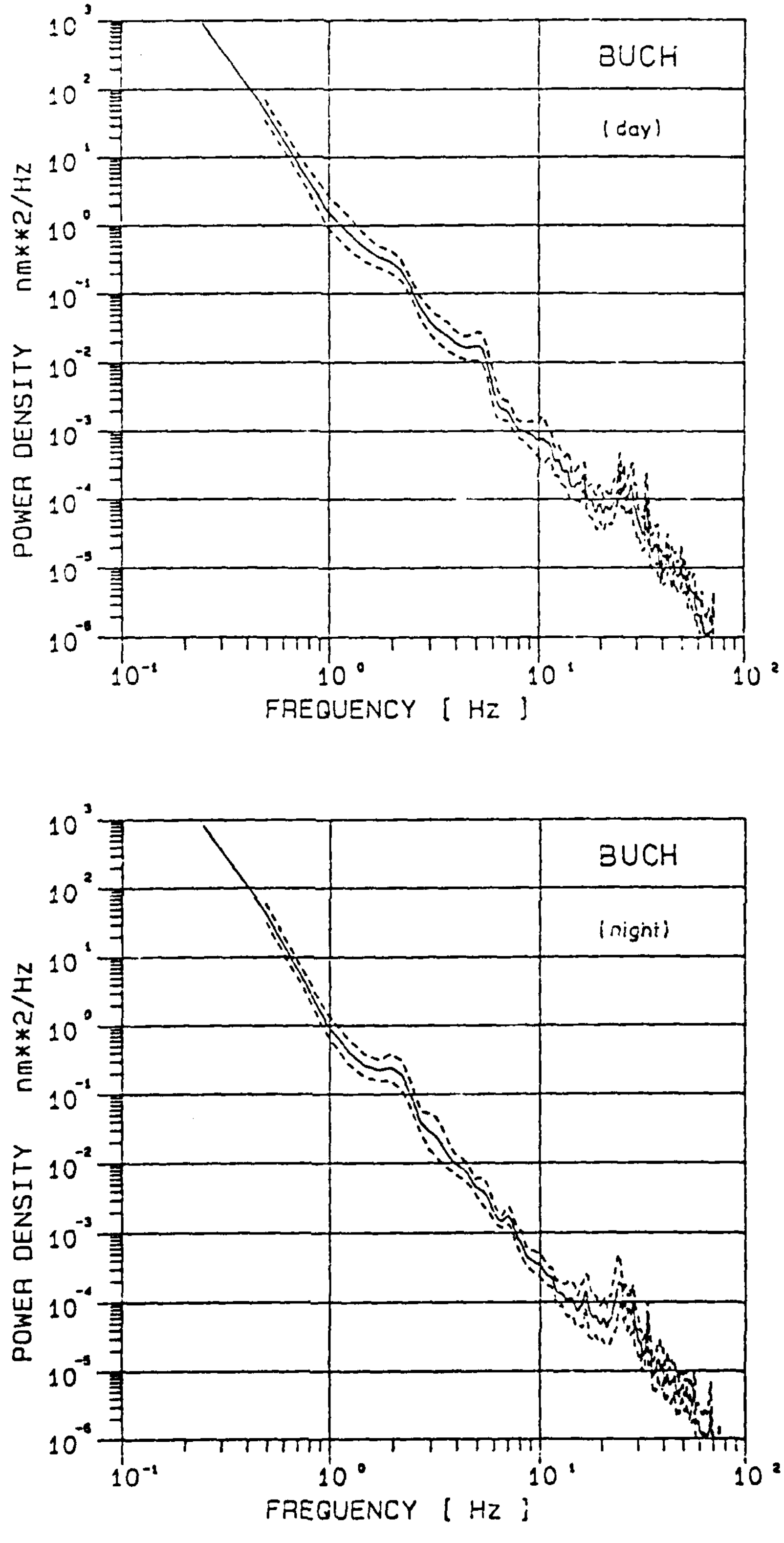
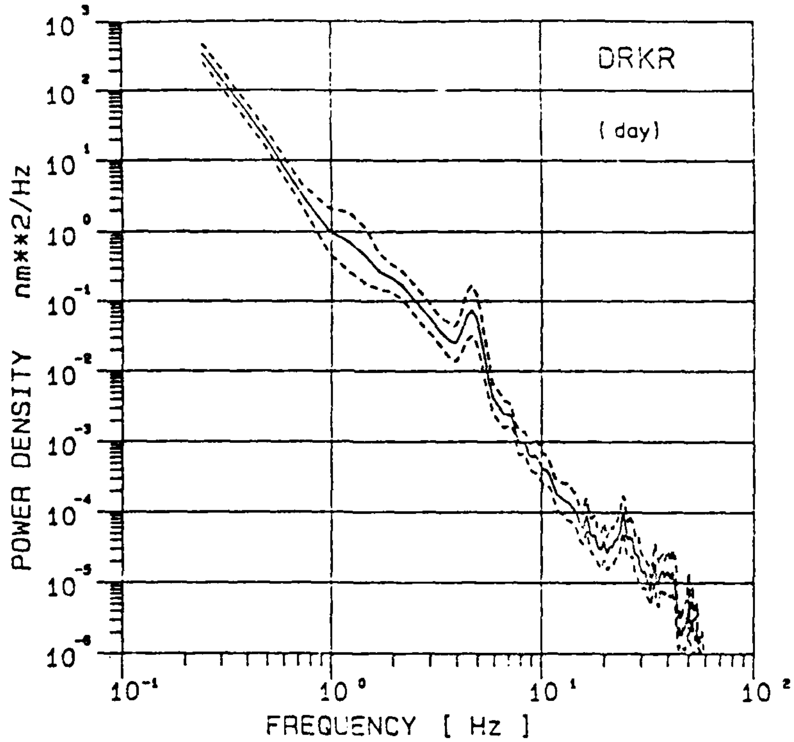


Fig. 3d : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station BUCHENAU



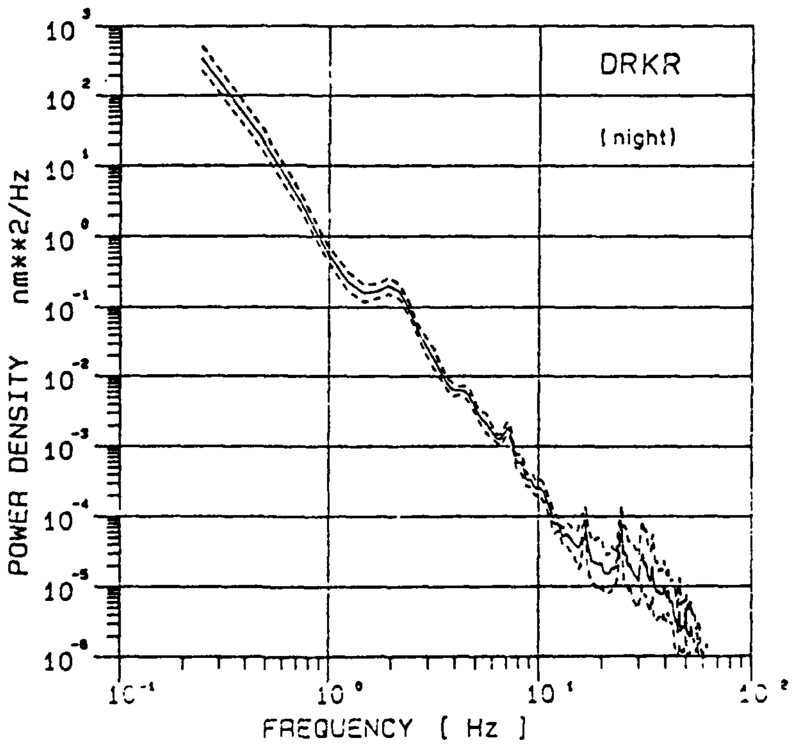


Fig. 3e : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station DREIKOEGELRIEGEL

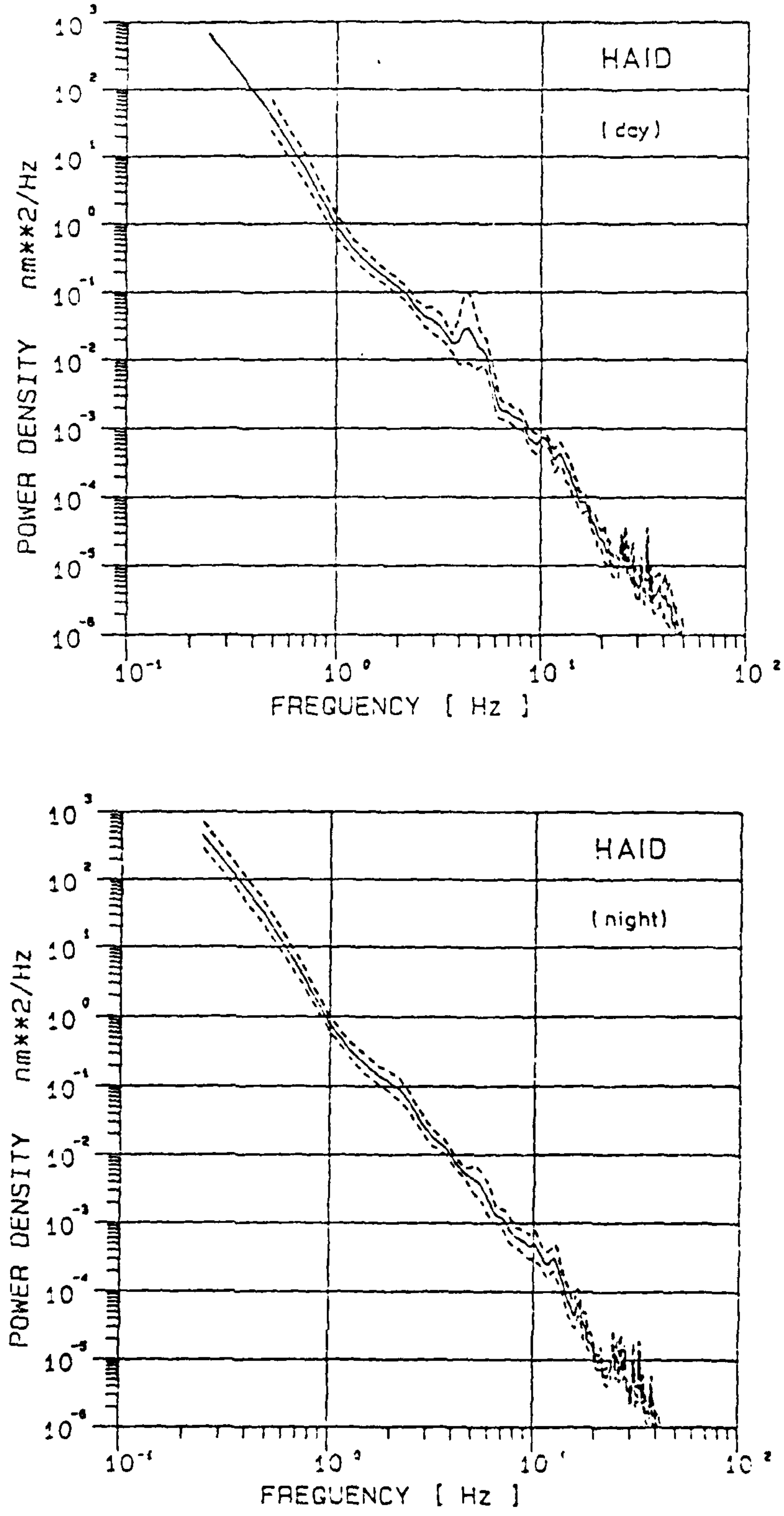
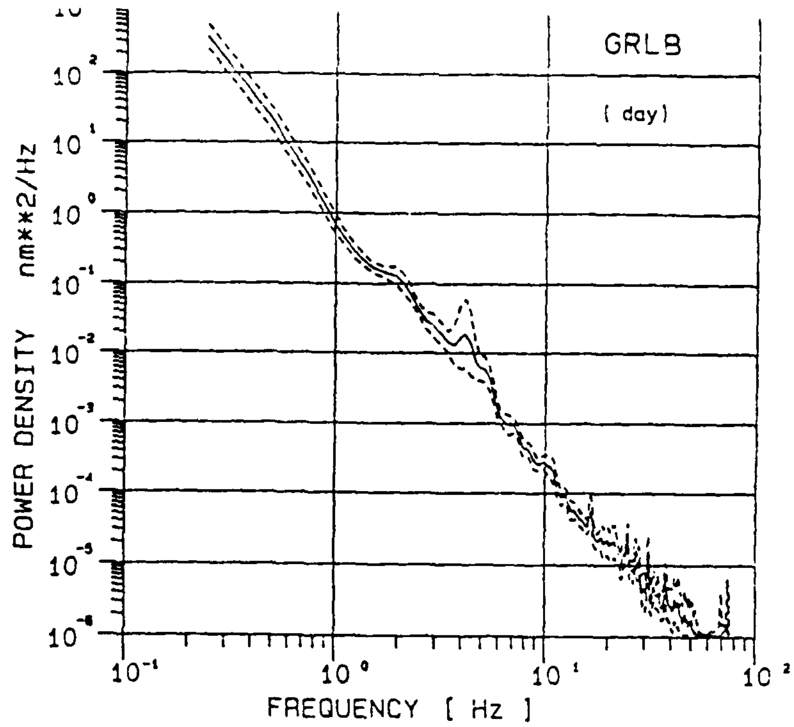


Fig. 3f : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station HAIDMUEHLE



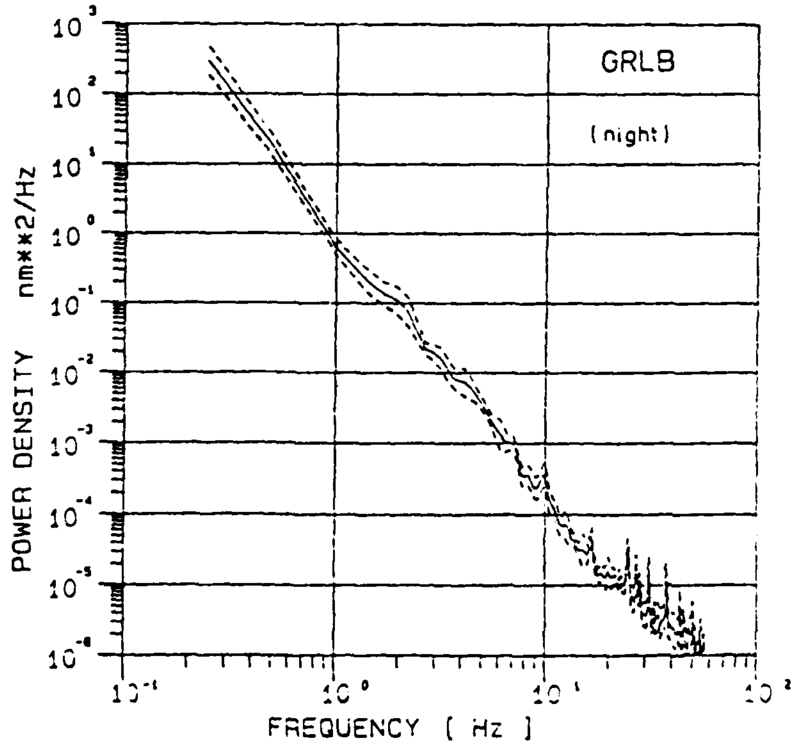
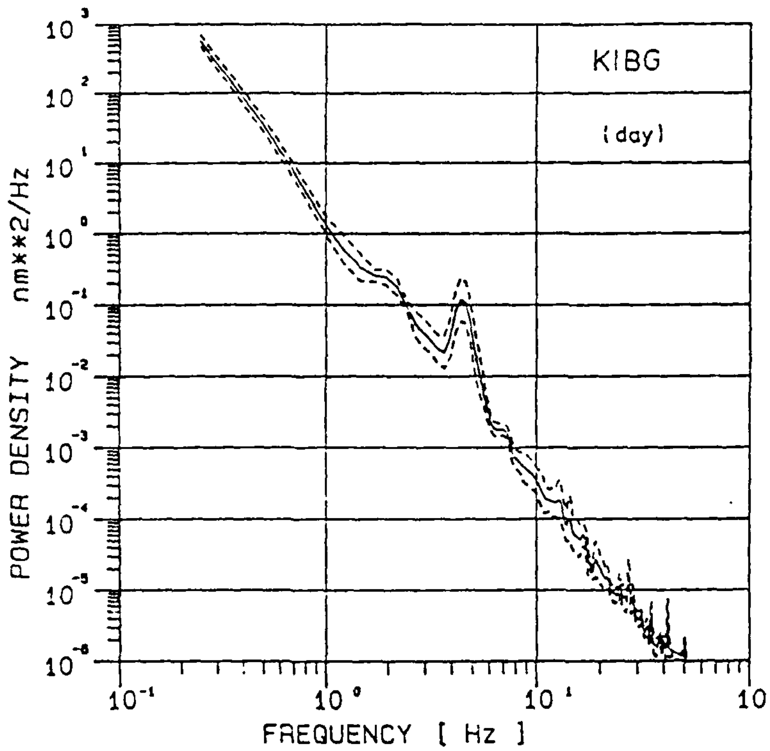


Fig. 3g : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station GROSS-LICHTENBERG



