Spatial and temporal characteristics of harmonic tremor at Sakurajima volcano

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We analyzed harmonic tremors recorded at Sakurajima volcano during the period from January 1982 to December 2002 in order to clarify theirs spatio-temporal characteristics. Two types of harmonic tremors have been recognized. One is HTB (Harmonic Tremor following B-type earthquakes). Waveforms of B-type earthquakes sometimes become monotonic gradually and change to harmonic tremor, named as C-type tremor (Nishi, 1984). HTBs continue for a few ten seconds to a few hours. The other type is HTE (Harmonic Tremor after an Explosive eruption), which occurred immediately after an explosive eruption. Tremor followed an explosive eruption and become harmonic after a few minutes. For 20 years, 1448 HTBs occurred and only 6 HTEs were recorded in the same period.

Spectra of harmonic tremor show a regular peak of frequencies and theirs integer multiple. Temporal change of the peak frequencies of HTB and HTE are shown in Fig. 1. Spectra of HTB, which occurred for almost 2 hours quasi-continuously on 14:06 July 20, 1990, show a nearly stable fundamental frequency at the range of 1.46 Hz – 1.66 Hz and *Q* factor fluctuates in the range of 10.07 – 18.44. HTE was recognized about 2 minutes after an explosive eruption on 11:15 October 11, 2002, because frequency ratios of second mode to fundamental mode become 2 and Q factor increase from 7.1 to 32.2 at 150-170 s. The fundamental frequencies of HTE gradually increased from 0.9 Hz to 3.5 Hz. The spectra of the both types were mostly consistent for three components at five stations. This suggests that the spectra were caused by the effect of sources, and source spectrum was kept at a constant in HTB and that became higher in HTE.

P-waves are identified only at the beginning part of wave packets of HTB at stations near the crater. Most of particle motions at fundamental frequency show Rayleigh and Love waves. Rayleigh type is dominant at HAR and KAB, and Love type is at HIK, ARI and KOM. (Figure 2) At higher modes, the particle motions of HTB almost represent Rayleigh waves at most of the stations and all higher mode frequencies. At stations HAR and KAB are dominated by Rayleigh waves and the others stations show complex motion which consist of Rayleigh and Love types at the frequency 0.9 Hz. Dominant surface waves of both HTB and HTE suggest shallow source depth.

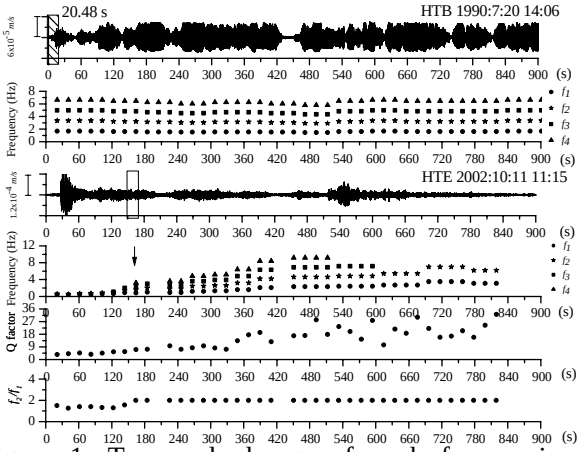

Figure 1. Temporal change of peak frequencies, Q-factors, and ratio between lowest peak and second peak of HTB and HTE.

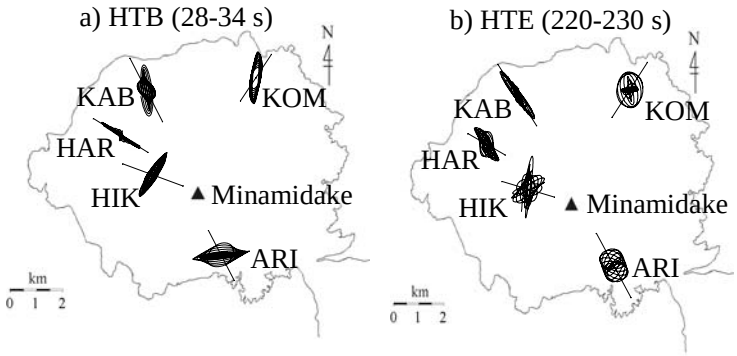

Figure 2. Particle motion at horizontal plane of HTB and HTE superimposed on the sketch of all stations location.