Ultralow- and very-low-frequency seismic and acoustic noise in the Pacific

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9:48

HHH10. Sensitivity analysis of Polymer Laboratories' dynamic mechanical thermal analyzer. R. J. Deigan and J. J. Dlubac (Code 1905.2, Ship Acoustics Department, David Taylor Research Center, Bethesda, MD 20084-5000)

Polymer Laboratories' dynamic mechanical thermal analyzer (DTMA) measures the dynamic Young's or shear modulus and loss factor of viscoelastic materials. The DMTA infers the modulus and loss factor by measuring the response of a small sample to forced vibrations in a small material sample. An analysis of the parameters affecting the DMTA dynamic modulus and loss factor data is presented. Test results are affected by errors in the input parameters or by violating the assumptions leading to the solution. The extent to which either error affects the test results is quantified. As a result of this analysis, recommended DMTA test procedures are presented.

10:00

HHH11. Acoustic coatings for a large water-filled tank. Robert D. Corsaro, Joel Covey, Brian Houston (Naval Research Laboratory, Code 5135, Washington, DC 20375-5000), Gregory Spryn, Paul Bednarchik, and Duane Weaver (Sachs/Freedman Associates, 1401 McCormick Drive, Landover, MD 20785-5396)

This paper describes four sound absorbing coatings designed to reduce extraneous wall echoes in water-filled pools in the frequency range 7.5–25 kHz. These coatings were specifically developed for use in the NRL Acoustic Pool Facility, where acoustic studies have occasionally been hampered by reflections from the concrete pool walls. At frequencies above 25 kHz, the pool is sufficiently large (11.5×8.0 m and 6.1 m deep) that wall echoes can generally be excluded from the data record by using familiar time-domain filtering; however, this filtering is not helpful for many interesting test geometries at frequencies below 25 kHz. Hence, to extend the usable frequency range of this facility, echo reducing wall coatings were considered. The most economical treatment meeting these requirements was found to require the use of four anechoic (antireflective) coatings, each with different characteristics and each covering selected regions of the pool. These four coatings were subsequently developed from classical design principles, using either layers or wedges of absorptive rubber. The acoustic characteristics of the materials used are also discussed.

10:12

HHH12. Hilbert transform method for determining the reflecting surface of acoustic materials. Yasushi Miki (Faculty of Engineering, Takushoku University, 815-1 Tatemachi, Hachioji, 193 Japan)

A new method for measuring delay time is proposed. If an observed signal is regarded as an output signal of a minimum phase system with delay, its delay time can be estimated by use of the Hilbert transform relationship between the log magnitude and the phase of the transfer function of the minimum phase system. Discussions are mainly focused on practical cases were the observed signal is bandlimited. A procedure for extrapolating the frequency characteristics of the signal is also presented to minimize the estimation error due to the bandwidth limitation. The method is applied to measure the boundary location of acoustic materials whose reflection characteristics are minimum phase. An estimation error less than ± 0.8 mm in distance is achieved when a test signal of 5-kHz bandwidth is used. As an example, the location of the reflecting surface of gravel is estimated. Using this result, the acoustic impedance of gravel is computed.

FRIDAY MORNING, 18 NOVEMBER 1988 — MAUI ROOM, 8:00 TO 10:37 A.M.

Session III. Underwater Acoustics VIII: Seismo-Acoustics of the Pacific Basin

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Chairman's Introduction—8:00

Invited Papers

8:05

III1. Ultralow- and very-low-frequency seismic and acoustic noise in the Pacific. John A. Orcutt (Institute of Geophysics and Planetary Physics (A-025), Scripps Institution of Oceanography, La Jolla, CA 92093)

A discussion of the sources of seafloor noise is most conveniently broken into four frequency bands since the noise is dominated by different physics in each of these bands. The first, and most familiar, band is from 3–50 Hz. This band is known as the *very-low-frequency* (*VLF*) or *infrasonic* band but is termed *high-frequency noise* for these puposes. The best documented mechanisms for the generation of ambient noise in this band is shipping. The next lower band, from 80 mHz to 3 Hz, is commonly called the *microseism band* after the high-level microseismic noise that is clearly recorded at all sites on the Earth's surface and results from nonlinear wave–wave interactions. The third band, the *noise notch* (20–80 mHz), has a variable bandwidth and is observed on both the continents and in the ocean. Noise levels within this notch appear to be controlled largely by currents and turbulence in the seafloor boundary layer. The final *ultralow-frequency* (*ULF*) band extends from dc to 20 mHz and the levels can be attributed to surface gravity waves. Very limited pressure and inertial displacement measurements have been made in the Pacific within these bands.

