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VI.3 The new regional array: 1983 field experiments

The planning work for the new regional array to be installed in 1984 has continued during the reporting period. There have been extensive discussions between NORSAR personnel and representatives of the Sandia Laboratories, Albuquerque, New Mexico, which is the U.S. organization responsible for supplying and installing all hardware (seismometers, amplifiers, power cables, fiber optic cables for signal transmission, electronic equipment at the central site) for the new array. The new array will be deployed around NORSAR station 06C02 and according to status of the project as of November 1983 the new array should be operational by September 1984. This contribution gives a description of experiments with temporary field installations during the summer of 1983 and some preliminary results from analysis of the data collected. These experiments were undertaken in order to have a 'last minute' check on current design ideas for the 1984 array.

Borehole experiments

Results from a study of high-frequency noise recorded at the bottom of a 60 m deep borehole and comparison with simultaneously recorded noise at the surface have previously been reported by Bungum (1983). During 1983, PDR-2 recording equipment was operated in trigger mode to collect event data for the same experimental configuration. An example showing the P-phase from a local event at a distance of about 3^{o} is given in Fig. VI.3.1. As is seen from the scaling factors the maximum amplitude of the signal is drastically reduced for the borehole record. Spectral differences are particularly pronounced above 8-10 Hz. It is suggested that the signal loss in the borehole is due to destructive interference of the direct P-wave with the surface reflected one. Crude calculations on wavelengths and time delays involved tend to support this assumption.

The problem at hand is that of finding the optimum depth of deployment of the 3-axis package to go into a borehole at the center of the new array. Data collected as described above in addition to borehole data collected in the U.S. will be evaluated to settle this question. An uncertainty factor here is the coupling between the seismometers and the bedrock and its influence on recorded amplitudes at different frequencies.

3-axis experiment

During the period June 10-July 5, 1983, data were recorded on a 5-station array of 3-axis stations. The geometry of that array is shown in Fig. IV.1. During this period a number of local events were recorded.

The new array to be installed in 1984 will comprise 4 3-axis elements, whereof one will be located in a borehole at the center of the array. The location of the remaining 3 3-axis elements is still under consideration, and any one of the 24 remaining sites is and remains a possible candidate for deployment of 3-axis systems. The data collected this summer will now be subjected to analysis with the purpose of deciding where to deploy the 3 3-axis sets in the new array next summer.

21-channel array experiment

Theoretical work related to the design of the 25-element vertical array has been discussed by Mykkeltveit (1983). Discussions were held during the spring and early summer of 1983 between NORSAR personnel and representatives of Lawrence Livermore National Laboratory on the subject of the geometry of the new array. It was agreed to test the proposed geometry by a temporary installation during the summer of 1984. The temporary array became operational on July 25, 1983, and will be operated throughout the winter of 1984. It comprises 21 channels and its geometry is identical to that of the proposed 25-element array with the exception of 4 channels in the outer ring which have not been installed. The geometry of the temporary array is shown in Fig. IV.2. Analysis of the data recorded so far indicates that the geometry agreed upon is a very useful one, and the final decision has been made to implement it in 1984.

The correlation curves for signals and noise on which the proposed geometry was based have been confirmed by the new data as shown in Fig.

VI.3.2, providing a much denser sampling and broader range of intersensor spacings than available at earlier times.

The performance of the f-k analysis for detected phase arrivals will be of crucial importance to the on-line location capability of the new array. We are now in the process of collecting and analyzing data from events with known location (or location known to within a few km). Results of the f-k analysis (azimuth and phase velocity) for regional events analyzed so far are very promising. An example is given in Fig. VI.3.3 showing results from f-k analysis of the first P arrival (Pg) from a local event. F-k analysis is performed at 6 and 8 Hz, and the true azimuth to the event is 200°, which is also the azimuth resulting from the f-k analysis for both frequencies. For more results here, see Section VI.4.

S. Mykkeltveit
H. Bungum

References

Bungum, H., 1983: Seismic noise at high frequencies, NORSAR Semiannual Tech. Summ. 1 Oct 1982-31 Mar 1983.

Mykkeltveit, S., 1983: A new regional array in Norway: Design work, NORSAR Semiannual Tech. Summ., 1 Oct 1982-31 Mar 1983.

