S 56

A DIGITAL EVENT DETECTOR

K. F. Veith
J. Sherwin (both at: Teledyne Geotech, Garland, Texas 75041)

Low power microprocessors have been incorporated into a digital event recorder to examine the character of the incoming data. Data is recorded only if it is determined to be in the frequency band of interest and event-like in nature. The basic discrimination algorithm was adapted from the one developed by Rex Allen and his coworkers at the USGS. The modifications allow the sensitivity of the algorithm to have a broad or sharply peaked response curve peaked at frequencies from 1 to 40 Hz as the field needs dictate. When operated with two or three channels, the detector can be set to require all channels to detect the event within a time frame consistent with the array size. Control parameters such as digitizing rate, minimum acceptable signal to noise ratio for detection, minimum signal frequency of interest are entered through a keyboard. The great flexibility of the keyboard control allows the detector to be finely tuned for each individual field site and provides strong discrimination between seismic signals and cultural and environmental noise.

The event detector was used on field data taken from stations near a fault on the Nevada Test Site. Both the background noise and the sporadic noise at the stations varies greatly with activity at the test site. Data rates from 20 to 200 samples/second were used and both teleseismic and microseismic events were sought. Results are presented and compared to results obtained from power level and short term/long term average detectors.

S 57

MICROEARTHQUAKE RECORDING IN SHALLOW BOREHOLES IN KANSAS

Don W. Steeples
Thomas W. Stander (both at: Kansas Geological Survey, University of Kansas, Lawrence, Ks. 66044)

Twenty six felt earthquakes with epicenters in Kansas have been reported during the past 120 years. The largest were MM Intensity VII events that occurred in the Manhattan vicinity in 1867 and 1906. Early investigators attempted to relate these earthquakes to the Nemaha anticline which trends NNE through Kansas or more specifically, to the associated Humboldt fault zone which forms the east flank of the Nemaha structure in Kansas and Nebraska. Epicenters of the larger earthquakes along the Nemaha trend are 30 to 40 kilometers west of the Humboldt fault zone, however, suggesting that the seismicity may be related to the margins of the Keweenawan Mafic Belt rocks and the associated Midcontinent Geophysical Anomaly which parallel the west flank of the Nemaha anticline in Kansas and SE Nebraska. The Kansas Geological Survey has recently established a telemetered borehole microearthquake network in an effort to more accurately determine the causes of the larger historic events. Emphasis has been placed on instrumentation of the Nemaha/Humboldt system, the Midcontinent Geophysical Anomaly, and the recently discovered Big Springs magnetic anomaly. Since wind velocities in Kansas often exceed 20 km/hr for extended periods, the use of borehole seismometers enhances data quality by about 12dB at most stations. Borehole seismometers that will fit down a 2 1/2 inch casing are now available in the $500 price range. Our borehole installations including drilling, cementing, and casing to a depth of 58 meters, cost $600-$1,000 per station. We believe the extra cost is easily justified by the higher quality data.

S 58

TRIGGERED RECORDING SEISMOGRAPH: TWO AREAS OF DEVELOPMENT

L. A. Powell (Dept. of Geology and Geophysics, Univ. of Wisconsin, Madison, Wi. 53706)
R. P. Meyer (Dept. of Geology and Geophysics, Univ. of Wisconsin, Madison, Wi. 53706)

The recording of digital data at high density using compact field equipment is of concern both for land and ocean bottom seismic applications. Using the delay modulation code, also known as the Ampex-Miller code, we achieve packing densities of 2500 bits per inch per track on audio machines with 100 μ inch heads. With four tracks on five inch reels of 1/4 inch audio tape our instrument allows 360 minutes of active recording time. This time is based on 100 samples per second of each of three components plus synchronization, timing and error correction.

In another phase of instrument development, small and generally affordable hardware is being used to process the Omega navigation system's 10 second repeated pattern to automatically rate local chronometers to within a few hundreths of a second.

S 59

STRONG RESONANCES IN OBS'S

G. H. Sutton
F. K. Duennebier
A. R. Lazarewicz
P. A. Cooper (all at: Hawaii Institute of Geophysics, Univ. of Hawaii, Hon., Hawaii 96822)

Data obtained by the Hawaii Institute of Geophysics pop-up ocean bottom seismometers are often plagued by a strong resonance in the signal, especially when the OBS is located in a sediment pond. This resonance, at frequencies from 2 to 7 Hz, is stationary in the statistical sense but changes in frequency and Q with change in the station location. We now believe that this resonance is caused by the large impedance difference between the OBS package and the ocean floor. The frequency of resonance can be shifted to a higher frequency by either increasing the area in contact with the sediment or decreasing the weight of the package. Experiments done in shallow water off Oahu have been used to supply information supporting the hypothesis that the resonance is caused by the impedance mismatch. It appears that the frequency and Q of this resonance in itself provides parameters for calculation of the elastic and anelastic properties of the upper few feet of sediment.