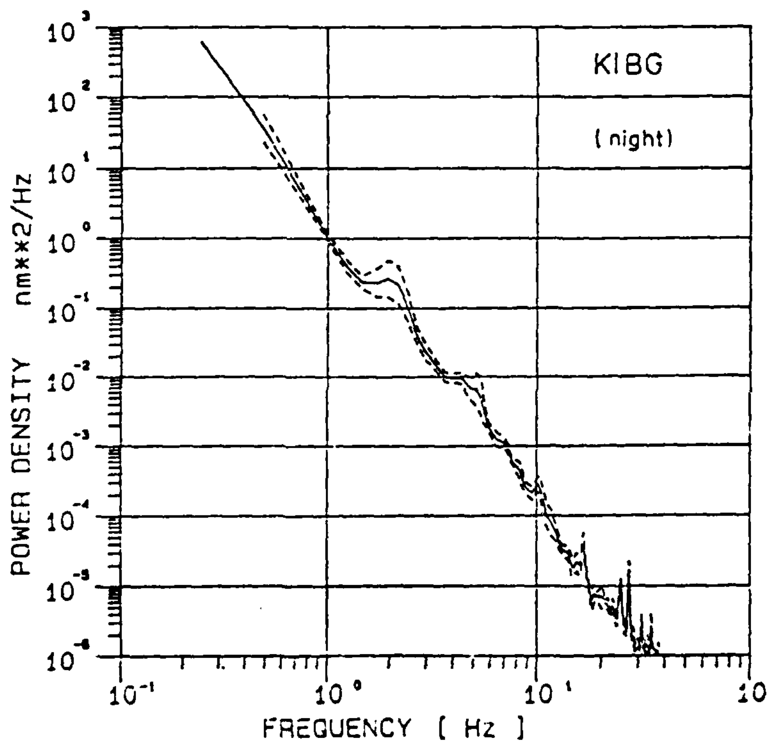


Fig. 3h : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station KIESBERG

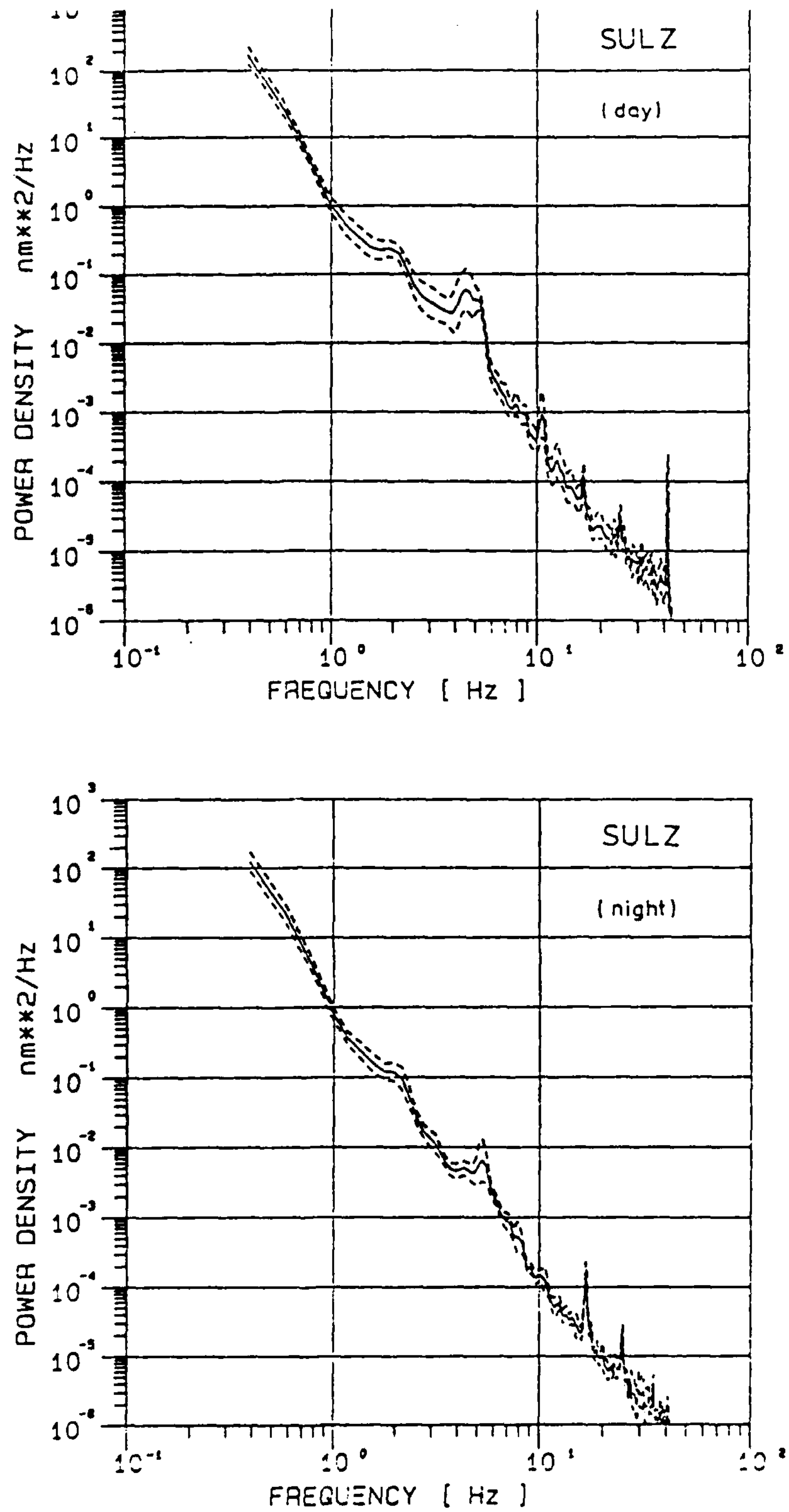
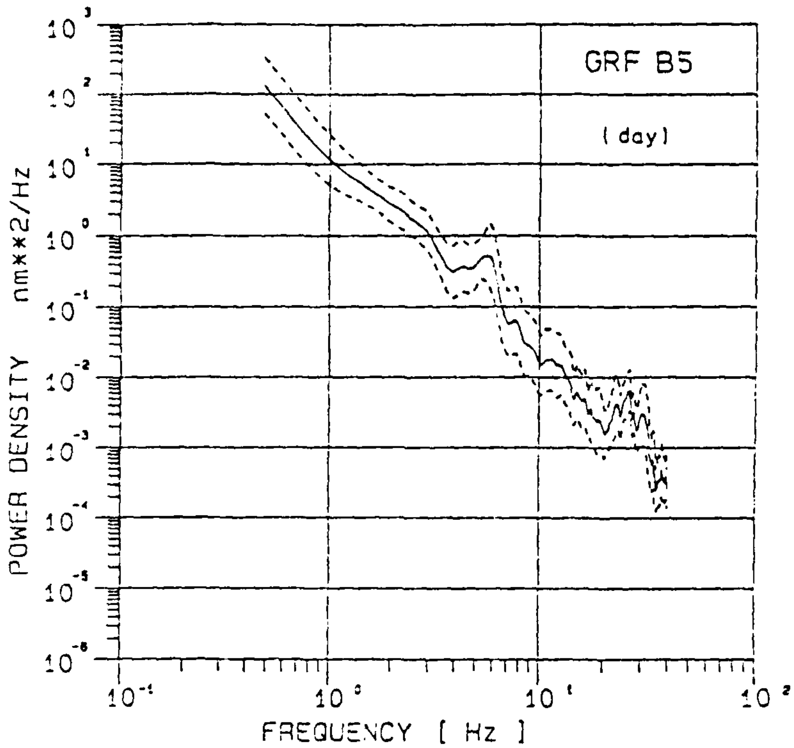


Fig. 3i : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station SULZBERG



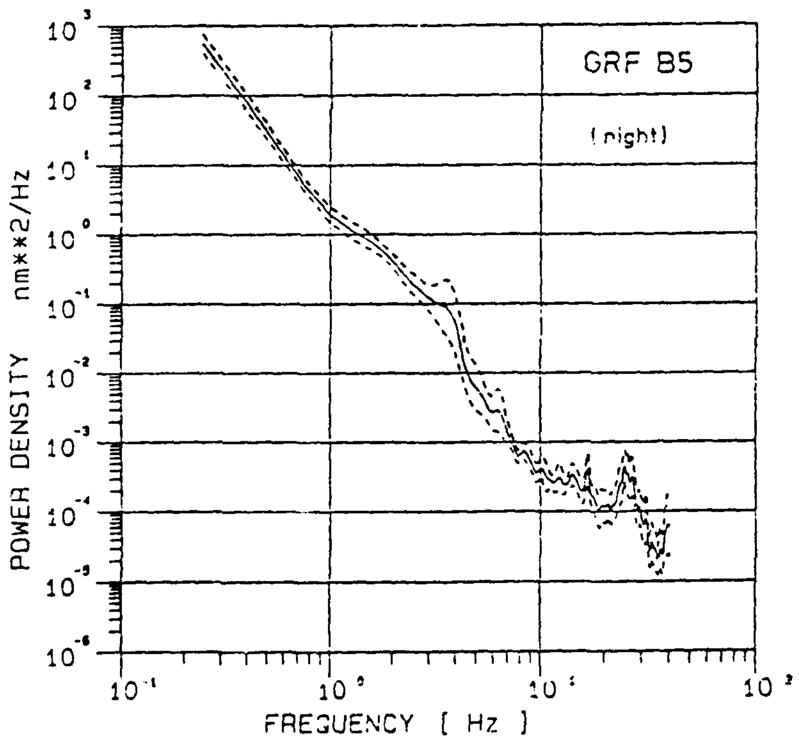


Fig. 3j : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station GRAEFENBERG

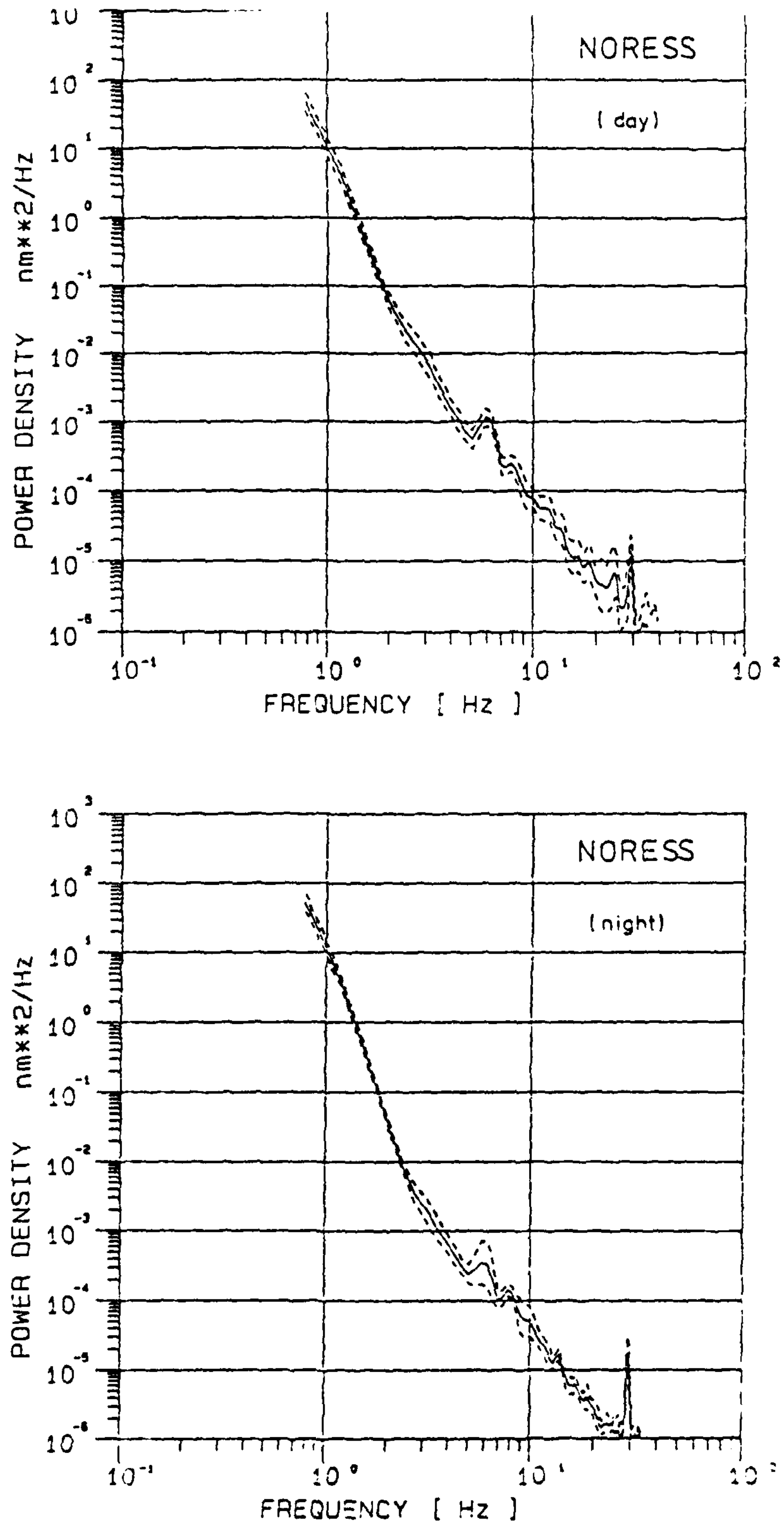


Fig. 3k : Spectral Power Density Estimates of Noise (mean and standard deviation) for Station NORESS

4. *Event Recordings*

During the noise survey the data acquisition system principally operated in detection mode as outlined in chapter 2. A conventional STA/LTA-detector algorithm was applied. Using an updating LTA the recording length was variable but generally the complete interval between Pn-waves and Lg-waves was recorded.

After inspection of the detection times which were compared with various bulletins, i.e. PDE for teleseismic events, NORSAR and EMSC (European Mediterranean Seismic Centre) for regional seismicity and the GRF-monthly bulletin for local events, the corresponding waveforms were extracted from the original data which filled about 80 digital tapes (2400", 1600 bpi). When three field stations had triggered, an independent epicentre determination was carried out for local events.

Although the whole field campaign lasted for a time period of more than three months, the actual recording time covered only 60 days. The remaining time was needed for setting up stations, changing batteries, and preparing new sites.

During the 60 days 504 events were detected and evaluated. About half of these events (265) were found to be teleseismic, 93 occurred at regional distances (150 km - 2000 km), and 146 events were classified as local seismicity. All events were plotted and tabulated in a station bulletin which is attached as an appendix to this report.

4a. *Global Detection Capability*

Data from a field survey with a recording time of 60 days can only give a rough estimate of the global detection capability of the investigated site. A permanent seismometer installation in a vault will certainly diminish the influence of wind noise. On the other hand, even a preliminary evaluation should show a correspondence between the detection threshold which can be inferred from the noise level and that from actual data.

In figure 4a a magnitude-frequency histogram is shown which includes all detected events with epicentral distances larger than 2000 km. From this diagram we derive an overall teleseismic detection threshold at about $m_b = 4.5$. A simple calculation yields a corresponding noise level of 2-4 nm at 1 Hz assuming an S/N-ratio of 2 for detection. This value is comparable to the power spectral estimates found in the area.

A peculiarity of the Bavarian Forest area with regard to teleseismic detection capabilities is certainly the large number of PKP-phases. 88 events - or roughly one third of the total 265 teleseismic detections - were PKP-detections originating from the Pacific. In fact, all detected teleseismic events with magnitudes less than $m_b = 3.6$ were identified as PKP-events. This result clearly demonstrates the potential of arrays on the Northern Hemisphere for monitoring special sites on the Southern Hemisphere as will be further shown in subchapter 4.c .

4b. *Regional Event Recordings*

As the planned array in the Bavarian Forest area is specifically aiming at high-frequency seismology, particular emphasis was given to recordings of regional events. During the field campaign, 93 events were recorded in a distance range of about 150 km to 2000 km. These events cover all azimuths although the majority of events are incident from east or southeast directions.

The Polish copper mines near Lubin and the coal mines in Upper Silesia contribute 19 events to the whole data set. Epicentral distance is 338 km and 411 km, respectively from the central area (GRLB). The spectral behaviour is quite different. Whereas the seismograms from Lubin copper mine show a very consistent picture with distinct Pn-, Pg-, and Lg-phases and relatively high frequencies (figure 4b), the seismograms from Upper Silesia coal mines are more complex (figure 4c), high frequencies are missing and often no clear Pn-onset can be defined. Several times the detector triggered on Lg-amplitudes for these coal-mining induced events, in contrast the detector never missed the Pn-arrival for Lubin events of comparable size.

Apart from these differences which are presumably related to the source process, variations of regional phases merely come from crustal differencies on the wave path. To the north and west of the investigated site, there are thick sedimentary layers which should attenuate high frequencies. The seismicity of these regions (central and northern Germany, France) is relatively low, but we recorded one $M_L = 2.3$ event from Eisenach/GDR, epicentral distance 328 km to the north (figure 4d) and a magnitude $M_L = 2.5$ event from France at a distance of 506 km to the west (figure 4e).

To the east several quarries in Czechoslovakia produce seismic signals. Many of these are at distancies less than 150 km and contribute to the 146 detected local events which also originate from quarries in southern Germany and from a few earthquakes in the Austrian Alps. Figure 4f shows an example of a recording of a CSSR event at 340 km distance. Remarkably large amplitudes can be seen in the 5 Hz - 20 Hz bandpass-filtered trace.

To the southeast of the BF-site the activity of the Eurasian earthquake belt is monitored. In ascending distance we recorded earthquakes from Jugoslavia (distance = 330 km), the Adriatic Sea (distance = 750 km), Greece (distance = 1300 km) and Turkey (distance = 1450 km).

Typical spectral differencies can be revealed from two different Adriatic Sea earthquakes which occurred in the same source region, figure 4g shows a magnitude m_b = 5.3 event compared to a m_b = 3.8 earthquake.

At distances of 1000 km and more the waveforms from earthquakes in Greece and Turkey as well as from southern Italy and northern Africa are very complex, no significant signal energy can be recognized above 10 Hz. Whether this observation generally depends on the heterogeneous wave path or whether it results from our limited data set, needs further investigation.

4c. *Records of Nuclear Explosions Including the JVE-Events*

None of the established sites for underground testing of nuclear weapons is within regional distances from the Bavarian Forest area. The epicentral distance to the Soviet test site in Kazakhstan is 41.3° and to Novaja Semlja 30.5° , the distance to NTS is 83.6° , and the French test site at Mururoa is in PKP-distance of 145.6° .

The following presumed explosions were recorded with various field stations :

Kazakhstan	Nevada	Mururoa
4.5.88	2.6.88	11.5.88
14.6.88	7.7.88	25.5.88
14.9.88	17.8.88	16.6.88
		23.6.88

Records from the JVE-events seemed to be of specific interest. A station was temporarily installed in the central area of the Bavarian Forest near the village of Bischofsreut at the GRLB-site (compare chapter 2). Figure 4h shows one trace of the Nevada explosion together with the signal and noise spectrum. The explosion yielded an amplitude of 32 nm at a period of 1.2 sec (m_b = 5.42).

Figure 4i shows the Kazakhstan explosion, in the upper part of the figure again the signal and noise spectra are plotted. For this event a P-amplitude of 320 nm at a period of 0.96 sec was measured (m_b = 6.03). Comparing the spectra from figures 4h and 4i, the Nevada explosion already vanishes at 2 Hz in the noise spectrum whereas the Kazakhstan explosion dominates the noise spectrum up to 8 Hz. At the moment it cannot be decided whether this difference is a source or path effect or both.

As already mentioned the BF-area is within the PKP-focus to Mururoa test site. The excellent detection capability for this distance can be demonstrated by the record of a presumed explosion on

16.6.88 which was only reported by the seismological agency in New Zealand. This event (figure 4j) does not appear in any other published bulletin (e.g. NEIC, NORSAR etc).