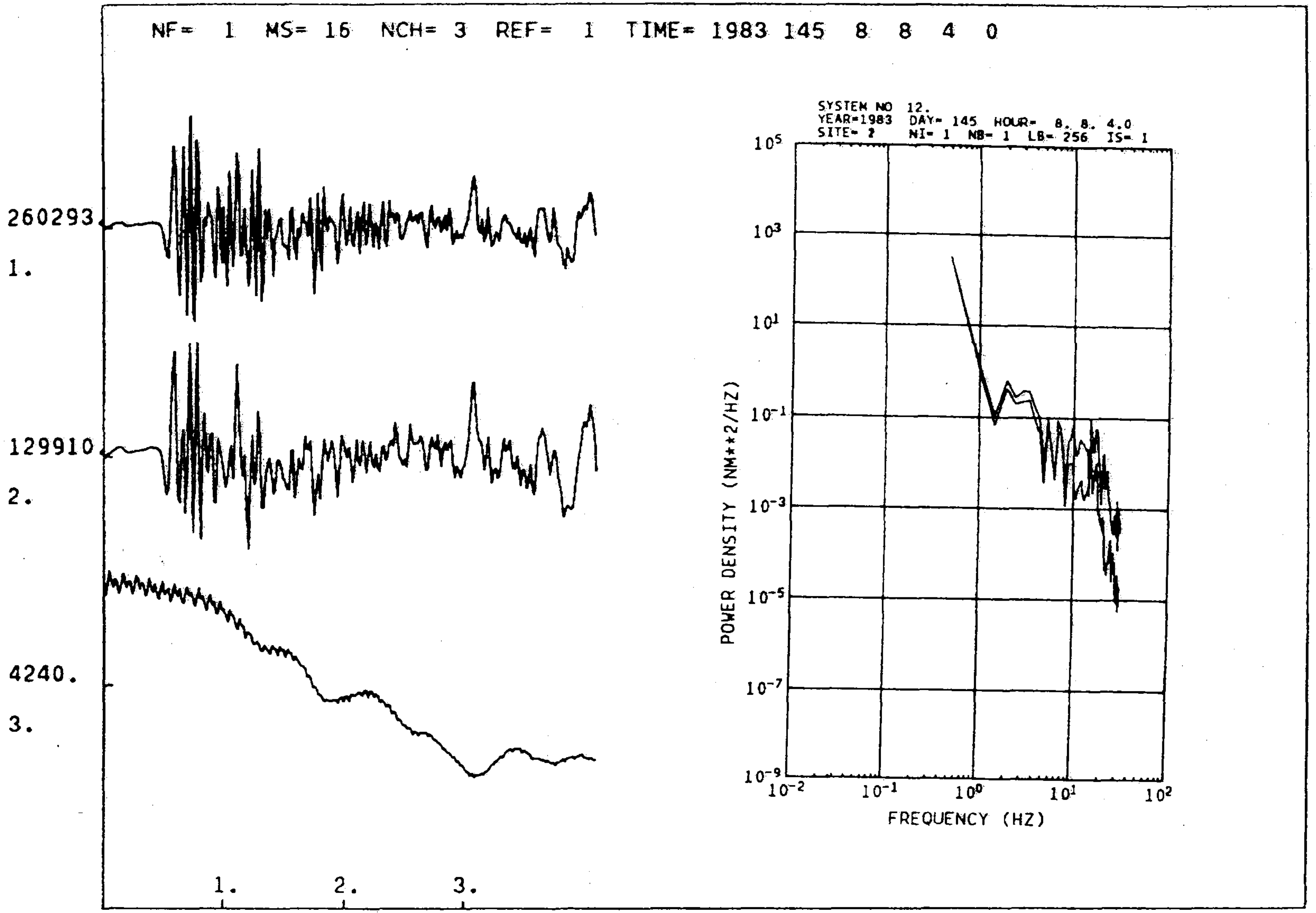

Fig. VI.3.1 P-wave signals and spectra for a local event at a distance of about 3°. Channel 1: Surface recording. Channel 2: Recording at the bottom of a 60 m deep borehole. Channel 3: Wind speed. Scaling factors to the left. Data sampling rate is 62.5 Hz.

