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Pressure Fluctuations on the Open-Ocean Floor off the Gulf of California: Tides, Earthquakes, Tsunamis

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ABSTRACT

This paper supplements an initial article on sea-floor pressure observations conducted with a sensitive though not “perfectly” stable transducer. A variety of examples are used to demonstrate that a wide range of research subjects in the fields of physical oceanography and submarine geophysics can be studied with measurements from Bourdon-tube pressure sensors combined with inherently linear and friction-free electro-optical feedback. Results from a three-month experiment in the Pacific Ocean, off the entrance of the Gulf of California, are presented.

The background sea level variations in the subtidal and intertidal bands are found to be more energetic than those observed 300 km east of Hawaii, that is, at a great distance offshore. The difference between the spectra from the Hawaii and the Gulf of California measurements has a maximum at 0.025 cph of nearly two decades. Baroclinic wave trapping along the coast of North America may play a role at the lower frequencies, while meteorological noise, intense in the Gulf of California, may explain the contribution near tidal and intertidal frequencies.

The tidal behavior at the experimental site is representative of the open ocean conditions that control the oscillation of the Gulf of California. The new tidal data provide more realistic boundary conditions to the mathematical modeling of the tides in the Gulf than previously available. A subjective extrapolation offshore of the co-tidal and co-range patterns in the Gulf comes closer to the observed values for the semi-diurnal than for the diurnal tide.

At supra-tidal frequencies the pressure signature of local surface waves is significant. It is more evident in the new measurements than in the Hawaii experiment because of the shallower depth which results in a high-frequency extension of the response band. The displacement of the high-frequency cutoff is consistent with the difference in depth of the ocean at the two experimental sites and confirms the interpretation of the high-frequency spectral bump in terms of ordinary surface waves.

The occurrence during the experiment of the Petatlan earthquake (14 March 1979) provided the opportunity to record

a tsunami traveling in deep water. The seismic disturbance from the earthquake was also recorded. The amplitude and travel time of the seismic perturbation are consistent with the theoretical propagation of mantle seismic waves from earthquakes. This is confirmed by the signals received from the Alaska earthquake of 18 February 1979. This earthquake was sufficiently distant for various propagation modes to be separated by dispersion

At the highest frequencies we examined instrumental noise, the deep pressure signature of surface waves and swells, and the possibility of monitoring microseism activity. We conclude that high-frequency and high-resolution deep-sea-floor pressure observations could he successfully undertaken to investigate the generation and propagation of microseisms. This objective would require minimal adaptation of the present instrumentation.

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