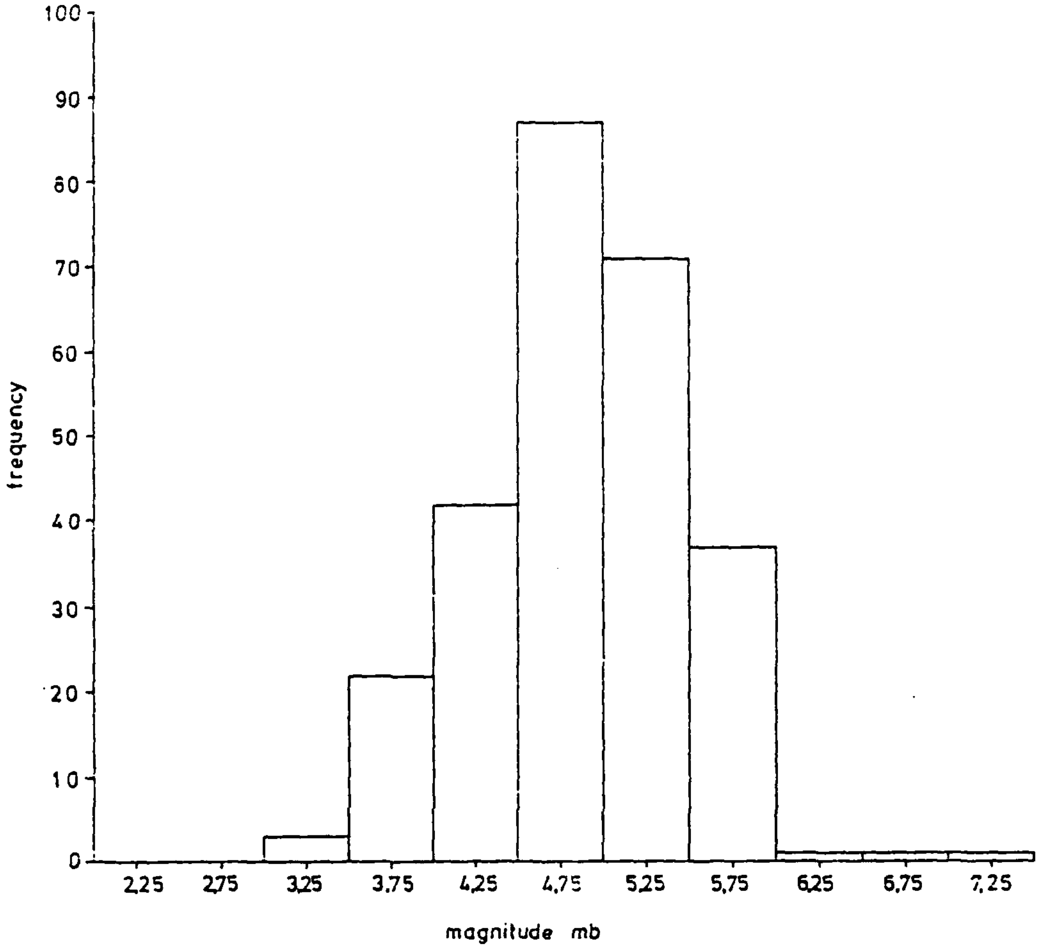


Fig. 4a : Magnitude-Frequenzy Histogram of Detected Teleseismic ($\Delta > 2000$ km) Events

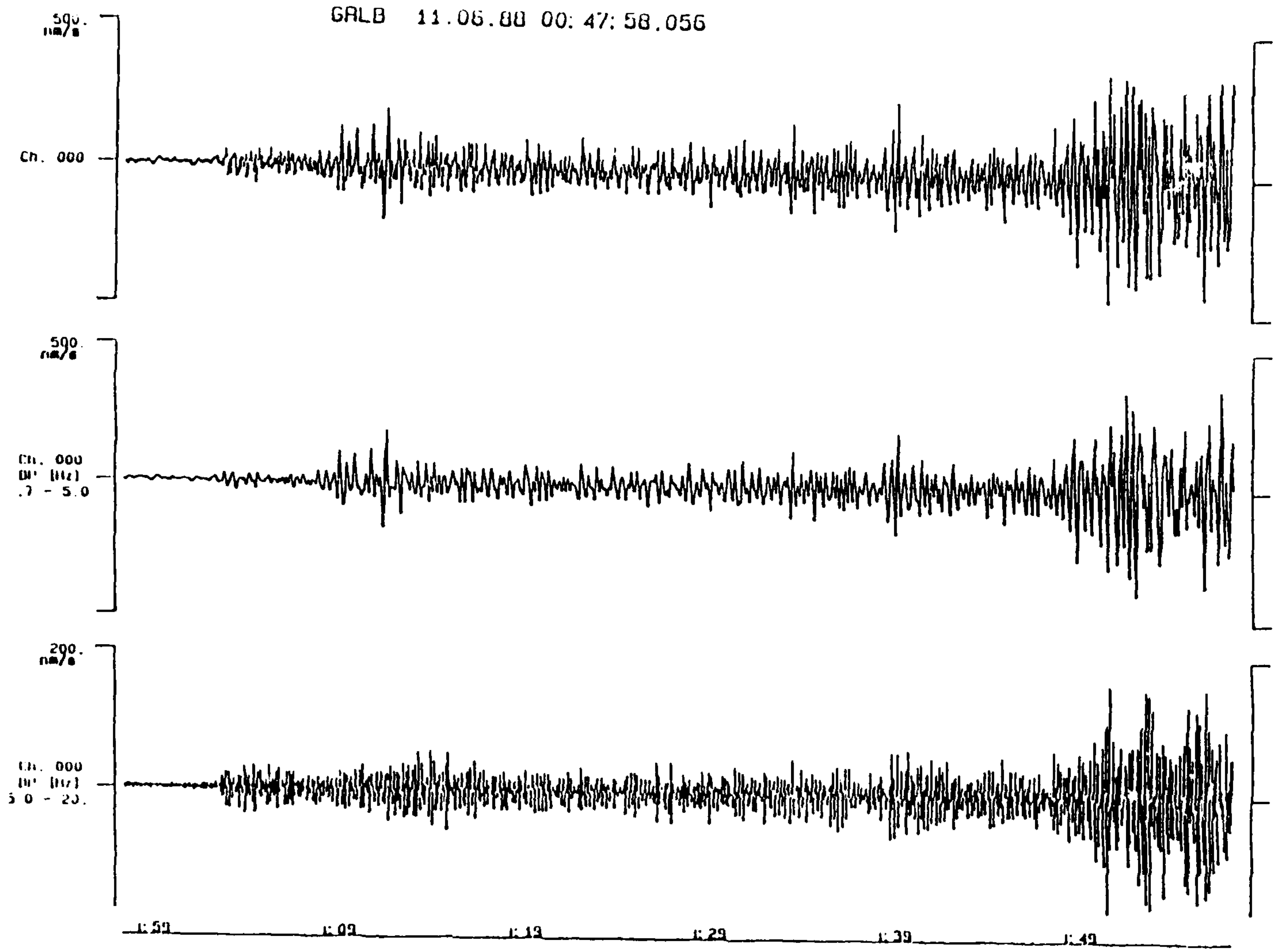


Fig. 4b : Lubin (Copper Mine) Event : $M_L = 3.6$, $\Delta = 338$ km
Original Recording (top), Lowpass (middle) and Highpass (bottom) Filtered Trace

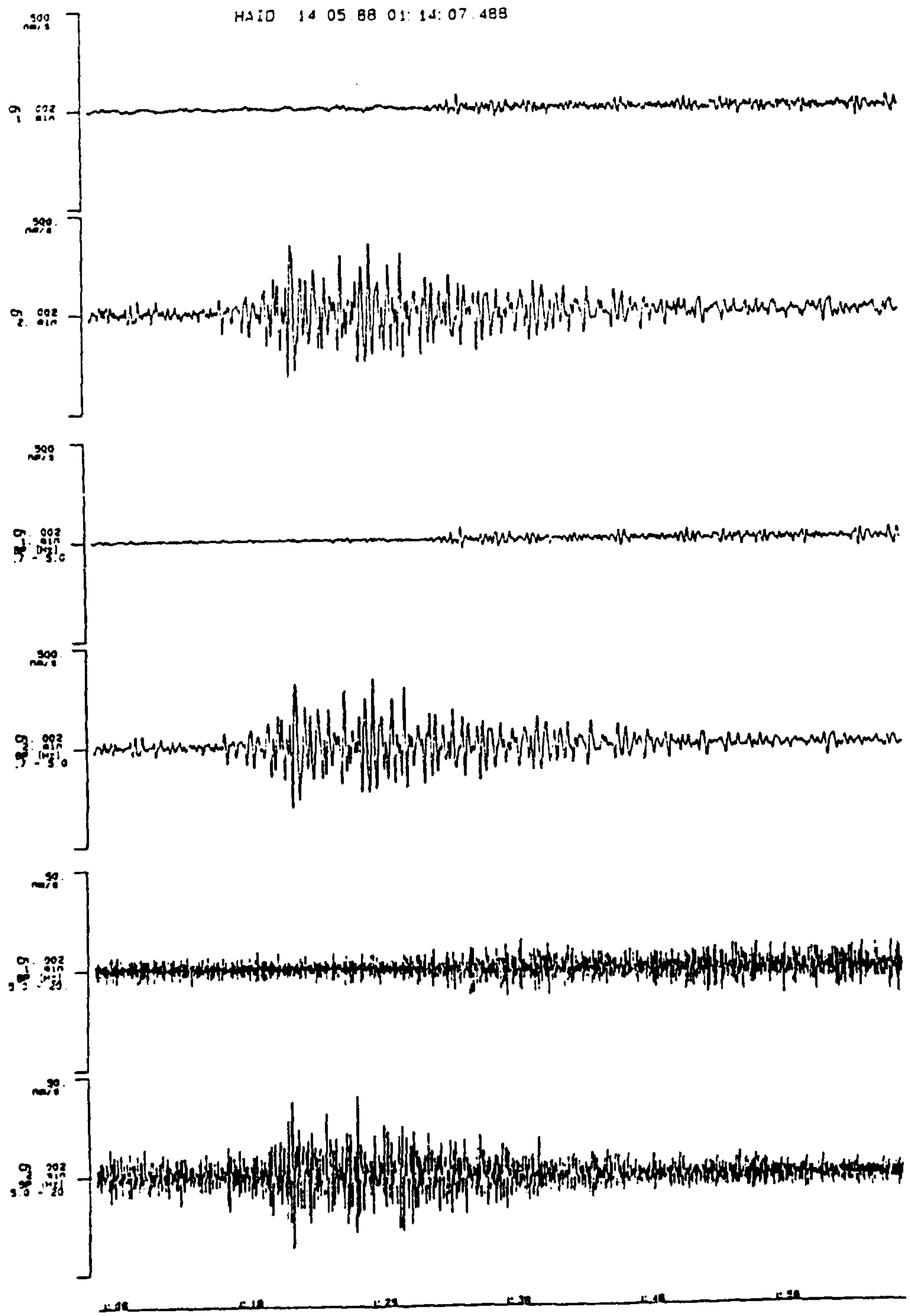


Fig. 4c : Upper Silesia (Coal Mine) Event, $M_L = 3.1$, $\Delta = 411$ km
Original Recording (upper traces), Lowpass (middle)
and Highpass (bottom traces) Filtered Seismograms

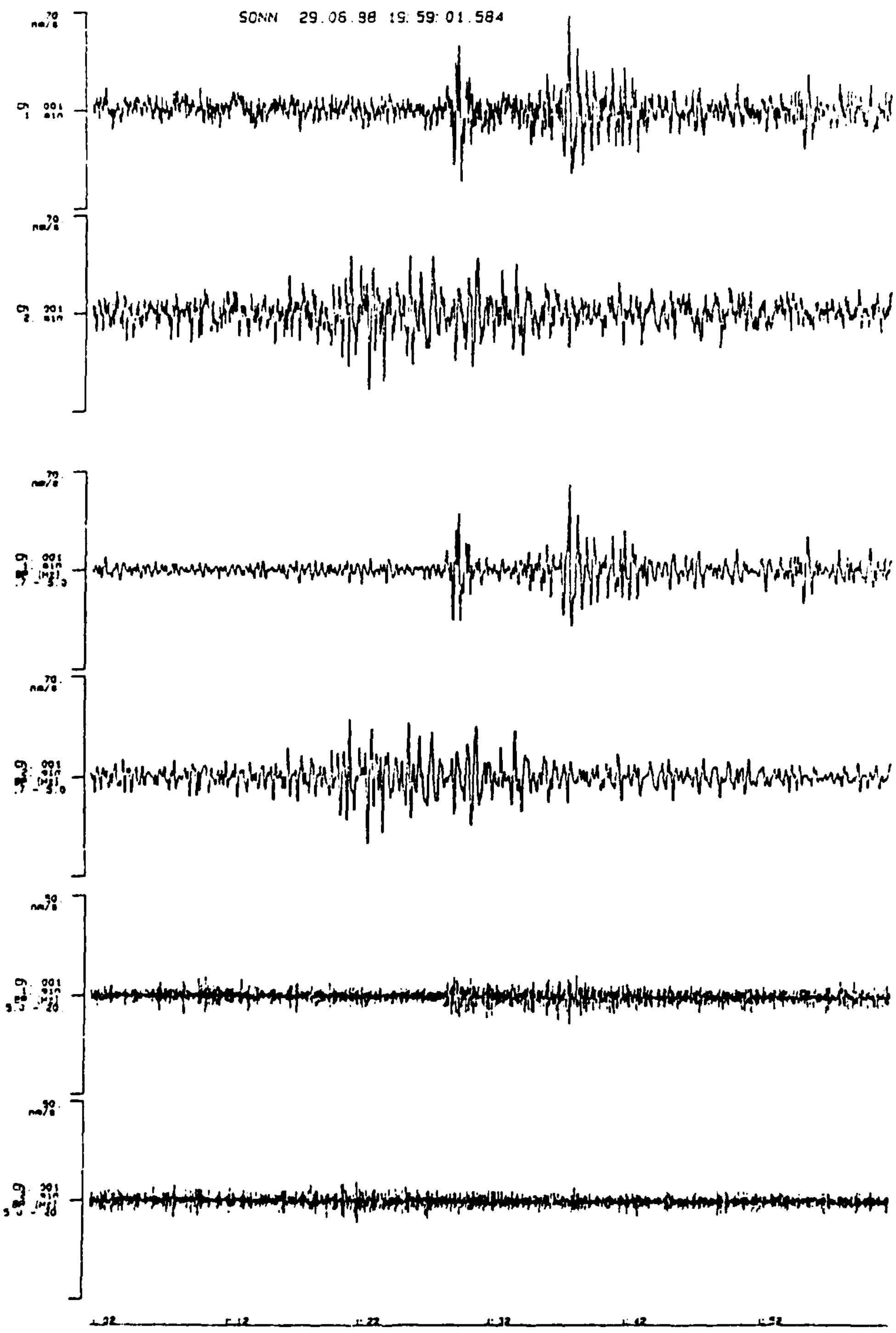


Fig. 4d : Earthquake near Eisenach / GDR : $M_L = 2.3$, $\Delta = 328$ km
Original Recording (upper two lines), Lowpass (middle) and Highpass (bottom traces) Filtered Seismograms

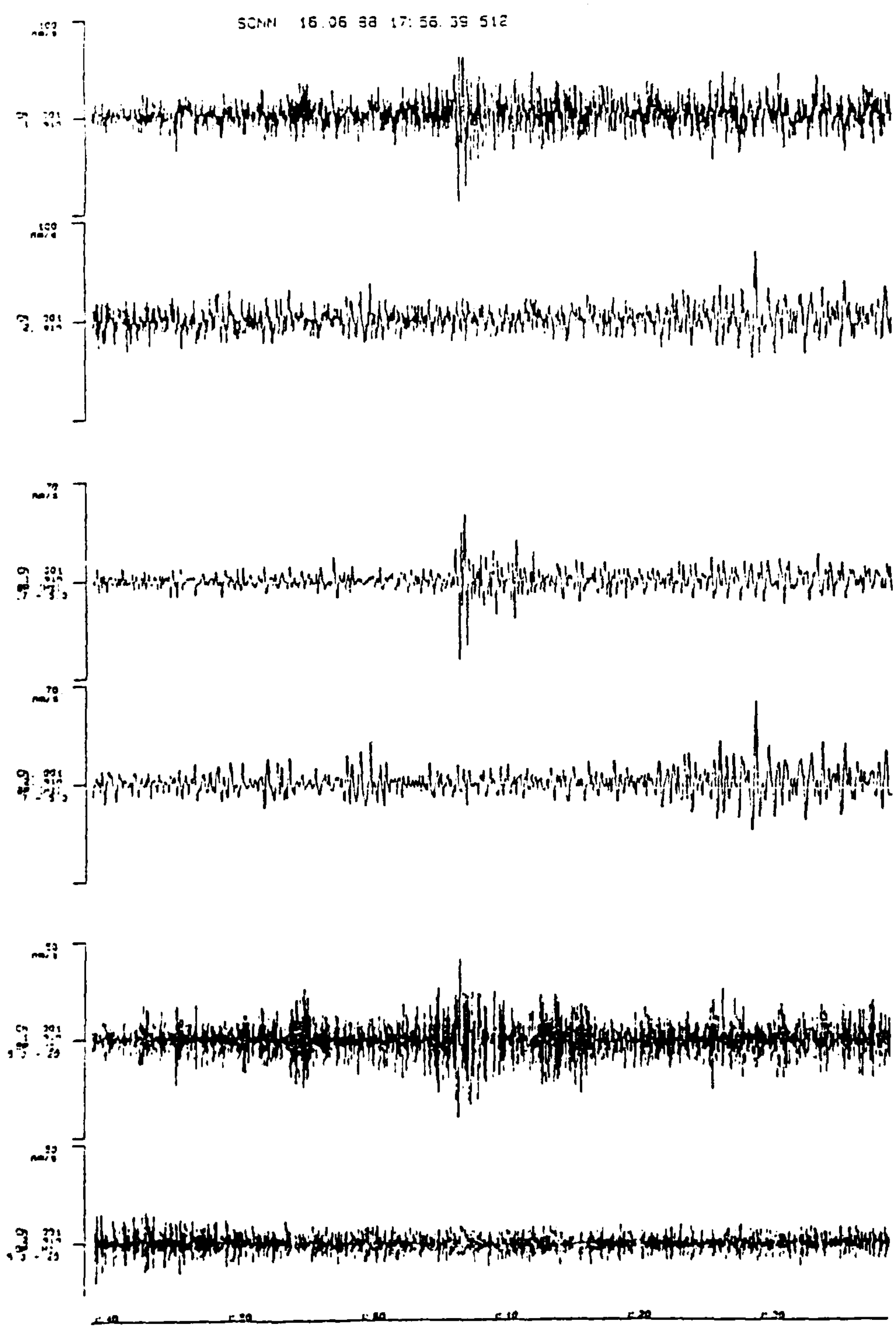


Fig. 4e : Earthquake in France : M_L = 2.5, Δ = 506 km
Original Recording (upper two lines), Lowpass (middle) and Highpass (bottom traces) Filtered Seismograms