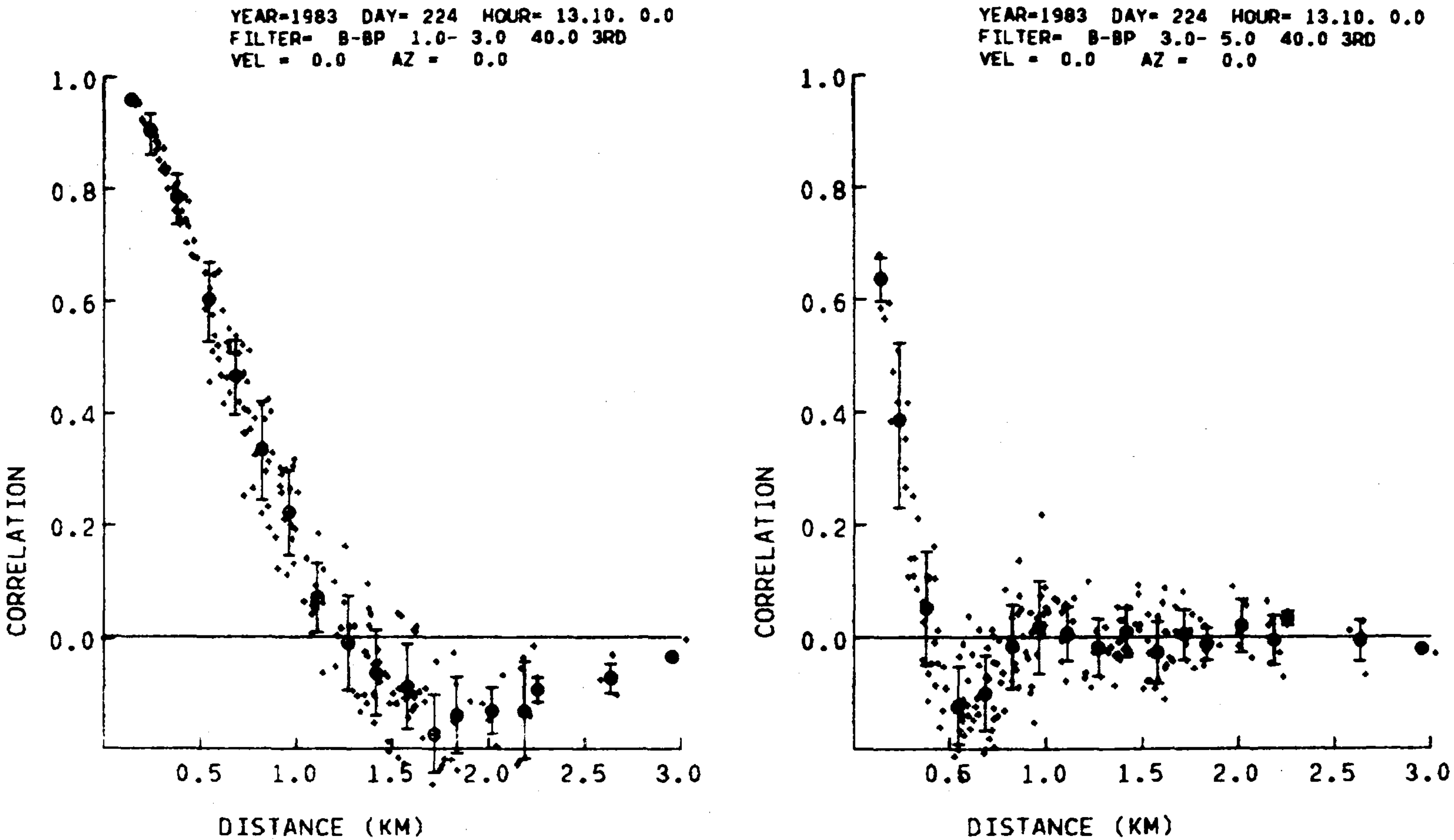

Fig. VI.3.2 Noise correlation curves for two frequency bands for the 21-element array. The data interval is 102.4 sec long. Mean values and standard deviations within separation intervals of 150 m are given by special symbols.