8:25

III2. Estimation of sediment shear Q using horizontal component OBS refraction data. Peter D. Bromirski, Frederick K. Duennebier, and L. Neil Frazer (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, HI 96822)

Shear Q was estimated by amplitude comparison of horizontal component reflectivity synthetic seismograms with exceptionally high-quality horizontal component ocean bottom seismometer (OBS) refraction data collected at DSDP site 581C in the Northwest Pacific using a Soviet air gun source. Computations were performed on a CRAY X-MP/48 using an algorithm developed by Mallick and Frazer (1987). Sediment modeling was constrained by well log data and two-way V_P travel time from a normal incidence reflection profile. The velocity structure of the sediments and the upper 2 km of the basement was refined using ray tracing and reflectivity modeling. A strong shear conversion at the top of layer 2 constrains the shear-wave travel time through the sediments to about 1.8 s, giving an average V_S of about 0.2 km/s. Additional constraints on the modeling were imposed by matching the amplitudes of the primary as well as later arrivals. Preliminary results of a sensitivity analysis of the modeling indicate a minimum sediment shear Q of about 200 ($\alpha = 0.0136$ N/wavelength) at 9 Hz is necessary to match amplitudes of later arrivals. A stability analysis to determine the sensitivity of the modeling to Q_P, Q_S, density, and velocity will be presented. [Work supported by ONR.]

8:45

III3. Geoacoustic scattering from the Pacific seafloor. Ralph A. Stephen (Woods Hole Oceanographic Institution, Woods Hole, MA 02543)

It is amazing how much has been learned about the sediments and igneous crust beneath the sea by invoking the assumption of lateral homogeneity because almost every record obtained of sound propagating through the seafloor contains evidence of lateral heterogeneity and scattering. Three scales of scattering are evident: (1) There is the focusing and scattering of energy due to lateral heterogeneity within the seafloor. This causes anomalously high- or low-amplitude arrivals but no new arrivals; (2) there are diffractions from isolated topographic irregularities such as hills and valleys. In some cases, the hyperbolic appearance of these arrivals is evident on refraction sections; and (3) fine scale heterogeneity in the seafloor causes incoherency and time spread of arrivals. These are ubiquitous effects in seafloor reflections and refractions. These three phenomena will be demonstrated in observed data from the Pacific and in synthetic seismograms.

9:05

III4. Development of off-line, deep-towed seismic profiler. Kiyokazu Nishimura, Kiyoyuki Kishimoto, Teruki Miyazaki, Masato Joshima, and Fumitoshi Murakami (Marine Geology Department, Geological Survey of Japan, 1-1-3 Higashi, Tsukuba, 305 Japan)

A deep-towed seismic reflection profiler has been developed by the Geological Survey of Japan. The aim of the system is to obtain detailed profiles of subbottom structures in the deep seas. The system consists of deep-towed seismic recording packages with a deep-sea hydrophone streamer, a shipboard data logging and processing system, and an acoustic navigation system for the deep-towed packages. The packages are towed near the seafloor, and a sound source (an air gun) is towed near the sea surface. After the recovery of the packages on board, the seismic data in the package are transferred to the data logging and processing system through a high-speed serial link. The system has the following features. (1) Off-line towing: the hydrophone streamer and the recording packages are towed by an ordinary wire without a conducting cable. (2) No depth limitation: all electrical packages are kept in pressure-proof housings (depth limit 10 000 m), and unlimited-depth hydrophone elements are used for the streamer. (3) Digital recording and nonvolatile, solid-state memories: an A/D converter with a floating-point amplifier is used. Digitized seismic data are recorded in 16-megabyte magnetic bubble memories. Field tests of the system were successfully carried out. Some preliminary profiles of deep-towed digital seismic data were obtained.

Contributed Papers

9:25

III5. Seismic profiling at the West Pacific Ocean by DDC1-1 geosonar. Zhang Shuying and Ren Leifa (Shanghai Acoustics Laboratory, Academia Sinica, 456 Xiao-Mu-Qiao Road, Shanghai, People's Republic of China)

Some valuable records of seismic profiling at the West Pacific Ocean have been obtained by using DDC1-1 geosonar. A significant discovery is that a layer of sediment, the thickness of which is more than 500 m, exists at the area of Ryn-Kyn Ocean Trench, where the water depth is over 6700 m. The DDC1-1 geosonar consists mainly of a 30 000-J sparker as a strong wideband sound source and a 50-m-long streamer, including 20 equally