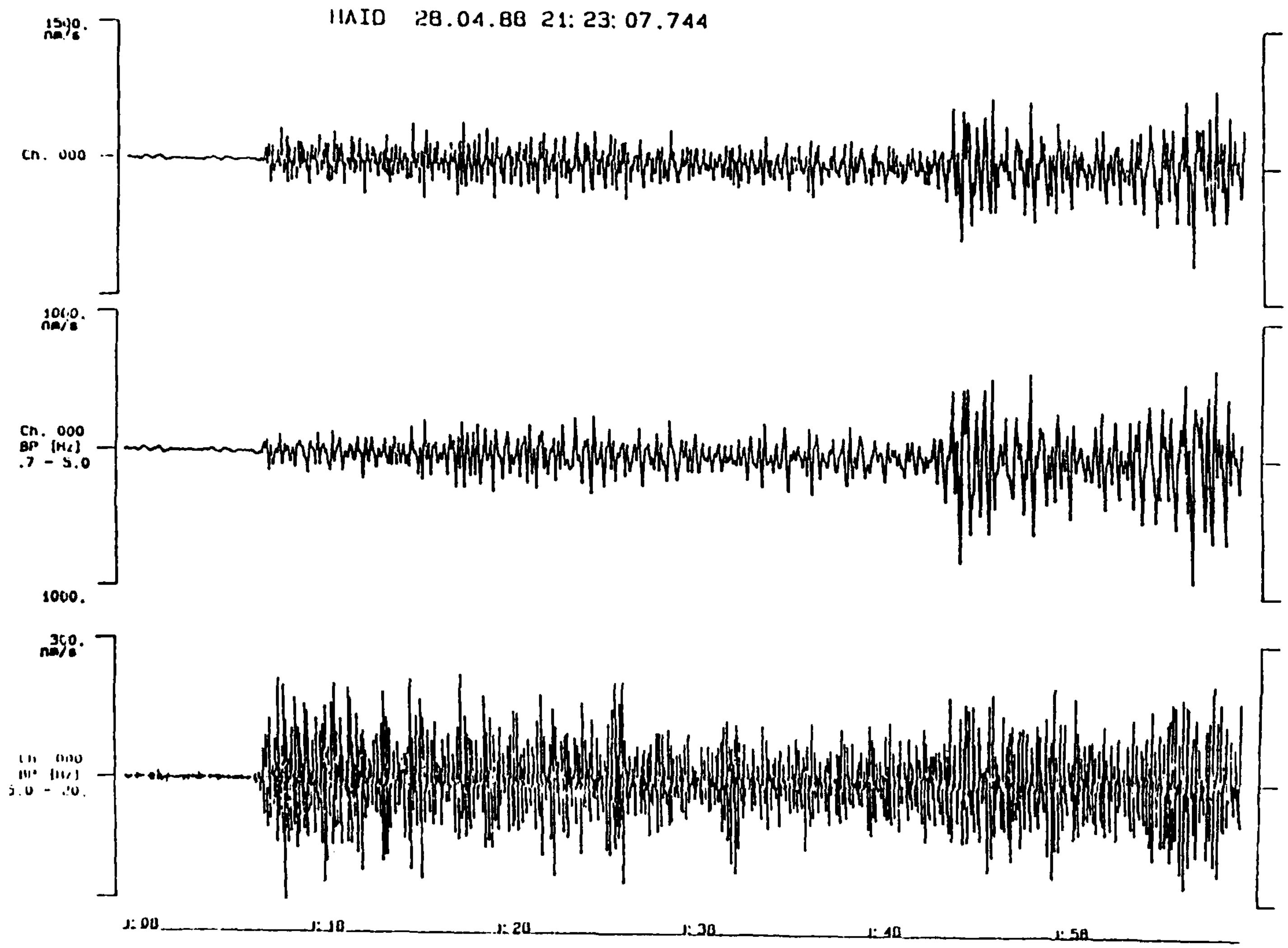


Fig. 4f : CSSR (quarry ?) Event in the West Carpatians : M_L = 3.3, Δ = 340 km
Original (top), Lowpass (middle) and Highpass (bottom) Filtered Recording

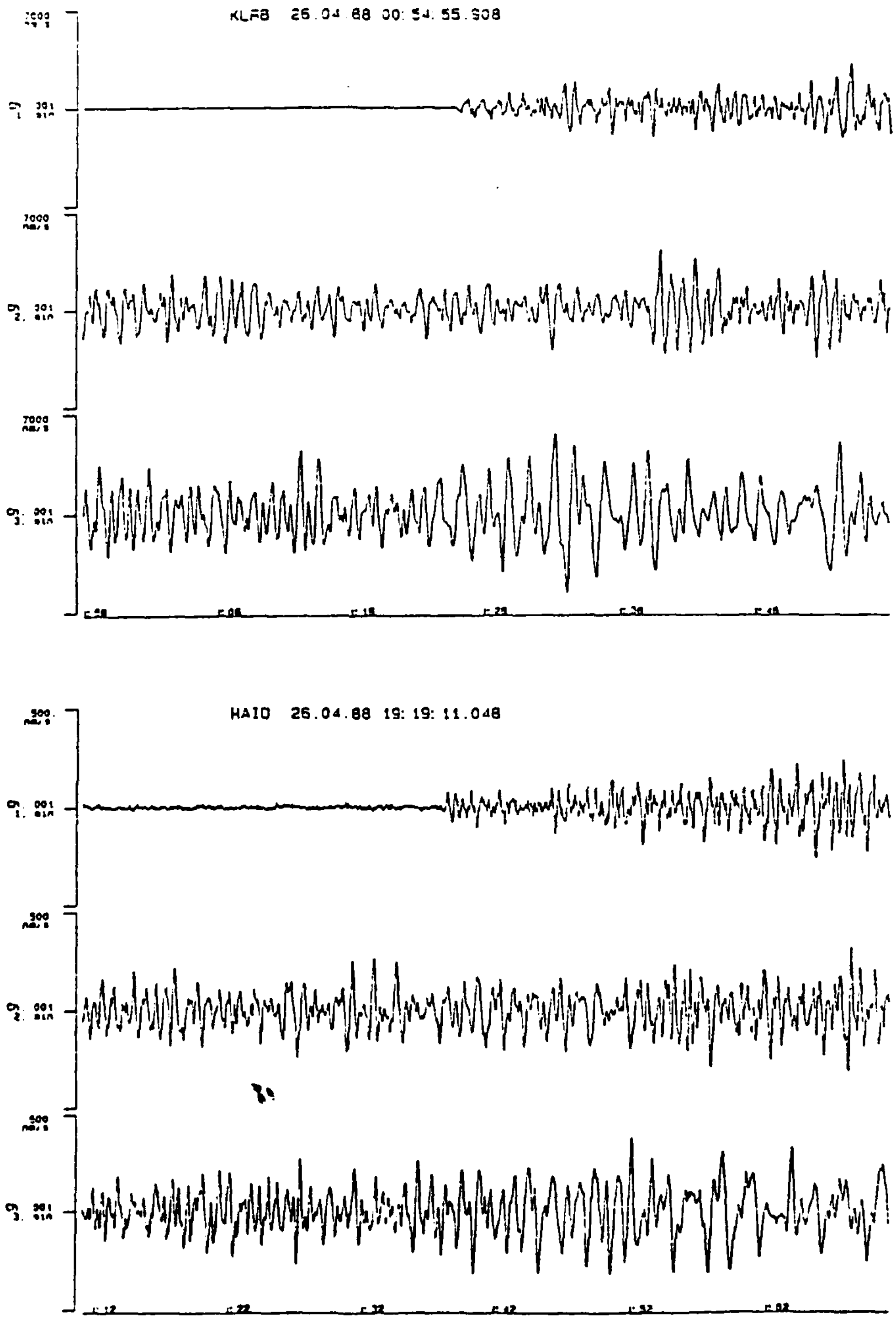


Fig. 4g : Adriatic Sea Earthquakes, Δ = 750 km
Top : Main Shock, m_b = 5.3
Bottom : Aftershock, m_b = 3.8

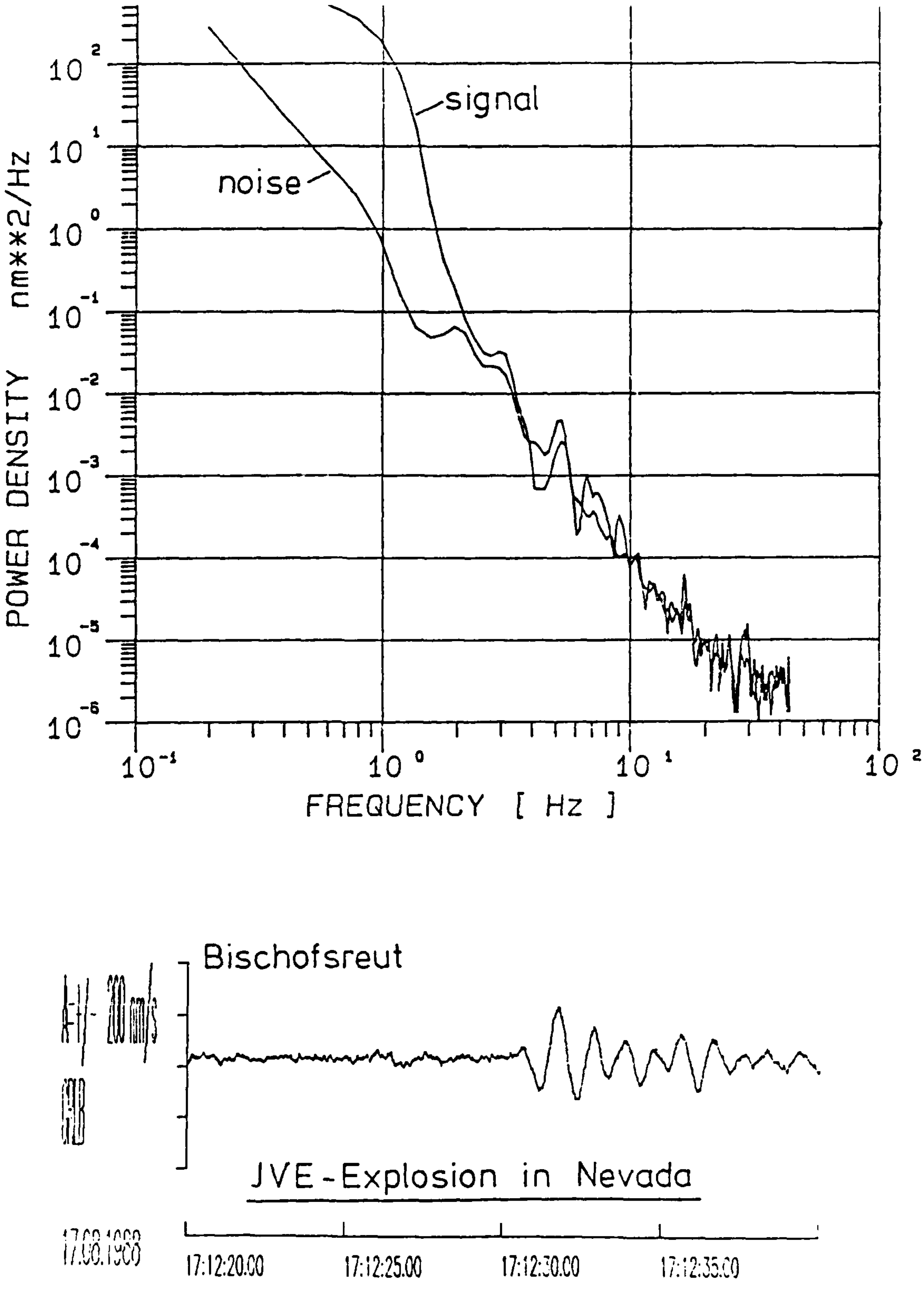
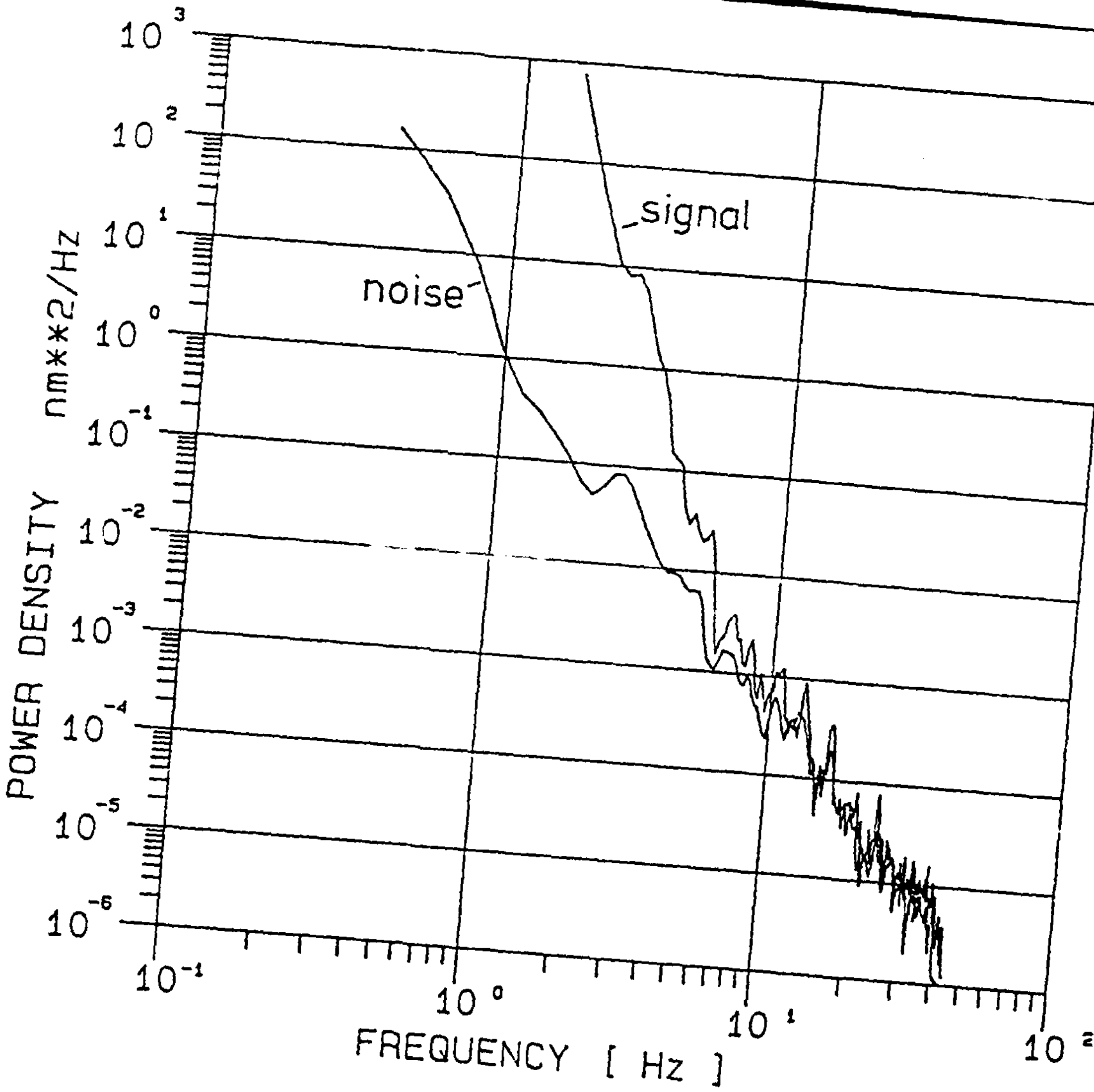


Fig. 4h : P-Wave Recording and Spectral Analysis of Nevada Explosion at proposed GERESS-site



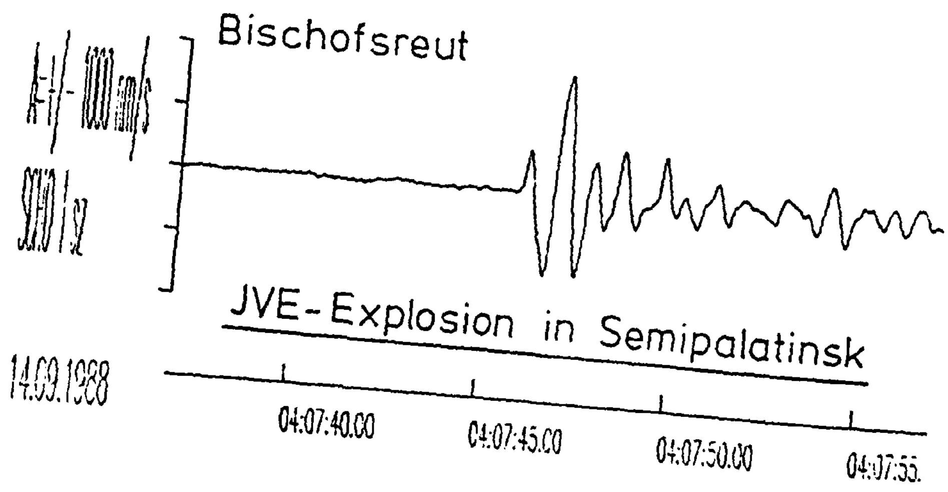


Fig. 4i : P-Wave Recording and Spectral Analysis of Kazakhstan Explosion at proposed GERESS-site

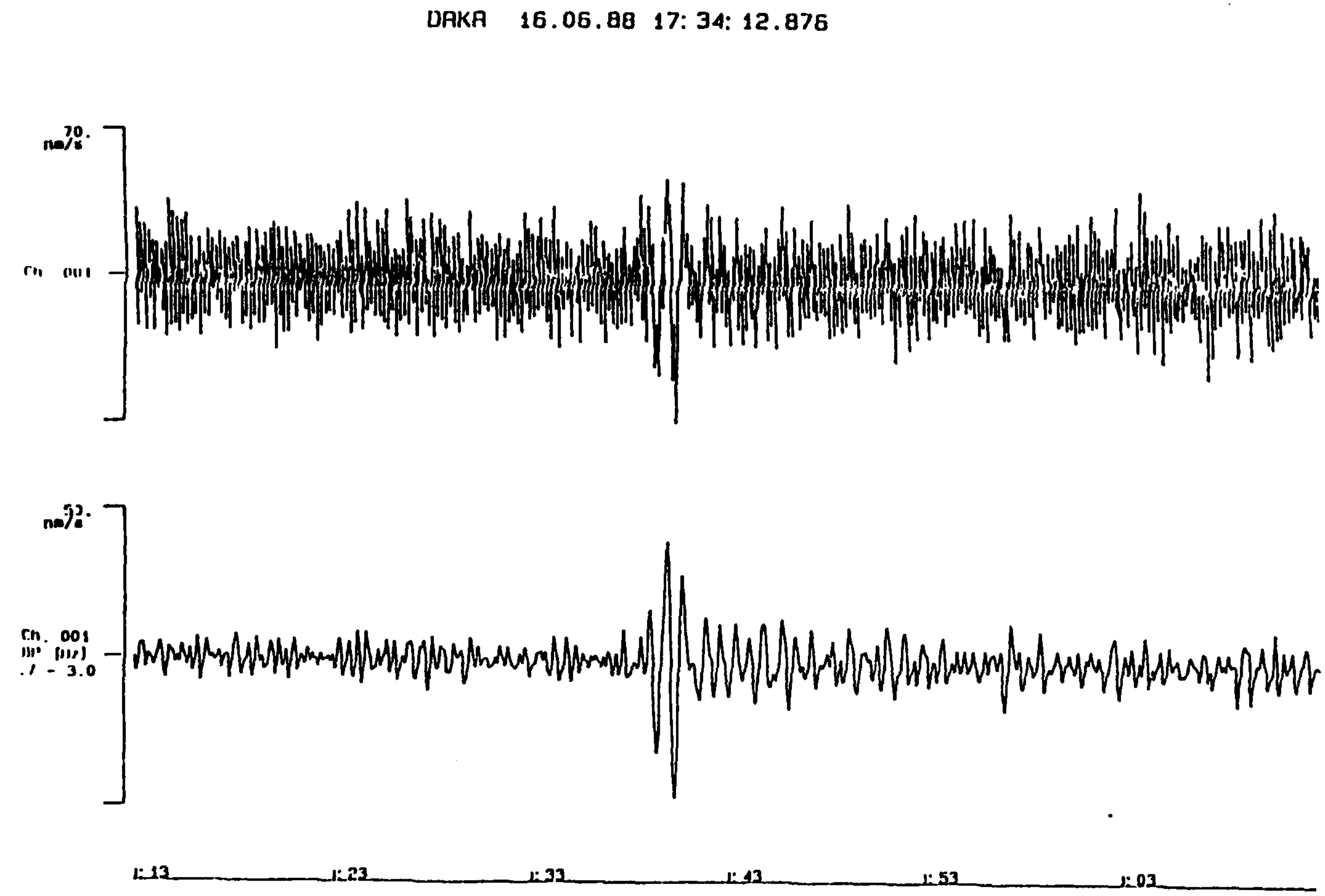


Fig. 4j : PkP-Recording of Small Mururoa Explosion : $\Delta = 145.5°$, A = 9nm, T = 0.9 sec

5. *Future Work*

As a consequence of the noise survey the most promising area for an array installation was found to be the central region of the Bavarian Forest east of the city of Freyung. This area was selected to establish a provisional 9-element array.

