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Semi-Diurnal Tidal Periodicity Observed by an Ocean Bottom Seismometer Deployed at a Location Very Close to Seafloor Fumaroles in Wakamiko Caldera, Northeast of Sakurajima Volcano

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An ocean bottom seismometer (OBS) recorded obvious semi-diurnal periodicity of the average velocity amplitudes of ground motions on the seafloor of Wakamiko Caldera (an active submarine volcano) northeast of Sakurajima Volcano in southwestern Kyushu, Japan. The ground motions were probably generated by the activity of the caldera's seafloor fumaroles, because we found bubbles ascending from those fumaroles just after deployment of the OBS. We compared changes in root-mean-square ground-velocity amplitudes in one-minute windows (RMSAs), tidal gravities (accelerations), and water levels during the observation period to obtain the characteristics of the periodicity. Those characteristics are summarized as follows: 1) We observed clear semi-diurnal periodicity of the RMSAs throughout September, 2007, though sometimes the periodicity was less obvious. 2) The timing of maxima RMSAs corresponded to maximum tidal gravities in the time domain. 3) The frequencies of four peaks seen in the power spectra of the changes in RMSAs were identical with those of the four major tidal components. 4) In detail, changes in RMSAs show saw-tooth shapes, and are irregular in periods of diurnal inequality. 5) Long-term or irregular changes in fumarole activity are possibly dominant in the period. The activity of hydrothermal fluids ascending from the deeper portion toward the seafloor fumaroles, which make up part of the circulation of a hydrothermal system, could be advanced as increasing upward tidal gravities (accelerations).

Key words: semi-diurnal periodicity, tidal gravity, ocean tide loading, seafloor fumaroles, Wakamiko Caldera

1. Introduction

Sakurajima Volcano is located in the northern part of Kagoshima Bay in southwest Japan. Most of Sakurajima Volcano is surrounded by the sea except its southeastern end (Fig. 1). Hypocenters of volcano-tectonic earthquakes that occurred around the volcano (Hidayati *et al*., 2007) were located beneath the sea using data obtained by seismic stations on land. Seismic observations made by ocean bottom seismometers (OBSs) would provide more precise hypocenters and focal mechanisms for those earthquakes. In 2007 we performed seismic observation using two OBSs over two periods in order to obtain seismic data on the earthquakes that are generated beneath the bay. Although no volcano-tectonic earthquakes beneath the bay occurred during the monitoring periods, we found obvious semi-diurnal changes in root-mean square ground-velocity amplitudes in one-minute time windows observed by one OBS installed on the seafloor of Wakamiko Caldera, northeast of Sakurajima Volcano (see Fig. 1). The clear, quasi-steady semi-diurnal periodicity agreed with the solid earth tide in the time domain throughout the observation period, which was over one month. Also, frequencies of four peaks derived from the power spectrum analysis for the changes in root mean squares are good agreement with the frequencies of the four major tidal components.

Tides can influence the periodicity of submarine hydrothermal activity (Glasby and Kasahara, 2001). The semi-diurnal periodicity observed on the seafloor of Wakamiko Caldera, therefore, suggests that changes in solid earth tides and/or ocean tide loadings modulate submarine fumarole activity. Several researchers have investigated the periodicities of tectonic earthquakes or volcanic activity. Glasby and Kasahara (2001) reviewed the influence of tidal effects on the periodicity of tectonic earthquakes,

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