RELATIONSHIPS BETWEEN T-PHASE DATA AND TSUNAMIGENESIS NEAR JAPAN

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

AUGUST 1991

By

Yoshihisa Hiyoshi

Thesis Committee:

Alexander Malahoff, Chairperson
Michael J. Mottl
Daniel A. Walker

INTRODUCTION

The chief objective of this thesis is to discuss possible relationships between mechanisms of regional tsunami generation and the spectral content of T-phases.

For this study we selected two regions off the east coast of Honshu, Japan; the Fukushima-Oki region (region-A at about 37 N) and the Sanriku-Oki region (region-B at about 40 N) (Fig.1). These regions experienced major seismic swarms with tsunamis (seismic sea waves) in 1987 (region-A) and in 1989 (region-B). Therefore these regions provide sufficient data for the purpose of this study (Table 1 and Table 2).

On 2 February 1987, earthquake no. 9 in region-A generated small tsunami waves recorded at three tide gauge stations (Ohfunato, Ishinomaki, and Onahama) on the east coast of Japan (Fig. 2). As for region-B, tsunamis excited by earthquakes nos. 45 and 46 were also recorded by tide gauges along the coast and no.46 was more strongly registered than the 1987 tsunami event (Figs 3 and 4). The Japan Meteorological Agency (JMA) issued a tsunami warning along the coast for these two tsunamis because of the relatively large magnitudes of the parent earthquakes.

While many land-based seismometers and tide gauges along the coast of Japan recorded these seismic and oceanic waves, the underwater hydrophone array at Wake Island at about (20 N, 166 E) (Fig. 5) also recorded their seismic and hydroacoustic signals. Data from Wake Island Array (WIA) have been digitally recorded since September of 1982. The data recorded consists of many seismic phases such as P, Po, So, and T phases. It is T-phases, body wave phases converted to hydroacoustic phases travelling in the SOFAR (SOund Fixing And Ranging) channel of the Pacific Ocean, that are the focus of attention in this thesis.

The driving force behind this research comes from the statement: "there might be a definite similarity between the type of mechanism that produce many tsunamis and that which produces T-phases" (p.51; Tolstoy and Ewing, 1950). From data acquired by the Wake array, it has long been known that detectable T-phases at great distances have substantial amounts of energy for frequencies from about 1 to 20 Hz. Walker (1989) has also noted that the peak accelerations observed in the near field of large earthquakes are also from about 1 to 20 Hz (Richter, 1985; Seed and Schnabel, 1972; Iwasaki, et al., 1978; Andrews, 1986; Houston and Kanamori, 1990; Somerville, et al., 1991). Since these observations could imply some relationship between the generation of T-phases and of tsunamis, Walker received a research contract to compare T-phase spectral content to Pacific-wide tsunamigenesis (Walker et al., 1991). To complement these studies of Pacific-wide tsunamigenesis, we investigate and compare the T-phase codas of regional tsunamigenic earthquakes for the Japan area with those of non-tsunamigenic earthquakes having comparable magnitudes, source mechanisms, seismic moments, locations, and travel paths.