Data from this installation will be used to study the coherence of signal and noise which is needed for the array design.

In late 1988 the seismometer vaults were prepared after the German Air Forces were kind enough to allow the use of a building which is ideally suited as a central array station.

It is planned to collect data until May 1989 and after evaluating these data and depending on the results, accurate seismometer sites for the planned regional array will be defined.

6. *Acknowledgements*

This report could not have been written without the support of L. Kuehne, N. Schnieders and D. Wand. Their engaged cooperation during field trip and data analysis is very much appreciated. The station bulletin was produced by B. Modenbach and A. Mueller. I would also like to thank them for their help.

7. *Literature*

Oppenheim, A. V. and R. W. Schafer, *Digital Signal Processing*, p. 585, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1975.

Welch, P. D., "The use of fast fourier transform for the estimation of power spectra : A method based on time averaging over short, modified periodograms", *IEEE Trans. Audio Electroacoust.*, vol. AU-15, pp. 70-73, IEEE, June 1967.

Appendix

EVENT-LIST

PORTABLE SEISMIC STATIONS

07. APR - 05. JUL 1988

date	origin time	epicenter	magnitude
07.04.	21:22:11 KLRB	51.45N 16.09E (Poland)	ml=3.9
08.04.	04:42:48 KLRB	17.60N 119.4E (Philippinen)	mb=5.6
08.04.	05:29:23 KLRB	2.0N 121.0E (Celebes Sea)	mb=5.1
08.04.	05:57:01 KLRB	37.33N 21.15E (Greece)	mb=3.9
09.04.	18:43:33 KLRB	18.00S 171.00E (Vanuatu Islands)	mb=4.7
11.04.	03:16:53 KLRB	36.N 69.E (Hindukusch)	mb=4.1
11.04.	06:30:30 KLRB	17.89S 172.51W (Tonga Islands)	mb=5.5
12.04.	19:41:13 KLRB	9.2N 65.2W (Venezuela)	mb=5.7
12.04.	23:19:50 KLRB	21.S 71.W (South India)	mb=6.6
13.04.	00:02:06 KLRB	51.N 149.W (Alaska)	mb=5.0
13.04.	00:39:33 KLRB	17.3S 72.6W (Coast of Peru)	mb=5.3
13.04.	(01:34) KLRB	----------- (Poland)	ml=3.3
13.04.	10:48:12 KLRB	9.0S 156.0E (Solomon Islands)	mb=5.0
13.04.	15:34:49 BUCH KLRB	46.06N 15.40E (Yugoslavia)	mb=3.1
13.04.	20:51:26 BUCH	51.6N 168.7W (Aleuten)	mb=5.1
13.04.	21:28:29 KLRB BUCH	39.72N 16.88E (South Italy)	mb=4.9
13.04.	23:01:17 KLRB BUCH	26.S 180.W (Fiji)	mb=4.3
14.04.	(09:31) BUCH KLRB	----------- ------	------

14.04.	(10:59) BUCH KLRB	-----------	------		------
15.04.	08:51:54 KLRB	16.N	96.W	(Mexico)	mb=5.0
15.04.	09:29:08 KLRB	41.0S	169.0E	(New Zealand)	mb=4.1
15.04.	10:55:43 HAID KLRB	2.S	113.E	(China)	mb=5.6
16.04.	01:08:22 BUCH KLRB HAID	14.29S	173.43W	(Samoa)	mb=5.1
16.04.	(06:49) BUCH HAID KLRB	------------	------		------
16.04.	07:34:00 KLRB HAID BUCH	34.19N	25.09E	(Crete)	mb=4.2
16.04.	08:31:03 BUCH	31.N	140.E	(Japan)	mb=4.5
16.04.	21:16:31 KLRB HAID BUCH	18.S	27.E	(Simbabwe)	mb=5.2
16.04.	21:24:32 HAID	52.N	175.W	(Aleuten)	mb=4.2
16.04.	22:47:17 BUCH	31.N	49.E	(Iran)	mb=4.2
17.04.	02:50:38 HAID	17.5S	72.4W	(Coast of Peru)	mb=5.1
17.04.	03:23:04 KLRB HAID BUCH	20.99S	178.32W	(Fiji Islands)	mb=4.8
17.04.	05:47:58 BUCH	33.N	48.E	(Iran)	mb=4.1
17.04.	09:49:44 BUCH	39.2N	143.5E	(Japan)	mb=4.9
17.04.	09:54:28 BUCH	39.N	143.5E	(Japan)	mb=4.7

17.04. 20:42:56 51.7N 17.8E (Poland) ml=3.5
BUCH
KLRB
HAID

18.04. 00:16:40 45.N 152.E (Kuril Islands) mb=4.5
BUCH

18.04. (09:15) ------------ ------ ------
BUCH
HAID
KLRB

18.04. (11:06) ------------ ------ ------
BUCH
HAID
KLRB

18.04. (12:17) ------------ ------ ------
HAID
KLRB
BUCH

18.04. (12:41) ------------ ------ ------
BUCH
KLRB
HAID

18.04. 17:13:30 24.9S 177.4W (Fiji Islands) mb=5.1
BUCH
HAID

18.04. 18:35:08 46.02N 12.25E (Northern Italy) ml=3.8
KLRB
HAID
BUCH

18.04. 19:25:43 34.N 72.E (Pakistan) mb=3.9
BUCH

18.04. 20:37:24 44.N 154.E (Kuril Islands) mb=4.4
BUCH

18.04. 22:00:21 34.83N 25.81E (Crete) mb=4.3
KLRB
HAID

19.04. (01:19) ------------ ------ ------
HAID
KLRB
BUCH

19.04. 01:56:41 44.N 142.E (Japan) mb=4.9
BUCH
KLRB
HAID

19.04. 05:54:01 19.N 141.E (Mariana Islands) mb=5.5
BUCH
HAID

19.04.	(09:29)	------------		------	------
	HAID				
	KLRB				
	BUCH				
19.04.	(09:59)	------------		------	------
	BUCH				
	HAID				
	KLRB				
19.04.	(11:05)	------------		------	------
	HAID				
	KLRB				
	BUCH				
19.04.	(12:02)	------------		------	------
	HAID				
	BUCH				
	KLRB				
19.04.	(15:00)	------------		------	------
	BUCH				
	HAID				
	KLRB				
19.04.	19:10:52	5.N	127.E	(Talaud Islands)	mb=5.6
	KLRB				
19.04.	20:48:54	2.0N	127.3E	(Molucca Passage)	mb=5.7
	KLRB				
19.04.	20:56:24	34.20N	104.38E	(China)	mb=5.3
	KLRB				
	BUCH				
19.04.	22:04:50	54.7N	152.W	(Alaska)	mb=5.1
	BUCH				
	HAID				
	KLRB				
20.04.	03:50:10	35.4N	39.4E	(Iran)	mb=5.7
	KLRB				
	HAID				
	BUCH				
20.04.	04:25:36	0.95N	30.24W	(Mid-Atlantic)	mb=5.7
	BUCH				
	KLRB				
	HAID				
20.04.	06:40:50	29.N	83.E	(Bengalen)	mb=5.3
	BUCH				
	HAID				
20.04.	08:03:11	16.7S	177.24W	(Fiji Islands)	mb=5.0
	BUCH				

20.04.	(08:50)	------------	------	------
	HAID			
	KLRB			
	BUCH			
20.04.	(09:25)	------------	------	------
	KLRB			
	BUCH			
	HAID			
20.04.	(09:59)	------------	(Taiwan)	------
	KLRB			
	BUCH			
	HAID			
20.04.	10:27:29	26.N 131.E	(Ryukyu Islands)	mb=5.1
	BUCH			
	HAID			
	KLRB			
20.04.	10:27:43	28.17N 130.0E	(Ryukyu Islands)	mb=5.2
	BUCH			
20.04.	(11:42)	------------	------	------
	HAID			
	KLRB			
	BUCH			
20.04.	18:15:43	49.19N 6.87E	(Germany,Saarland)	------
	KLRB			
21.04.	10:01:51	39.17N 44.16E	(Central USSR)	mb=4.6
	BUCH			
21.04.	(11:44)	------------	------	------
	BUCH			
	KLRB			
	HAID			
21.04.	(12:45)	------------	------	ml=3.5
	BUCH			
	HAID			
21.04.	18:28:01	43.9N 149.9E	(North Pacific)	mb=5.3
	HAID			
	BUCH			
22.04.	01:54:25	32.N 48.E	(Iran)	mb=4.7
	HAID			
22.04.	(07:53)	------------	------	------
	HAID			
	KLRB			
	BUCH			
22.04.	(09:32)	------------	------	------
	BUCH			
	HAID			
	KLRB			

22.04.	(10:01)	------------	------	------
	BUCH			
	HAID			
	KLRB			
22.04.	(11:05)	------------	------	------
	BUCH			
	HAID			
	KLRB			
23.04.	(12:11)	------------	------	------
	HAID			
24.04.	10:10:35	38.88N	20.52E (Mediterranean Sea)	mb=4.2
	HAID			
	KLRB			
24.04.	15:48:06	0.N	31.W (Mid-Atlantic Ridge)	mb=4.5
	KLRB			
24.04.	20:03:22	22.3N	122.4E (Taiwan)	mb=5.7
	HAID			
	KLRB			
	BUCH			
24.04.	20:49:36	40.85N	28.24E(Turkey)	mb=4.5
	HAID			
	KLRB			
	BUCH			
25.04.	00:41:56	51.49N	15.99E(Poland)	ml=3.6
	HAID			
	KLRB			
25.04.	01:18:54	33.S	177.E (Fiji Islands)	mb=4.6
	HAID			
	KLRB			
	BUCH			
25.04.	(07:52)	------------	------	------
	KLRB			
	HAID			
	BUCH			
25.04.	10:10:31	78.0S	158.E (Solomon Islands)	mb=6.0
	KLRB			
	HAID			
	BUCH			
25.04.	(10:46)	------------	------	------
	HAID			
	KLRB			
	BUCH			
25.04.	(11:17)	------------	------	------
	BUCH			
	HAID			
	KLRB			

25.04.	(12:29)	------------	------		------
	HAID				
	KLRB				
	BUCH				
25.04.	12:59:13	1.7N	126.5E	(Molucca Passage)	mb=5.1
	HAID				
25.04.	(13:33)	------------	------		------
	HAID				
	KLRB				
	BUCH				
25.04.	16:13:50	22.N	66.E	(Pakistan)	mb=4.0
	KLRB				
25.04.	17:40:02	36.N	72.E	(Afghanistan)	mb=4.7
	KLRB				
25.04.	18:53:39	8.0S	159.0E	(Solomon Islands)	mb=4.6
	KLRB				
25.04.	20:11:00	72.0N	10.0E	(Greenland)	mb=4.7
	HAID				
26.04.	00:43:43	54.0S	33.0W	(South Georgia)	mb=5.2
	HAID				
26.04.	00:53:45	42.34N	16.59E	(Adriatic Sea)	mb=5.3
	KLRB				
	HAID				
26.04.	01:42:55	22.0N	107.0W	(Coast of Mexico)	mb=5.3
	KLRB				
26.04.	02:31:29	42.32N	16.5E	(Adriatic Sea)	ml=3.8
	KLRB				
26.04.	03:49:43	33.0S	180.0W	(Kermadec Islands)	mb=4.1
	KLRB				
26.04.	(07:53)	------------	------		------
	KLRB				
	HAID				
	BUCH				
26.04.	(08:25)	------------	------		------
	HAID				
	KLRB				
	BUCH				
26.04.	(10:06)	------------		(Poland)	------
	HAID				
	KLRB				
	BUCH				
26.04.	15:57:54	51.27N	15.97E	(Poland)	------
	HAID				
	BUCH				

26.04.	19:17:58 KLRB HAID	42.22N	16.56E(Meditrranean Sea)	mb=3.8
27.04.	00:52:07 HAID	55.56N	4.71E(North Sea)	------
27.04.	(07:53) KLRB HAID BUCH	------------	------	------
27.04.	(09:57) BUCH HAID KLRB	------------	------	------
27.04.	(10:06) HAID BUCH KLRB	------------	------	------
27.04.	15:29:37 HAID	8.0N	92.0W (Cent. America)	mb=4.3
28.04.	10:18:51 BUCH HAID	78.52N	7.35E(Greenland)	mb=4.6
28.04.	21:02:40 HAID	41.0N	146.0E (Japan)	mb=4.3
28.04.	21:22:27 HAID BUCH	48.94N	18.36E(CSSR)	mb=3.3
28.04.	22:40:37 BUCH HAID	25.0S	179.0E (Fiji Islands)	mb=4.2
28.04.	22:41:08 BUCH	18.0S	178.5W (Fiji Islands)	mb=5.3
29.04.	04:37:47 HAID	51.44N	16.0E (Poland)	ml=3.7
29.04.	07:36:06 BUCH	34.0S	174.0E (Kermadec Islands)	mb=4.7
30.04.	06:50:02 BUCH HAID	21.0S	171.0E (Loyalty Islands)	mb=4.9
30.04.	13:25:05 BUCH HAID	51.75N	16.16E(Poland)	mb=3.4
30.04.	16:32:56 HAID BUCH	51.54N	16.06E(Poland)	ml=3.3

30.04.	19:46:26 BUCH HAID	32.0S	175.0W (Fiji Islands)	mb=3.5
01.05.	02:58:01 HAID	44.63N	10.34E(Northern Italy)	ml=3.4
01.05.	05:41:22 HAID	24.0S	170.0E (Loyalty Islands)	mb=4.1
01.05.	10:06:52 BUCH HAID	51.7N	162.4E (Kuril Islands)	mb=5.6
01.05.	15:21:27 HAID BUCH	27.0S	171.0E (Santa Cruz)	mb=5.4
01.05.	15:42:38 HAID	47.0N	173.0W (Aleutian Islands)	mb=3.9
01.05.	18:01:16 BUCH	51.67N	16.40E(Poland)	ml=3.5
01.05.	19:30:49 HAID	49.0N	156.0E (Kuril Islands)	mb=3.7
02.05.	02:13:46 HAID	41.0N	80.0E (China)	mb=5.1
02.05.	12:27:58 BUCH	44.1N	10.8E (Northern Italy)	ml=3.7
03.05.	07:31:34 HAID BUCH	1.0S	96.0E (Sumatera)	mb=4.5
03.05.	08:41:31 HAID	43.63N	47.59E(Eastern Caucasus)	mb=4.6
03.05.	08:53:44 BUCH	32.27N	49.92E(Western Iran)	mb=4.8
03.05.	09:15:29 HAID BUCH	42.47N	47.56E(Eastern Caucasus)	mb=5.1
03.05.	10:07:36 HAID	39.0N	46.0E (Iran-USSR)	mb=4.2
03.05.	10:35:07 BUCH	18.0N	116.0E (South China)	mb=4.0
03.05.	20:27:55 BUCH HAID	41.0N	150.0E (Kuril Islands)	mb=5.5
03.05.	23:22:09 BUCH HAID	18.0S	175.0E (Loyalty Islands)	mb=5.6

04.05.	00:57:07	50.0N	79.0E (Semipalatinsk)	mb=6.1
	HAID			
	BUCH			
04.05.	02:53:24	26.0S	179.0W (South of Fiji)	mb=3.5
	BUCH			
	HAID			
04.05.	07:21:37	29.0S	179.0W (Kermadec Islands)	mb=4.2
	BUCH			
	HAID			
04.05.	17:59:59	17.2S	179.4W (Fiji Islands)	mb=4.7
	HAID			
05.05.	00:03:21	2.7S	140.0E (Western Irian)	mb=5.3
	HAID			
05.05.	00:03:21	2.7S	140.6E (Western Irian)	mb=5.3
	BUCH			
	HAID			
05.05.	02:50:23	45.0N	151.0E (Kuril Islands)	mb=4.5
	BUCH			
	HAID			
05.05.	10:04:18	26.0S	116.0W (Easter Island)	mb=5.6
	BUCH			
	HAID			
05.05.	20:46:07	51.5N	16.08E(Poland)	ml=3.9
	BUCH			
	HAID			
05.05.	20:51:08	7.0S	98.0E (Sumatera)	mb=5.0
	HAID			
	BUCH			
05.05.	22:32:52	22.0S	123.0W (Easter Island)	mb=4.9
	BUCH			
05.05.	23:34:57	55.0S	140.0E (Macquarie Islands)	mb=4.4
	HAID			
06.05.	05:47:46	21.07S	173.9W (Tonga Islands)	mb=5.2
	BUCH			
	HAID			
06.05.	09:23:33	12.6N	94.2E (Nicobar Islands)	mb=5.3
	HAID			
	BUCH			
06.05.	09:31:04	17.0N	91.0W (Bay of Bengalen)	mb=4.3
	HAID			
06.05.	12:18:50	36.94N	29.66E(Turkey)	mb=4.4
	BUCH			