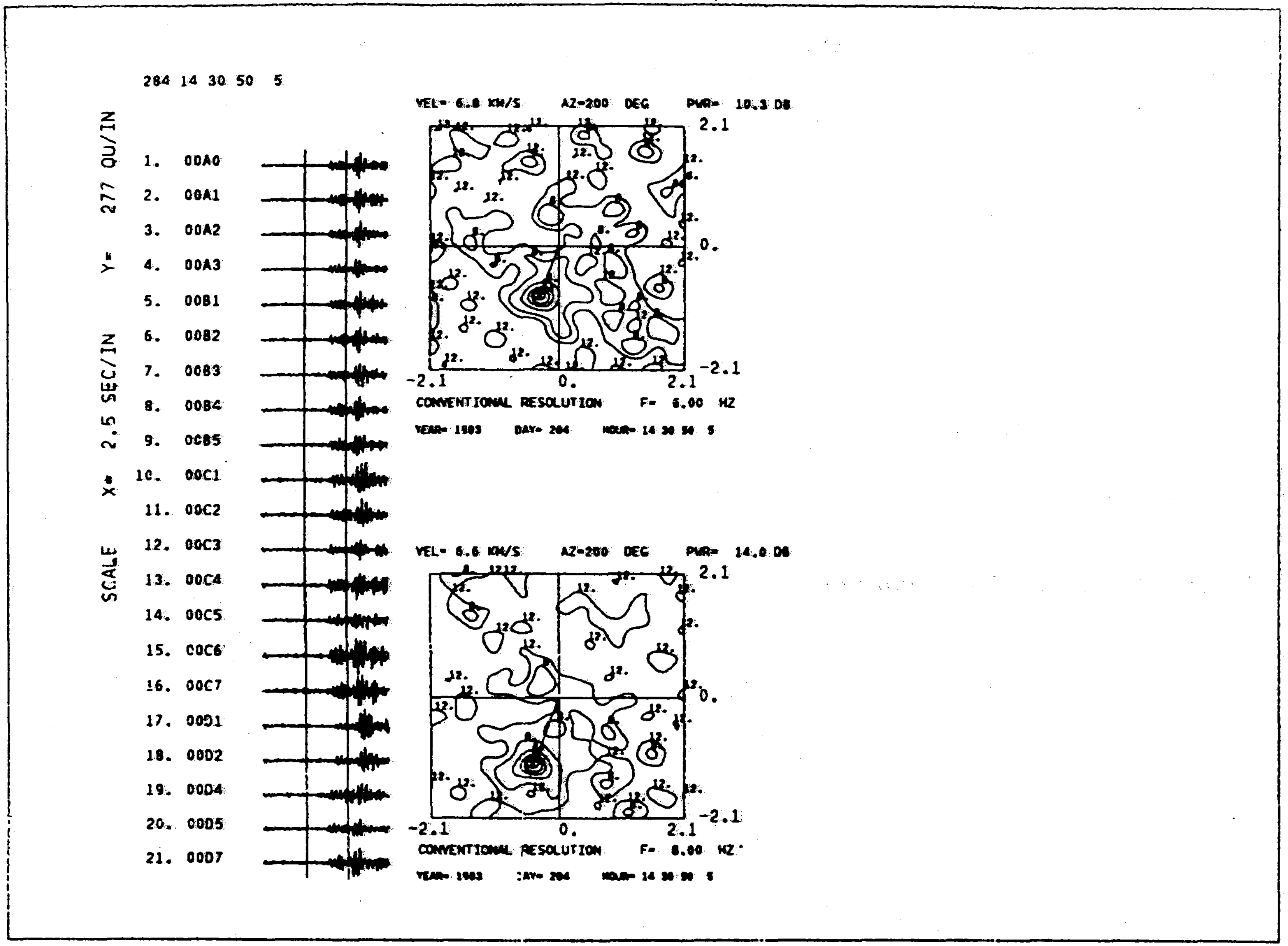

Fig. VI.3.3 Data from the new 21-channel vertical array for a local event at a true azimuth of 200° and distance 118 km subjected to f-k analysis. The data window (between vertical bars) for f-k analysis contains the onset of the Pg phase. Data have been filtered 3-9 Hz before analysis.