T-PHASE DETECTION AND IDENTIFICATION OF LARGE EXPLOSIONS AT TELESEISMIC DISTANCES IN THE PACIFIC

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ABSTRACT

We analyze T-phases of very large amplitudes recorded at a number of Pacific sites in 1969 and 1970. We interpret these signals as generated by explosions, which we assume to have been part of the CHASE experiments. Specifically, we study signals from three sources reported in various bulletins (USGS, ISC, etc.), on 13 August 1969, 01 October 1969, and 28 May 1970, and which were assigned earthquake magnitudes of m_b = 4.6, 4.7, and 4.9 respectively. In addition, we detected two similar events on 09 September 1969 and 04 September 1970, unreported in the seismological literature. All events locate off the coast of Washington State, south of Vancouver Island. Abundant T phases were detected by stations of the Polynesian network, by land-based stations of the Hawaiian Volcano Observatory, and were also detectable on island stations such as KIP, RAR, and AFI of the WWSSN, despite mediocre short-period magnifications at the latter (as low as 6250). We also include in our dataset records of the 04 Sept. 1970 shock at a Wake Island hydrophone, as described by R.H. Johnson.

We carry out a systematic relocation of the sources of the T waves, using a variable velocity model based of the regional acoustic speeds of Levitus, and including station corrections accounting for the land propagation of the wave, following conversion at the receiving shore. Finally, we correct for the dispersion of the wave with frequency over the oceanic path. The sources of the T waves are found to be generally incompatible with the published seismic epicenters, the latter leading to negative residuals (meaning the T waves would arrive early), as large as 20 to 30 seconds. Rather, the acoustic epicenters are found to lie approximately 40 km to the west of the seismic ones. A similar discrepancy is not observed in the case of the larger CHASE shots, such as the 1966 event off California, and the 1968 one off the Aleutians. While the seismic epicenter may be grossly in error, we speculate that, under favorable conditions, the acoustic and seismic sources may actually be separated in space and time. We note in this respect that all seismic epicenters are located on the slope of the continental shelf, where water depth corresponds to the SOFAR axis.

The signals are interpreted as explosive in nature, based on the amplitude duration criterion introduced by Talandier and Okal (2001), and it is estimated that their yield could be on the order of 100 tons. The timing of the events in 1969-1970 makes it probable that they were part of the CHASE experiments. Additional characteristics of the T wave signals, such as a strong frequency dispersion, also suggest an explosive origin.

We will also report on other, smaller presumed explosions detected in the Pacific, notably two events off the coast of Oahu on 13 April 2000.

KEY WORDS: T phases, Pacific Ocean, explosions, hydroacoustic detection.