06.05.	14:46:21 BUCH	12.0N 83.0W (Nicaragua)	mb=5.7
06.05.	16:34:45 BUCH	5.0S 73.0W (Peru-Brazil)	mb=5.6
07.05.	00:54:18 BUCH	45.7N 151.8E (Kuril Islands)	mb=5.5
07.05.	00:57:17 BUCH	45.7N 151.8E (Kuril Islands)	mb=5.4
07.05.	01:22:20 BUCH	45.7N 151.8E (Kuril Islands)	mb=5.4
07.05.	01:30:20 BUCH	35.0S 178.0W (New Zealand)	mb=4.4
11.05.	16:59:59 BUCH HAID	22.0S 139.0W (Mururoa)	mb=4.7
11.05.	18:57:29 BUCH	0.0N 121.0E (Alaska)	mb=4.8
11.05.	19:55:59 BUCH	21.0S 179.0W (Fiji Islands)	mb=5.0
11.05.	20:47:45 BUCH	12.0N 120.0E (Philippine Islands)	mb=4.8
11.05.	23:03:54 BUCH	11.0N 89.0E (Bay of Bengal)	mb=3.9
11.05.	(23:34) BUCH	------------ ------	------
12.05.	02:42:35 BUCH	56.0N 161.0W (Alaska)	mb=4.8
12.05.	02:45:49 BUCH	28.0N 88.0E (Tibet)	mb=3.8
12.05.	12:56:23 HAID	32.0N 77.0E (Northern India)	mb=4.2
12.05.	13:14:34 HAID	32.0S 177.0W (Kermadec Islands)	mb=3.8
13.05.	04:44:39 HAID	15.35S 175.02W (Tonga Islands)	mb=5.7
13.05.	14:28:46 HAID	9.0N 31.0W (North Atlantic)	mb=4.2
14.05.	01:13:26 HAID BUCH	50.38N 18.88E (Poland)	ml=3.1

14.05.	11:11:35 BUCH HAID	48.0N	155.0E	(Kuril Islands)	mb=4.3
14.05.	15:33:07 BUCH	24.0S	168.0E	(New Caledonia)	mb=4.5
14.05.	(19:56) HAID BUCH	51.6N	16.7E	(Poland)	ml=3.3
15.05.	08:21:36 BUCH HAID	40.0N	150.0E	(North Pacific)	mb=5.7
16.05.	13:53:14 BUCH	44.0N	155.0E	(North Pacific)	mb=4.3
16.05.	23:07:49 BUCH HAID	14.0S	164.0E	(Vanuatu Islands)	mb=5.7
17.05.	02:45:07 HAID	19.0N	88.0W	(Yucatan Penins.)	mb=4.7
18.05.	03:58:47 BUCH HAID	26.0S	129.0W	(South of Fiji)	mb=3.9
18.05.	05:17:43 HAID BUCH	39.0N	22.0E	(Greece)	mb=5.5
18.05.	05:40:18 BUCH HAID	16.0N	42.0W	(North Atlantic)	mb=5.4
18.05.	05:44:44 BUCH HAID	13.54N	44.87W	(North Atlantic)	mb=5.2
18.05.	06:13:42 BUCH HAID	52.0N	176.0E	(Aleuten)	mb=5.4
18.05.	07:59:49 HAID BUCH	45.0N	140.0E	(Eastcoast USSR)	mb=4.8
18.05.	(10:00) BUCH HAID	------------	------		------
19.05.	03:22:29 HAID	20.0S	180.0E	(Fiji Islands)	mb=5.2
19.05.	18:32:33 BUCH	34.0S	174.0W	(S. of Kermadec I.)	mb=4.0
20.05.	03:19:47 HAID	17.0S	72.0W	(Peru)	mb=4.8

20.05. 09:17:26 HAID	15.17S	173.95W(Tonga Islands)	mb=5.3
20.05. 14:59:47 BUCH HAID	16.0N	36.0W (Mid Atlantic)	mb=5.9
21.05. 00:08:22 HAID	5.0S	95.0E (Sumtera)	mb=4.8
21.05. (15:24) HAID	------------	------	------
21.05. 15:16:18 BUCH	4.0N	27.0W (North Atlantic)	mb=5.4
21.05. 15:16:21 HAID	20.24S	173.68W (Tonga Islands)	mb=5.2
22.05. 03:44:16 HAID BUCH	38.37N	20.52E(Greece)	mb=5.0
22.05. 09:39:55 BUCH HAID	53.6N	163.9W (Unimak Islands)	mb=5.7
22.05. 12:51:24 HAID BUCH	24.0N	51.0W (North Atlantic)	mb=4.5
22.05. 19:17:57 BUCH HAID	58.0N	150.0W (Golf of Alaska)	mb=4.7
23.05. 07:45:17 BUCH HAID	32.0S	180.0E (Kermadec Islands)	mb=3.6
23.05. 16:39:01 BUCH HAID	37.0S	175.0E (New Zealand)	mb=4.0
23.05. 18:50:54 BUCH	51.4N	160.9E (Kamchatka)	mb=4.9
23.05. 22:54:33 BUCH HAID	13.0S	141.0E (Queensland)	mb=4.7
24.05. [illegible] BUCH	25.9S	174.0W (S. of Tonga I.)	mb=3.8
24.05. 19:30:32 HAID	51.14N	15.96E(Poland)	ml=3.2
24.05. 21:39:59 HAID BUCH	19.96S	168.65E(Vanuatu Islands)	mb=5.0

24.05.	22:27:51 HAID BUCH	20.5S	168.7E (Loyalty Islands)	mb=4.4
25.05.	10:11:10 HAID	37.0N	22.0E (Southern Greece)	mb=3.8
25.05.	13:33:36 BUCH	31.0N	124.0E (East of China)	mb=4.5
25.05.	14:05:17 HAID	50.6N	173.4W (Aleuten)	mb=6.0
25.05.	17:01:00 BUCH HAID	22.0S	139.0W (Mururoa)	mb=5.1
25.05.	18:22:35 HAID BUCH	46.0N	82.0E (China)	mb=5.0
26.05.	10:04:32 BUCH HAID	2.0S	102.0E (Sumatera)	mb=4.7
26.05.	(17:02) HAID BUCH	------------	(Poland)	ml=3.2
26.05.	18:55:25 HAID BUCH	51.47N	16.17E(Poland)	ml=3.9
26.05.	19:01:26 BUCH HAID	47.0N	129.0W (Vancouver Islands)	mb=5.1
27.05.	(01:41) BUCH HAID	------------	------	------
27.05.	02:44:22 HAID	25.03S	177.0W(Fiji Islands)	mb=5.2
27.05.	14:18:38 BUCH	44.13N	26.60E (Yugoslavia)	mb=4.4
28.05.	07:57:39 BUCH GRLB	20.45S	178.94W (Fiji Islands)	mb=4.7

28.05.	10:06:04	51.42N	16.32E(Poland,Lubin)	mb=3.6
	BUCH			
	GRLB			
28.05.	10:24:38	31.9S	111.37W(Easter Islands)	mb=5.1
	GRLB			
28.05.	16:26:46	26.0S	180.0W (Fiji)	mb=4.8
	BUCH			
	GRLB			
	GRFB5			
28.05.	19:42:06	7.0N	95.0E (Nicobar Islands)	mb=4.2
	GRLB			
29.05.	06:24:22	16.8S	172.5W (Samoa Islands)	mb=5.2
	GRLB			
	BUCH			
29.05.	(23:38)	------------	------	------
	GRLB			
30.05.	00:26:13	28.78N	51.21E(South of Iran)	mb=4.4
	BUCH			
30.05	(10:21)	-------------	------	------
	GRFB5			
	BUCH			
	GRLB			
30.05.	10:45:20	38.0N	139.0E (Japan)	mb=5.1
	BUCH			
30.05.	16:47:03	40.29N	25.93E(North Aegaeis)	mb=3.9
	BUCH			
30.05.	18:00:55	33.0N	89.0E (Tibet)	mb=4.7
	GRLB			
	BUCH			
	GRFB5			
30.05.	19:36:48	43.14N	13.96E(Italy)	ml=3.6
	GRFB5			
	GRLB			
30.05.	21:11:13	9.0S	124.0E (Banda Sea)	mb=7.3
	GRLB			
	BUCH			
	GRFB5			
30.05.	21:22:14	31.7S	69.1W (Prov.Argentina)	mb=5.9
	BUCH			
31.05.	(11:45)	------------	------	------
	GRLB			
	BUCH			
	GRFB5			

31.05.	14:20:32	20.2S	168.5E	(Loyalty Islands)	mb=4.8
	BUCH				
	GRLB				
	GRFBS				
31.05.	18:51:36	20.5S	176.0W	(Tonga Islands)	mb=5.2
	BUCH				
	GRFBS				
	GRLB				
01.06.	00:04:31	50.9N	14.8E	(Czechoslovakia)	------
	GRLB				
01.06.	06:31:22	66.9W	33.0N	(South Bolivia)	------
	BUCH				
01.06.	07:41:16	71.5W	33.0N	(Chile)	mb=5.0
	GRLB				
	BUCH				
01.06.	16:55:28	32.9S	72.1W	(West Chile)	------
	BUCH				
02.06.	09:47:14	45.8N	27.3E	(Romania)	------
	BUCH				
02.06.	11:58:49	36.6S	179.1E	(New Zealand)	mb=5.5
	BUCH				
	GRLB				
02.06.	13:00:00	37.2N	116.4W	(Nevada Test Site)	mb=5.4
	BUCH				
	GRLB				
02.06.	13:31:24	18.3S	174.6W	(Tonga Islands)	mb=5.0
	BUCH				
02.06.	13:48:21	52.4N	170.6W	(Aleutian)	mb=4.8
	GRLB				
03.06.	01:13:47	19.8S	177.8W	(Fiji Islands)	mb=4.8
	BUCH				
	GRLB				
	SONN				
03.06.	05:49:59	36.5N	71.5E	(Afghanistan Border)	mb=5.0
	SONN				
	GRLB				
	BUCH				
03.06.	(10:18)	------------		(CSSR,Bruenn)	------
	BUCH				
	GRLB				
	SONN				
03.06.	(10:30)	------------		(CSSR,Pilsen)	------
	GRLB				
	BUCH				
	SONN				

03.06.	15:39:23	53.1N	170.3W	(Aleutian)	mb=5.1
	BUCH				
	GRLB				
	SONN				
03.06.	18:26:07	36.2N	70.6E	(Hindukush Region)	mb=4.9
	SONN				
	GRLB				
	BUCH				
03.06.	23:27:34	45.0S	167.5E	(New Zealand)	mb=6.0
	SONN				
	GRLB				
	BUCH				
04.06.	03:09:00	36.9N	45.2E	(Northwestern Iran)	mb=4.8
	SONN				
	GRLB				
	BUCH				
04.06.	07:24:21	55.8N	113.0E	(East of Lake Baikal)	mb=4.7
	BUCH				
04.06.	(11:06)	-------------	------		------
	BUCH				
	GRLB				
	SONN				
04.06.	14:31:16	24.8N	126.7E	(Ryukyu Islands)	mb=4.5
	GRLB				
	SONN				
05.06.	01:41:33	21.5S	178.3W	(Fiji Islands)	mb=5.0
	BUCH				
	GRLB				
	SONN				
05.06.	08:19:05	49.1N	128.2W	(Washington)	mb=4.7
	GRLB				
	SONN				
05.06.	08:56:13	39.4N	142.2E	(Japan, Honshu)	mb=4.8
	BUCH				
05.06.	(10:32)	------------	-------		------
	GRLB				
	BUCH				
	SONN				
05.06.	18:22:49	15.4S	167.6E	(Vanuatu Islands)	mb=5.9
	GRLB				
	BUCH				
	SONN				
05.06.	18:26:58	27.9N	33.8E	(Egypt)	mb=4.3
	SONN				
	GRLB				
05.06.	21:42:53	32.0S	177.0W	(Kermadec Islands)	mb=3.8
	GRLB				

05.06.	21:46:56	25.6N	142.6E	(Vocano Islands)	mb=4.9
	GRLB				
06.06.	05:33:37	27.0N	56.0E	(Iran)	mb=4.0
	GRLB				
06.06.	05:57:41	38.3N	20.4E	(Greece)	mb=4.8
	GRLB				
06.06.	08:42:02	29.8N	51.1E	(Iran/Irak)	mb=4.9
	GRLB				
	BUCH				
06.06.	09:55:21	53.3N	35.2W	(North Atlantic)	mb=4.8
	GRLB				
	SONN				
06.06.	10:43:51	20.3S	173.8W	(Tonga Islands)	mb=5.1
	BUCH				
	GRLB				
06.06.	(11:09)	------------	------		------
	BUCH				
	GRLB				
	SONN				
06.06.	13:22:02	38.3N	20.5E	(Greece)	mb=3.8
	BUCH				
	GRLB				
	SONN				
06.06.	15:01:26	59.1N	137.8W	(Alaska)	mb=5.0
	BUCH				
06.06.	17:28:45	29.0N	94.8E	(China)	mb=4.7
	GRLB				
	SONN				
06.06.	(19:16)	------------	------		------
	BUCH				
	SONN				
07.06.	(07:53)	------------	------		------
	SONN				
	GRLB				
	BUCH				
07.06.	(08:55)	------------	------		------
	GRLB				
	SONN				
	BUCH				
07.06.	(09:28)	------------	------		------
	GRLB				
	SONN				
	BUCH				

07.06.	(11:06)	------------	------		------
	BUCH				
	GRLB				
	SONN				
07.06.	(11:34)	------------	------		------
	BUCH				
	GRLB				
	SONN				
07.06.	11:46:34	44.4N	11.0E	(Northern Italy)	mb=3.2
	BUCH				
07.06.	(12:46)	------------	------		------
	BUCH				
	GRLB				
	SONN				
07.06.	14:25:28	7.2S	120.5E	(Banda Sea)	mb=5.1
	BUCH				
08.06.	02:15:54	38.0N	81.0E	(China)	mb=4.0
	GRLB				
08.06.	(07:01)	------------	------		------
	BUCH				
	GRLB				
	SONN				
08.06.	(09:07)	------------	------		------
	BUCH				
	GRLB				
	SONN				
08.06.	(09:13)	------------	------		------
	BUCH				
	GRLB				
	SONN				
08.06.	(10:11)	------------	------		------
	GRLB				
	SONN				
	BUCH				
08.06.	(10:17)	------------	------		------
	BUCH				
	GRLB				
	SONN				
08.06.	(10:47)	------------	------		------
	BUCH				
	GRLB				
	SONN				
09.06.	00:09:50	28.5N	56.8E	(Southern Iran)	mb=5.0
	SONN				
09.06.	02:18:25	32.2N	28.0E	(E.Mediterranean Sea)	mb=4.7
	SONN				

09.06.	10:13:34	39.0N	96.0E	(China)	mb=3.8
	SONN				
09.06.	14:56:23	15.0N	98.5W	(Mexico)	mb=4.6
	SONN				
09.06.	21:56:08	53.5N	35.4W	(Noth Atlantic Ridge)	mb=4.6
	SONN				
10.06.	03:10:21	12.7S	166.8E	(Santa Cruz Islands)	mb=5.7
	BUCH				
10.06.	05:06:47	13.9N	51.7E	(Golf of Aden)	mb=4.7
	BUCH				
10.06.	(10:37)	------------		(Germany,Erzgebirge)	------
	BUCH				
	GRLB				
	SONN				
10.06.	10:48:07	6.8S	131.1E	(Tanimber Islands)	------
	BUCH				
	GRLB				
	SONN				
10.06.	11:31:52	6.9S	72.2E	(Chagos Archipelago)	mb=5.5
	BUCH				
	SONN				
	GRLB				
10.06.	14:15:52	4.9S	151.8E	(New Britain Region)	------
	SONN				
	GRLB				
	BUCH				
10.06.	(14:37)	------------		------	------
	SONN				
	GRLB				
	BUCH				
10.06.	21:11:16	39.2N	71.5E	(Tajik SSR)	mb=4.8
	GRLB				
	BUCH				
11.06.	00:47:15	51.3N	16.0E	(Poland,Lubin)	ml=3.6
	BUCH				
	GRLB				
11.06.	02:50:02	5.9S	151.2E	(New Britain)	mb=5.2
	BUCH				
	GRLB				
11.06.	04:45:55	6.1S	151.3E	(New Britain)	mb=4.8
	BUCH				
11.06.	12:17:28	16.0S	180.0W	(Tonga Islands)	mb=5.9
	BUCH				
	GRLB				
	SONN				

11.06.	19:31:00 BUCH GRLB SONN	18.5S 175.6W	(Tonga Islands)	mb=5.1
11.06.	22:44:46 SONN GRLB	45.9N 6.8E	(Northern Italy)	ml=3.2
12.06.	00:47:21 GRLB BUCH	44.7N 149.6E	(Kuril Islands)	mb=4.8
12.06.	01:03:55 GRLB	51.4N 169.0W	(Aleutian Islands)	mb=4.9
12.06.	03:09:44 BUCH GRLB SONN	33.4N 138.2E	(Japan,Honshu)	mb=4.6
12.06.	04:17:57 SONN GRLB BUCH	46.2N 16.5E	(Yugoslavia)	ml=3.6
12.06.	07:18:47 GRLB BUCH	38.3N 55.3E	(Iran)	mb=5.5
12.06.	(08:03) SONN GRLB BUCH	------------	------	------
12.06.	(08:27) BUCH GRLB SONN	-------------	------	------
12.06.	08:56:14 SONN GRLB BUCH	34.7N 24.3E	(Crete)	mb=4.0
12.06.	13:23:31 BUCH	10.7S 156.1E	(Santa Cruz)	mb=4.9
12.06.	13:35:12 BUCH GRLB	10.7S 156.1E	(Santa Cruz)	mb=5.0
12.06.	13:39:40 GRLB SONN	10.8S 156.2E	(Santa Cruz)	mb=5.7
12.06.	15:38:25 BUCH	74.9N 96.1W	(Queen Elizabeth Isl.)	mb=4.5

12.06.	20:09:59 SONN GRLB	46.4N	12.6E	(North Italy)	md=3.8
12.06.	21:08:36 GRLB SONN	19.9S	176.5W	(Fiji Islands)	mb=4.7
12.06.	(12:01) GRLB	-------------		(Kattowice)	------
13.06.	(12:01) GRLB BUCH	-------------		(Poland)	ml=3.2
13.06.	21:31:49 SONN GRLB BUCH	28.4N	56.7E	(Iran)	mb=4.7
14.06.	02:27:06 GRLB SONN BUCH	50.0N	78.9E	(Kasachstan USSR)	mb=4.9
14.06.	07:43:45 GRLB	24.7N	140.9E	(Volcano Islands)	mb=4.5
15.06.	19:15:08 DRKR	3.4S	102.1E	(Sumatera)	mb=5.0
16.06.	08:08:49 SONN	51.6N	16.1E	(Poland)	ml=4.0
16.06.	(09:05) DRKR GRLB SONN	------------		(Germany,Bayr. Wald)	------
16.06.	09:02:30 GRLB SONN	7.0N	94.0E	(Nicobar Islands)	mb=4.0
16.06.	(09:21) SONN DRKR GRLB	------------		------	------
16.06.	(10:44) DRKR GRLB SONN	------------		------	ml=2.4
16.06.	(17:34) DRKR GRLB	-------------		(Mururoa)	------
16.06.	17:55:56 GRLB SONN	49.1N	6.9E	(France)	ml=2.5