S 60

BURP-OUT OCEAN BOTTOM SEISMOMETER

D. Byrne, F. K. Duennebier, D. H. Hussong, and G. H. Sutton (all at Hawaii Institute of Geophysics, 2525 Correa Road, Honolulu, Hawaii 96822)

(Sponsor: F. K. Duennebier)

A new configuration for a pop-up ocean bottom seismometer has been developed at the Hawaii Institute of Geophysics. Noise generated by interaction with bottom currents and by the tape recorder has been reduced and coupling to the ocean bottom improved. This has been accomplished by placing the geophones in a small independent cylindrical pressure case and using a timed fall-away scheme to separate the geophones from the rest of the system by approximately one meter. Direct comparison between signals from a standard HIG configuration and a burp-out configuration deployed at common deep water locations clearly demonstrates the superiority of the new configuration.

S 61

OCEAN BOTTOM SEISMOGRAPH DEVELOPMENT

Robert D. Moore
LeRoy M. Dorman (both at: Geological Research Division, Scripps Inst. of Oceanography, U.C. San Diego, La Jolla, CA 92093)
Marvin D. Elston (Marine Tech. Group, Scripps Inst. of Oceanography, U.C. San Diego, La Jolla, CA 92093)
Chin-Yen Huang (Geological Research Division, Scripps Inst. of Oceanography, U.C. San Diego, La Jolla, CA 92093)

We are developing a digital ocean bottom seismograph of advance design. This instrument uses a 3-component set of 1 Hertz seismometers and a hydrophone as sensors. The seismometers are leveled by lifting the seismometer assembly from its spherical supporting surface with a solenoid which is energized in pulses of short duration. The signals, whose usable frequency range is 0.1-30 Hz, are digitized with 12 bit accuracy and recorded in a serial format using a 4-track reel-to-reel recorder. The use of the Intersil CMOS 12-bit microprocessor allows a high degree of flexibility both in the programmed record mode, used for refraction experiments, and the event triggered mode, used for recording natural events. A memory of substantial size permits storage of a body of data without starting the recorder motor and generating the unavoidable mechanical noise. We plan to use this instrument to record crustal surface waves and teleseismic body waves, both of which have been relatively little used in studies of the ocean crust and lithosphere.

Synthetic Seismograms

California (JT), Tuesday 1330h

Ray Buland (University of California) and *M. Fehler* (Massachusetts Institute of Technology), Presiding

S 62 INVITED PAPER

SYNTHETIC SEISMOGRAMS BY MODAL SUMMATION

Ray Buland (Institute of Geophysics & Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, A-025, La Jolla, CA 92093)

At very long periods ($\tau > 45$s) it is natural to construct synthetic seismograms as a sum of normal modes. Not only are finite wavelength and spherical boundary effects (which are important at these periods) properly treated, but the entire seismogram is generated (not only the body phases or only the fundamental Raleigh wave). Also it is computationally sensible as only ~5500 modes are needed. The calculation of the dispersion curves and excitations is similar to synthetic surface wave algorithms except that discrete rather than continuous eigenvalues are found. Because one uses the whole earth this procedure generates body phases as well as surface waves. In some cases it is practical to generate subsets of a seismogram at even shorter periods. In particular one can reasonably generate an entire transverse seismogram or a higher mode Raleigh wave to periods as short as 15 or 20 sec.

S 63

CALCULATION OF SYNTHETIC SEISMOGRAMS BY THE USE OF ASYMPTOTIC EXPANSION OF PROPAGATORS

John Woodhouse (Institute of Geophysics and Planetary Physics, Scripps Inst. of Oceanography, La Jolla, CA 92093)
Jan Garmany
John Orcutt (both at: Geological Research Division, Scripps Inst. of Oceanography, U.C. San Diego, La Jolla, CA 92093)

A first order asymptotic expansion of propagators has been used to calculate synthetic seismograms in vertically inhomogeneous elastic media. The full response of the system including body and surface waves, is computed for high frequencies. The zeroth order term yields the Langer approximation, while the next higher term