17.06.	(08:00)	------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(08:20)	------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(09:00)	-------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(09:11)	------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(09:58)	------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(11:05)	------------	------	------
	DRKR			
	GRLB			
	SONN			
17.06.	(11:26)	------------	(DDR,Falkenstein)	------
	DRKR			
	GRLB			
	SONN			
17.06.	13:30:45	42.9N 77.5E	(Kasachstan USSR)	mb=5.3
	GRLB			
	SONN			
	DRKR			
17.06.	(14:28)	------------	------	------
	SONN			
	GRLB			
	DRKR			
17.06.	(14:45)	------------	------	------
	SONN			
	GRLB			
	DRKR			
18.06.	(10:55)	------------	(CSSR,Pilzen)	------
	DRKR			
	GRLB			
	SONN			
18.06.	(11:05)	-------------	(CSSR,Cheb)	------
	DRKR			
	GRLB			
	SONN			

18.06.	(11:26)	------------	------			------
	GRLB					
	SONN					
	DRKR					
18.06.	11:38:55	51.4N	16.3E	(Poland)		mb=3.8
	GRLB					
	SONN					
	DRKR					
18.06.	16:19:47	53.9N	85.1E	(Central USSR)		mb=5.0
	GRLB					
	DRKR					
18.06.	18:42:03	13.6N	91.1W	(Coast of Guatemala)		mb=5.2
	DRKR					
18.06.	20:12:27	13.6N	91.2W	(Coast of Guatemala)		mb=5.0
	DRKR					
18.06.	(22:39)	------------	------			------
	SONN					
	DRKR					
	GRLB					
18.06.	22:49:42	26.9N	110.9W	(Golf of California)		mb=5.8
	DRKR					
	GRLB					
	SONN					
18.06.	(23:05)	------------	------			------
	DRKR					
	GRLB					
	SONN					
19.06.	(10:27)	------------		(CSSR,Sokolov)		------
	DRKR					
	GRLB					
	SONN					
19.06.	(13:23)	------------	------			------
	GRLB					
	DRKR					
	SONN					
19.06.	13:05:05	18.2S	177.9W	(Fiji Islands)		mb=5.2
	GRLB					
	DRKR					
	SONN					
19.06.	(10:27)	-------------	------			------
	SONN					
19.06.	20:19:53	12.3N	121.1E	(Philippine)		mb=5.7
	GRLB					
	SONN					
	DRKR					

19.06.	20:24:13 DRKR	12.1N	121.1E	(Philippine)	mb=5.2
20.06.	(07:33) GRLB DRKR SONN	------------		(Austria,St. Poelten)	------
20.06.	07:51:23 GRLB SONN DRKR	43.9N	149.1E	(Kuril Islands)	mb=4.8
20.06.	(09:03) SONN DRKR GRLB	------------		(Germany,Regensburg)	------
20.06.	(09:30) GRLB SONN DRKR	------------		(CSSR,Brunn)	------
20.06.	(09:57) GRLB SONN DRKR	------------		------	------
20.06.	(10:19) DRKR GRLB SONN	------------		(CSSR,Most)	------
20.06.	11:54:55 DRKR GRLB SONN	51.2N	15.9E	(Poland,Lubin)	ml=3.5
20.06.	16:45:29 GRLB	11.0N	69.2W	(Venezuela)	mb=4.6
20.06.	(20:35) GRLB DRKR SONN	------------		------	------
21.06.	06:26:16 DRKR GRLB SONN	24.8N	45.8W	(North Atlantic)	mb=5.9
21.06.	(09:00) GRLB SONN DRKR	------------		(CSSR,Budejoice)	------
21.06.	(09:10) SONN GRLB DRKR	------------		(Germany,Gmuend)	------

21.06.	(09:57)	------------		(CSSR,Budejoice)	------
	GRLB				
	SONN				
	DRKR				
21.06.	(10:52)	------------		------	------
	DRKR				
	GRLB				
	SONN				
21.06.	(16:11)	------------		(Germany,Munich)	------
	DRKR				
	SONN				
	GRLB				
21.06.	16:02:55	3.7S	152.3E	(New Britain)	mb=4.4
	GRLB				
21.06.	21:22:43	19.1S	169.1E	(Vanuatu Islands)	mb=5.1
	DRKR				
21.06.	21:38:54	44.6N	148.9E	(Kuril Islands)	mb=5.6
	GRLB				
	SONN				
	DRKR				
21.06.	21:39:09	33.0N	54.0E	(Iran)	mb=4.1
	SONN				
	GRLB				
	DRKR				
22.06.	01:11:37	50.9N	19.4E	(Poland)	ml=3.0
	GRLB				
	SONN				
	DRKR				
22.06.	01:52:34	41.1N	16.2E	(South Italy)	md=3.0
	SONN				
	GRLB				
	DRKR				
22.06.	(07:53)	------------		(Austria,St. Poelten)	------
	SONN				
	GRLB				
	DRKR				
22.06.	(09:13)	------------		------	------
	DRKR				
	GRLB				
	SONN				
22.06.	(09:38)	------------		------	------
	DRKR				
	GRLB				
	SONN				
22.06.	(10:09)	------------		------	------
	SONN				
	DRKR				
	GRLB				

22.06.	(10:31)	------------	------		------
	SONN				
	GRLB				
	DRKR				
22.06.	(13:13)	------------	------		------
	DRKR				
	GRLB				
	SONN				
22.06.	21:53:08	15.2S	168.2E	(Vanuatu Islands)	mb=5.4
	DRKR				
22.06.	22:39:52	27.9N	139.8E	(Bonin Islands Region)	mb=4.7
	DRKR				
23.06.	01:31:56	30.8N	50.0E	(Iran)	mb=4.5
	DRKR				
23.06.	05:59:35	15.1S	178.5W	(Fiji Islands)	mb=4.7
	DRKR				
23.06.	(14:00)	------------	------		------
	DRKR				
	GRLB				
	SONN				
23.06.	(14:37)	------------	------		------
	DRKR				
	GRLB				
	SONN				
23.06.	(14:58)	------------	------		------
	DRKR				
	GRLB				
	SONN				
23.06.	(15:04)	------------	------		------
	SONN				
	DRKR				
	GRLB				
23.06.	(15:19)	------------	-------		------
	GRLB				
	SONN				
	DRKR				
23.06.	15:39:32	39.0N	30.2E	(Turkey)	mb=3.7
	DRKR				
	SONN				
	GRLB				
23.06.	17:30:58	21.9S	139.0W	(Mururoa)	mb=5.3
	DRKR				
	GRLB				
	SONN				

24.06.	02:06:28	18.6N	121.0E	(Philippin Islands)	mb=5.3
	GRLB				
	SONN				
	DRKR				
24.06.	05:57:50	5.7S	145.3E	(New Guinea)	mb=5.4
	GRLB				
	SONN				
24.06.	(08:21)	------------	------		------
	SONN				
	GRLB				
	DRKR				
24.06.	(09:02)	------------	------		------
	DRKR				
	GRLB				
	SONN				
24.06.	08:57:54	10.2N	60.6E	(Trinidad)	mb=6.0
	DRKR				
	GRLB				
	SONN				
24.06.	(09:25)	------------	------		------
	DRKR				
	GRLB				
	SONN				
24.06.	(10:00)	------------	------		------
	DRKR				
	GRLB				
	SONN				
24.06.	(10:35)	------------	------		------
	SONN				
	GRLB				
	DRKR				
24.06.	10:30:30	6.9N	73.0W	(Northern Colombia)	mb=4.5
	DRKR				
24.06.	(11:07)	------------	------		------
	DRKR				
	GRLB				
	SONN				
24.06.	(11:15)	------------		(CSSR,Praha)	------
	GRLB				
	DRKR				
	SONN				
24.06.	12:25:40	6.3S	148.9E	(South of Tasmania)	mb=5.4
	GRLB				
24.06.	12:56:48	34.4S	177.9E	(Kermadec Islands)	mb=5.7
	GRLB				
	SONN				
	DRKR				

24.06.	(15:58)	------------		(Germany,Regensburg)	------
	DRKR				
	SONN				
	GRLB				
24.06.	22:06:51	37.2	137.8E	(Japan,Honshu)	mb=4.6
	GRLB				
	SONN				
	DRKR				
25.06.	06:24:23	33.4S	179.3W	(Kermadec Islands)	mb=5.6
	GRLB				
	SONN				
	DRKR				
25.06.	(06:49)	------------		(Germany,Weiden)	------
	SONN				
	DRKR				
	GRLB				
25.06.	(09:50)	------------		------	------
	DRKR				
	GRLB				
	SONN				
25.06.	(11:05)	------------		------	------
	DRKR				
	GRLB				
	SONN				
25.06.	(11:24)	------------		(Germany,Nuernberg)	------
	DRKR				
	GRLB				
	SONN				
25.06.	16:15:36	38.4N	43.1E	(Iran)	mb=5.3
	SONN				
	GRLB				
	DRKR				
25.06.	18:20:46	40.3N	63.9E	(UZBESSR)	mb=4.4
	GRLB				
26.06.	04:18:31	31.3N	64.8W	(North Atlantic)	mb=5.1
	DRKR				
	GRLB				
	SONN				
26.06.	06:01:28	25.0S	177.0W	(Fiji Islands)	mb=3.6
	GRLB				
	SONN				
	DRKR				
26.06.	(07:05)	------------		------	------
	DRKR				
	GRLB				
	SONN				

26.06.	07:03:23	10.2N 60.6W	(North Atlantic)	mb=5.0
	DRKR			
	GRLB			
	SONN			
26.06.	09:22:58	46.3N 144.1E	(Okhotsk)	mb=5.2
	GRLB			
	SONN			
	DRKR			
26.06.	(11:06)	------------	(CSSR,Sokolov)	------
	DRKR			
	GRLB			
	SONN			
26.06.	(11:24)	------------	------	------
	DRKR			
	GRLB			
	SONN			
26.06.	(11:57)	------------	------	------
	DRKR			
	GRLB			
	SONN			
27.06.	00:33:27	32.0S 180.0W	(Kermadec Islands)	mb=3.8
	DRKR			
	GRLB			
	SONN			
27.06.	06:07:51	20.2S 169.3E	(Vanuatu Islands)	mb=5.8
	GRLB			
	SONN			
	DRKR			
27.06.	(06:30)	------------	------	------
	SONN			
	GRLB			
	DRKR			
27.06.	(06:54)	------------	------	------
	DRKR			
	GRLB			
	SONN			
27.06.	(07:53)	------------	------	------
	SONN			
	GRLB			
	DRKR			
27.06.	(08:19)	------------	------	------
	DRKR			
	GRLB			
	SONN			
27.06.	(09:03)	------------	------	------
	GRLB			
	SONN			
	DRKR			

27.06.	09:23:17	17.9S	178.1W	(Fiji Islands)	mb=[illegible]
	GRLB				
	SONN				
	DRKR				
27.06.	(10:19)	------------	------		------
	DRKR				
	GRLB				
	SONN				
27.06.	12:08:21	20.8S	179.0W	(Fiji Islands)	mb=4.7
	GRLB				
	SONN				
	DRKR				
27.06.	13:54:11	17.7S	176.7W	(Fiji Islands)	mb=4.9
	DRKR				
27.06.	(15:18)	------------	------		------
	DRKR				
	GRLB				
	SONN				
27.06.	16:15:46	21.8S	179.2W	(Fiji Islands)	mb=5.4
	DRKR				
	GRLB				
	SONN				
27.06.	17:48:11	38.0N	11.0E	(Sicily)	mb=3.5
	DRKR				
27.06.	(18:42)	------------	------		------
	GRLB				
	DRKR				
	SONN				
27.06.	18:43:22	37.1N	121.9W	(Central California)	mb=4.8
	DRKR				
27.06.	21:36:59	45.0N	142.0E	(Japan)	mb=3.8
	DRKR				
28.06.	02:30:19	20.1N	95.0E	(Burma)	mb=4.5
	GRLB				
	SONN				
28.06.	(08:56)	------------	------		------
	DRKR				
	GRLB				
	SONN				
28.06.	(09:02)	------------	------		------
	DRKR				
	GRLB				
	SONN				
28.06.	(09:15)	------------	------		------
	DRKR				
	GRLB				
	SONN				

28.06.	(09:35)	------------	------		------
	GRLB				
	DRKR				
	SONN				
28.06.	(09:43)	------------	------		------
	SONN				
	GRLB				
	DRKR				
28.06.	(12:44)	------------	------		------
	SONN				
	DRKR				
	GRLB				
28.06.	(13:07)	------------	------		------
	SONN				
	GRLB				
	DRKR				
28.06.	(14:31)	------------	------		------
	DRKR				
	GRLB				
	SONN				
28.06.	16:47:34	4.0S	99.0E	(Sumatera)	mb=5.3
	GRLB				
	SONN				
	DRKR				
28.06.	18:47:50	30.5N	70.9E	(Pakistan)	mb=4.7
	GRLB				
	DRKR				
28.06.	20:52:48	25.7N	95.7E	(Burma/India Border)	mb=4.8
	GRLB				
28.06.	(21:43)	------------	------		------
	SONN				
	GRLB				
	DRKR				
29.06.	02:31:56	40.3N	42.0E	(Turkey)	mb=4.4
	SONN				
	GRLB				
	DRKR				
29.06.	(16:31)	------------	------		------
	DRKR				
	SONN				
	GRLB				
29.06.	(19:59)	50.8N	10.4E	(Germany,DDR Eisenach)	ml=2.3
	DRKR				
	SONN				
	GRLB				

29.06.	20:45:42	39.0N	139.0E (Eastern Sea of Japan)	mb=5.[illegible]
	SONN			
	GRLB			
	DRKR			
29.06.	(21:44)	------------	------	------
	GRLB			
	SONN			
	DRKR			
30.06.	(01:05)	------------	------	------
	SONN			
	GRLB			
	DRKR			
30.06.	(07:41)	------------	------	------
	DRKR			
	GRLB			
	SONN			
30.06.	(09:01)	------------	(Germany,Regensburg)	------
	DRKR			
	KIBG			
	SONN			
30.06.	(10:30)	------------	(CSSR,Pilzen)	------
	DRKR			
	KIBG			
	SONN			
30.06.	(11:04)	------------	------	------
	DRKR			
	KIBG			
	SONN			
30.06.	(11:39)	------------	------	------
	SONN			
	KIBG			
	DRKR			
30.06.	(16:44)	------------	------	------
	DRKR			
	STEI			
	KIBG			
30.06.	(20:43)	------------	------	------
	KIBG			
	DRKR			
	STEI			
01.07.	02:07:00	16.2S	177.8W (Fiji Islands)	mb=5.5
	DRKR			
01.07.	02:55:32	16.2S	177.7W (Fiji Islands)	mb=5.5
	DRKR			
01.07.	(09:30)	------------	------	------
	DRKR			
	KIBG			
	STEI			

01.07. (09:47) KIBG DRKR STEI	------------	------	------
01.07. (11:06) KIBG STEI DRKR	------------	------	------
01.07. (11:24) KIBG STEI DRKR	------------	------	------
01.07. (12:50) DRKR KIBG STEI	------------	(CSSR,Praha)	------
02.07. 03:30:37 DRKR	33.4N 140.8E	(Japan,Honshu)	mb=4.8
02.07. 10:01:30 DRKR	14.3S 167.2E	(Vanuatu Islands)	mb=5.9
02.07. 10:54:53 DRKR	26.0N 128.5E	(Ryukyu Islands)	mb=5.3
03.07. 05:09:42 DRKR	24.7S 179.3E	(South of Fiji Isl.)	mb=5.6
03.07. 08:19:18 DRKR	22.0N 94.3E	(Burma)	mb=5.2
03.07. (10:08) DRKR KIBG STEI	------------	(CSSR,Most)	------
03.07. (10:24) DRKR STEI KIBG	------------	(CSSR,Sokolov)	------
03.07. (11:42) DRKR STEI KIBG	------------	(CSSR,Most)	------
03.07. (11:56) KIBG STEI DRKR	------------	------	------

03.07.	(23:21)	------------		------		------
	DRKR					
	KIBG					
	STEI					
03.07.	11:43:14	8.9N	137.9E	(West Caroline Isl.)		mb=5.9
	DRKR					
04.07.	08:26:36	33.0S	178.0E	(North of New Zealand)		mb=4.6
	DRKR					
	KIBG					
	STEI					
04.07.	(10:52)	------------		(CSSR,Pilzen)		------
	DRKR					
	KIBG					
	STEI					
04.07.	(12:06)	------------		------		------
	DRKR					
	KIBG					
	STEI					
04.07.	(14:07)	------------		------		------
	DRKR					
	STEI					
	KIBG					
04.07.	(14:21)	------------		(Germany,Regensburg)		------
	DRKR					
	KIBG					
	STEI					
05.07.	(08:01)	------------		(CSSR,Brunn)		------
	KIBG					
	STEI					
	DRKR					
05.07.	(09:36)	------------		(CSSR,Pradubice)		------
	KIBG					
	DRKR					
	STEI					
05.07.	(09:43)	------------		------		------
	STEI					
	KIBG					
	DRKR					
05.07.	(09:58)	------------		(Germany,Zwiesel)		------
	DRKR					
	KIBG					
	STEI					
05.07.	(11:04)	------------		------		------
	DRKR					
	KIBG					
	STEI					

CONTRACTORS (United States)

Professor Keiiti Aki
Center for Earth Sciences
University of Southern California
University Park
Los Angeles, CA 90089-0741

Professor Thomas Ahrens
Seismological Lab, 252-21
Div. of Geological and Planetary
Sciences
California Institute of Technology
Pasadena, CA 91125

Professor Charles B. Archambeau
Cooperative Institute for Resch
in Environmental Sciences
University of Colorado
Boulder, CO 80309

Dr. Thomas C. Bache Jr.
Science Applications Int'l Corp.
10210 Campus Point Drive
San Diego, CA 92121 (2 copies)

Dr. Muawia Barazangi
Institute for the Study of
of the Continent
Cornell University
Ithaca, NY 14853

Dr. Douglas R. Baumgardt
Signal Analysis & Systems Div.
ENSCO, Inc.
5400 Port Royal Road
Springfield, VA 22151-2388

Dr. Jonathan Berger
Institute of Geophysics and
Planetary Physics
Scripps Institution of Oceanography
A-025
University of California, San Diego
La Jolla, CA 92093

Dr. S. Bratt
Science Applications Int'l Corp.
10210 Campus Point Drive
San Diego, CA 92121

Dr. Lawrence J. Burdick
Woodward-Clyde Consultants
P.O. Box 93245
Pasadena, CA 91109-3245 (2 copies)

Professor Robert W. Clayton
Seismological Laboratory/Div. of
Geological & Planetary Sciences
California Institute of Technology
Pasadena, CA 91125

Dr Karl Coyner
New England Research, Inc.
76 Olcott Drive
White River Junction, VT 05001

Dr. Vernon F. Cormier
Department of Geology & Geophysics
U-45, Room 207
The University of Conneticut
Storrs, Connecticut 06268

Dr. Steven Day
Dept. of Geological Sciences
San Diego State U.
San Diego, CA 92182

Dr. Zoltan A. Der
ENSCO, Inc.
5400 Port Royal Road
Springfield, VA 22151-2388

Professor John Ferguson
Center for Lithospheric Studies
The University of Texas at Dallas
P.O. Box 830688
Richardson, TX 75083-0688

Professor Stanley Flatte'
Applied Sciences Building
University of California,
Santa Cruz, CA 95064

Dr. Alexander Florence
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025-3493

Professor Steven Grand
University of Texas at Austin
Dept of Geological Sciences
Austin, TX 78713-7909

Dr. Henry L. Gray
Associate Dean of Dedman College
Department of Statistical Sciences
Southern Methodist University
Dallas, TX 75275

Geosciences Department
403 Deike Building
The Pennsylvania State University
University Park, PA 16802

Professor David G. Harkrider
Seismological Laboratory
Div of Geological & Planetary Sciences
California Institute of Technology
Pasadena, CA 91125

Professor Donald V. Helmberger
Seismological Laboratory
Div of Geological & Planetary Sciences
California Institute of Technology
Pasadena, CA 91125

Professor Eugene Herrin
Institute for the Study of Earth
and Man/Geophysical Laboratory
Southern Methodist University
Dallas, TX 75275

Professor Robert B. Herrmann
Department of Earth & Atmospheric
Sciences
Saint Louis University
Saint Louis, MO 63156

Professor Bryan Isacks
Cornell University
Dept of Geological Sciences
SNEE Hall
Ithaca, NY 14850

Professor Lane R. Johnson
Seismographic Station
University of California
Berkeley, CA 94720

Professor Thomas H. Jordan
Department of Earth, Atmospheric
and Planetary Sciences
Mass Institute of Technology
Cambridge, MA 02139

Dr. Alan Kafka
Department of Geology &
Geophysics
Boston College
Chestnut Hill, MA 02167

Professor Leon Knopoff
University of California
Institute of Geophysics
& Planetary Physics
Los Angeles, CA 90024

Geosciences Department
403 Deike Building
The Pennsylvania State University
University Park, PA 16802

Professor Thorne Lay
Department of Geological Sciences
1006 C.C. Little Building
University of Michigan
Ann Arbor, MI 48109-1063

Dr. Randolph Martin III
New England Research, Inc.
76 Olcott Drive
White River Junction, VT 05001

Dr. Gary McCartor
Mission Research Corp.
735 State Street
P.O. Drawer 719
Santa Barbara, CA 93102 (2 copies)

Professor Thomas V. McEvilly
Seismographic Station
University of California
Berkeley, CA 94720

Dr. Keith L. McLaughlin
S-CUBED,
A Division of Maxwell Laboratory
P.O. Box 1620
La Jolla, CA 92038-1620

Professor William Menke
Lamont-Doherty Geological Observatory
of Columbia University
Palisades, NY 10964

Professor Brian J. Mitchell
Department of Earth & Atmospheric
Sciences
Saint Louis University
Saint Louis, MO 63156

Mr. Jack Murphy
S-CUBED
A Division of Maxwell Laboratory
11800 Sunrise Valley Drive
Suite 1212
Reston, VA 22091 (2 copies)

Professor J. A. Orcutt
IGPP, A-205
Scripps Institute of Oceanography
Univ. of California, San Diego
La Jolla, CA 92093

Professor Keith Priestley
University of Nevada
Mackay School of Mines
Reno, NV 89557

Professor Paul G. Richards
Lamont-Doherty Geological
Observatory of Columbia Univ.
Palisades, NY 10964

Wilmer Rivers
Teledyne Geotech
314 Montgomery Street
Alexandria, VA 22314

Dr. Alan S. Ryall, Jr.
Center of Seismic Studies
1300 North 17th Street
Suite 1450
Arlington, VA 22209-2308 (4 copies)

Professor Charles G. Sammis
Center for Earth Sciences
University of Southern California
University Park
Los Angeles, CA 90089-0741

Professor Christopher H. Scholz
Geological Sciences
Lamont-Doherty Geological Observatory
Palisades, NY 10964

Dr. Jeffrey L. Stevens
S-CUBED,
A Division of Maxwell Laboratory
P.O. Box 1620
La Jolla, CA 92038-1620

Professor Brian Stump
Institute for the Study of Earth & Man
Geophysical Laboratory
Southern Methodist University
Dallas, TX 75275

Professor Ta-liang Teng
Center for Earth Sciences
University of Southern California
University Park
Los Angeles, CA 90089-0741

Dr. Clifford Thurber
State University of New York at
Stony Brooks
Dept of Earth and Space Sciences
Stony Brook, NY 11794-2100

Professor M. Nafi Toksoz
Earth Resources Lab
Dept of Earth, Atmospheric and
Planetary Sciences
Massachusetts Institute of Technology
42 Carleton Street
Cambridge, MA 02142

Professor Terry C. Wallace
Department of Geosciences
Building #77
University of Arizona
Tucson, AZ 85721

Weidlinger Associates
ATTN: Dr. Gregory Wojcik
4410 El Camino Real, Suite 110
Los Altos, CA 94022

Professor Francis T. Wu
Department of Geological Sciences
State University of New York
at Binghamton
Vestal, NY 13901

Dr. Monem Abdel-Gawad
Rockwell Internat'l Science Center
1049 Camino Dos Rios
Thousand Oaks, CA 91360

Professor Shelton S. Alexander
Geosciences Department
403 Deike Building
The Pennsylvania State University
University Park, PA 16802

Dr. Ralph Archuleta
Department of Geological
Sciences
Univ. of California at
Santa Barbara
Santa Barbara, CA

J. Barker
Department of Geological Sciences
State University of New York
at Binghamton
Vestal, NY 13901

Mr. William J. Best
907 Westwood Drive
Vienna, VA 22180

Dr. N. Biswas
Geophysical Institute
University of Alaska
Fairbanks, AK 99701

Dr. G. A. Bollinger
Department of Geological Sciences
Virginia Polytechnical Institute
21044 Derring Hall
Blacksburg, VA 24061

Mr. Roy Burger
1221 Serry Rd.
Schenectady, NY 12309

Dr. Robert Burridge
Schlumberger-Doll Resch Ctr.
Old Quarry Road
Ridgefield, CT 06877

Science Horizons, Inc.
ATTN: Dr. Theodore Cherry
710 Encinitas Blvd., Suite 101
Encinitas, CA 92024 (2 copies)

Professor Jon F. Claerbout
Professor Amos Nur
Dept. of Geophysics
Stanford University
Stanford, CA 94305 (2 copies)

Dr. Anton W. Dainty
AFGL/LWH
Hanscom AFB, MA 01731

Professor Adam Dziewonski
Hoffman Laboratory
Harvard University
20 Oxford St.
Cambridge, MA 02138

Professor John Ebel
Dept of Geology and Geophysics
Boston College
Chestnut Hill, MA 02167

Dr. Donald Forsyth
Dept of Geological Sciences
Brown University
Providence, RI 02912

Dr. Anthony Gangi
Texas A&M University
Department of Geophysics
College Station, TX 77843

Dr. Freeman Gilbert
Institute of Geophysics &
Planetary Physics
University of California, San Diego
P.O. Box 109
La Jolla, CA 92037

Mr. Edward Giller
Pacific Seirra Research Corp.
1401 Wilson Boulevard
Arlington, VA 22209

Dr. Jeffrey W. Given
Sierra Geophysics
11255 Kirkland Way
Kirkland, WA 98033

Rong Song Jih
Teledyne Geotech
314 Montgomery Street
Alexandria, Virginia 22314

Professor F.K. Lamb
University of Illinois at
Urbana-Champaign
Department of Physics
1110 West Green Street
Urbana, IL 61801

Dr. Arthur Lerner-Lam
Lamont-Doherty Geological Observatory
of Columbia University
Palisades, NY 10964

Dr. L. Timothy Long
School of Geophysical Sciences
Georgia Institute of Technology
Atlanta, GA 30332

Dr. Peter Malin
University of California at
Santa Barbara
Institute for Central Studies
Santa Barbara, CA 93106

Dr. George R. Mellman
Sierra Geophysics
11255 Kirkland Way
Kirkland, WA 98033

Dr. Bernard Minster
IGPP, A-205
Scripps Institute of Oceanography
Univ. of California, San Diego
La Jolla, CA 92093

Professor John Nabelek
College of Oceanography
Oregon State University
Corvallis, OR 97331

Dr. Geza Nagy
U. California, San Diego
Dept of Ames, M.S. B-010
La Jolla, CA 92093

Dr. Jack Oliver
Department of Geology
Cornell University
Ithaca, NY 14850

Dr. Robert Phinney/Dr. F. A. Dahlen
Dept of Geological
Geological Science University
Princeton University
Princeton, NJ 08540

RADIX System, Inc.
Attn: Dr. Jay Pulli
2 Taft Court, Suite 203
Rockville, Maryland 20850

Dr. Norton Rimer
S-CUBED
A Division of Maxwell Laboratory
P.O. 1620
La Jolla, CA 92038-1620

Professor Larry J. Ruff
Department of Geological Sciences
1006 C.C. Little Building
University of Michigan
Ann Arbor, MI 48109-1063

Dr. Richard Sailor
TASC Inc.
55 Walkers Brook Drive
Reading, MA 01867

Thomas J. Sereno, Jr.
Service Application Int'l Corp.
10210 Campus Point Drive
San Diego, CA 92121

Dr. David G. Simpson
Lamont-Doherty Geological Observ.
of Columbia University
Palisades, NY 10964

Dr. Bob Smith
Department of Geophysics
University of Utah
1400 East 2nd South
Salt Lake City, UT 84112

Dr. S. W. Smith
Geophysics Program
University of Washington
Seattle, WA 98195

Dr. Stewart Smith
IRIS Inc.
1616 N. Fort Myer Drive
Suite 1440
Arlington, VA 22209

Rondout Associates
ATTN: Dr. George Sutton,
Dr. Jerry Carter, Dr. Paul Pomeroy
P.O. Box 224
Stone Ridge, NY 12484 (4 copies)

Dr. L. Sykes
Lamont Doherty Geological Observ.
Columbia University
Palisades, NY 10964

Dr. Pradeep Talwani
Department of Geological Sciences
University of South Carolina
Columbia, SC 29208

Dr. R. B. Tittmann
Rockwell International Science Center
1049 Camino Dos Rios
P.O. Box 1085
Thousand Oaks, CA 91360

Professor John H. Woodhouse
Hoffman Laboratory
Harvard University
20 Oxford St.
Cambridge, MA 02138

Dr. Gregory B. Young
ENSCO, Inc.
5400 Port Royal Road
Springfield, VA 22151-2388

FOREIGN (OTHERS)

Dr. Peter Basham
Earth Physics Branch
Geological Survey of Canada
1 Observatory Crescent
Ottawa, Ontario
CANADA K1A OY3

Professor Ari Ben-Menahem
Dept of Applied Mathematics
Weizman Institute of Science
Rehovot
ISRAEL 951729

Dr. Eduard Berg
Institute of Geophysics
University of Hawaii
Honolulu, HI 96822

Dr. Michel Bouchon - Universite
Scientifique et Medicale de Grenob
Lab de Geophysique - Interne et
Tectonophysique - I.R.I.G.M-B.P.
38402 St. Martin D'Heres
Cedex FRANCE

Dr. Hilmar Bungum/NTNF/NORSAR
P.O. Box 51
Norwegian Council of Science,
Industry and Research, NORSAR
N-2007 Kjeller, NORWAY

Dr. Michel Campillo
I.R.I.G.M.-B.P. 68
38402 St. Martin D'Heres
Cedex, FRANCE

Dr. Kin-Yip Chun
Geophysics Division
Physics Department
University of Toronto
Ontario, CANADA M5S 1A7

Dr. Alan Douglas
Ministry of Defense
Blacknest, Brimpton,
Reading RG7-4RS
UNITED KINGDOM

Dr. Manfred Henger
Fed. Inst. For Geosciences & Nat'l Res.
Postfach 510153
D-3000 Hannover 51
FEDERAL REPUBLIC OF GERMANY

Ms. Eva Johannisson
Senior Research Officer
National Defense Research Inst.
P.O. Box 27322
S-102 54 Stockholm
SWEDEN

Tormod Kvaerna
NTNF/NORSAR
P.O. Box 51
N-2007 Kjeller, NORWAY

Mr. Peter Marshall, Procurement
Executive, Ministry of Defense
Blacknest, Brimpton,
Reading FG7-4RS
UNITED KINGDOM (3 copies)

Dr. Robert North
Geophysics Division
Geological Survey of Canada
1 Observatory crescent
Ottawa, Ontario
CANADA, K1A OY3

Dr. Frode Ringdal
NTNF/NORSAR
P.O. Box 51
N-2007 Kjeller, NORWAY

Dr. Jorg Schlittenhardt
Federal Inst. for Geosciences & Nat'l Res.
Postfach 510153
D-3000 Hannover 51
FEDERAL REPUBLIC OF GERMANY

University of Hawaii
Institute of Geophysics
ATTN: Dr. Daniel Walker
Honolulu, HI 96822

Dr. Ramon Cabre, S.J.
Observatorio San Calixto
Casilla 5939
La Paz Bolivia

Professor Peter Harjes
Institute for Geophysik
Rhur University/Bochum
P.O. Box 102148, 4630 Bochum 1
FEDERAL REPUBLIC OF GERMANY

Dr. E. Husebye
NTNF/NORSAR
P.O. Box 51
N-2007 Kjeller, NORWAY

Professor Brian L.N. Kennett
Research School of Earth Sciences
Institute of Advanced Studies
G.P.O. Box 4
Canberra 2601
AUSTRALIA

Dr. B. Massinon
Societe Radiomana
27, Rue Claude Bernard
7,005, Paris, FRANCE (2 copies)

Dr. Pierre Mechler
Societe Radiomana
27, Rue Claude Bernard
75005, Paris, FRANCE

Dr. Svein Mykkeltveit
NTNF/NORSAR
P.O. Box 51
N-2007 Kjeller, NORWAY (3 copies)

GOVERNMENT

Dr. Ralph Alewine III
DARPA/NMRO
1400 Wilson Boulevard
Arlington, VA 22209-2308

Dr. Robert Blandford
DARPA/NMRO
1400 Wilson Boulevard
Arlington, VA 22209-2308

Sandia National Laboratory
ATTN: Dr. H. B. Durham
Albuquerque, NM 87185

Dr. Jack Evernden
USGS-Earthquake Studies
345 Middlefield Road
Menlo Park, CA 94025

U.S. Geological Survey
ATTN: Dr. T. Hanks
Nat'l Earthquake Resch Center
345 Middlefield Road
Menlo Park, CA 94025

Dr. James Hannon
Lawrence Livermore Nat'l Lab.
P.O. Box 808
Livermore, CA 94550

Paul Johnson
ESS-4, Mail Stop J979
Los Alamos National Laboratory
Los Alamos, NM 87545

Ms. Ann Kerr
DARPA/NMRO
1400 Wilson Boulevard
Arlington, VA 22209-2308

Dr. Max Koontz
US Dept of Energy/DP 5
Forrestal Building
1000 Independence Ave.
Washington, D.C. 20585

Dr. W. H. K. Lee
USGS
Office of Earthquakes, Volcanoes,
& Engineering
Branch of Seismology
345 Middlefield Rd
Menlo Park, CA 94025

Dr. William Leith
U.S. Geological Survey
Mail Stop 928
Reston, VA 22092

Dr. Richard Lewis
Dir. Earthquake Engineering and
Geophysics
U.S. Army Corps of Engineers
Box 631
Vicksburg, MS 39180

Dr. Robert Masse'
Box 25046, Mail Stop 967
Denver Federal Center
Denver, Colorado 80225

Richard Morrow
ACDA/VI
Room 5741
320 21st Street N.W.
Washington, D.C. 20451

Dr. Keith K. Nakanishi
Lawrence Livermore National Laboratory
P.O. Box 808, L-205
Livermore, CA 94550 (2 copies)

Dr. Carl Newton
Los Alamos National Lab.
P.O. Box 1663
Mail Stop C335, Group ESS-3
Los Alamos, NM 87545

Dr. Kenneth H. Olsen
Los Alamos Scientific Lab.
P.O. Box 1663
Mail Stop C335, Group ESS-3
Los Alamos, NM 87545

Howard J. Patton
Lawrence Livermore National
Laboratory
P.O. Box 808, L-205
Livermore, CA 94550

Mr. Chris Paine
Office of Senator Kennedy
SR 315
United States Senate
Washington, D.C. 20510

AFOSR/NP
ATTN: Colonel Jerry J. Perrizo
Bldg 410
Bolling AFB, Wash D.C. 20332-6448

HQ AFTAC/TT
Attn: Dr. Frank F. Pilotte
Patrick AFB, Florida 32925-6001

Mr. Jack Rachlin
USGS - Geology, Rm 3 C136
Mail Stop 928 National Center
Reston, VA 22092

Robert Reinke
AFWL/NTESG
Kirtland AFB, NM 87117-6008

Dr. Byron Ristvet
HQ DNA, Nevada Operations Office
Attn: NVCG
P.O. Box 98539
Las Vegas, NV 89193

HQ AFTAC/TGR
Attn: Dr. George H. Rothe
Patrick AFB, Florida 32925-6001

Donald L. Springer
Lawrence Livermore National Laboratory
P.O. Box 808, L-205
Livermore, CA 94550

Dr. Lawrence Turnbull
OSWR/NED
Central Intelligence Agency
CIA, Room 5G48
Washington, D.C. 20505

Dr. Tnomas Weaver
Los Alamos National Laboratory
P.O. Box 1663
MS C 335
Los Alamos, NM 87545

GL/SULL
Research Library
Hanscom AFB, MA 01731-5000 (2 copies)

Secretary of the Air Force (SAFRD)
Washington, DC 20330
Office of the Secretary Defense
DDR & E
Washington, DC 20330

HQ DNA
ATTN: Technical Library
Washington, DC 20305

DARPA/RMO/RETRIEVAL
1400 Wilson Blvd.
Arlington, VA 22209

DARPA/RMO/Security Office
1400 Wilson Blvd.
Arlington, VA 22209

GL/XO
Hanscom AFB, MA 01731-5000

GL/LW
Hanscom AFB, MA 01731-5000

DARPA/PM
1400 Wilson Boulevard
Arlington, VA 22209

Defense Technical
Information Center
Cameron Station
Alexandria, VA 22314
(5 copies)

Defense Intelligence Agency
Directorate for Scientific &
Technical Intelligence
Washington, D.C. 20301

Defense Nuclear Agency/SPSS
ATTN: Dr. Michael Shore
6801 Telegraph Road
Alexandria, VA 22310

AFTAC/CA (STINFO)
Patrick AFB, FL 32925-6001

Dr. Gregory van der Vink
Congress of the United States
Office of Technology Assessment
Washington, D.C. 20510

Mr. Alfred Lieberman
ACDA/VI-OA'State Department Building
Room 5726
320 - 21St Street, NW
Washington, D.C. 20451