Mapping the b-value beneath Mt. Fuji volcano: Indication for magma at 12 - 14 km depth

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We mapped in cross-section and three-dimensions the spatial distribution of the b-value beneath Mt. Fuji. Using data available to us to date (1991 to Feb. 2001, M > 0.3, about 450 earthquakes) show high b-values (b >1.8) between 11 and 14 km depth, about 5 km to the North of the summit, suggesting the existence of magmatic body nearby. Neighboring volumes to the south show a much lower b-value (b <1.2).

Remarkable activity of low-frequency microearthquakes has been observed beneath Mt. Fuji since October 2000. To evaluate the future development of the activity, it is important to obtain information about the presence of a magma reservoir near the seismic source region. To address this question, we mapped the spatial distribution of the b-value beneath Mt. Fuji in cross-section and three-dimensions. The b-value describes the slope of the frequency-magnitude distribution (log N = a - bM, where N is the cumulative number of events and a and b are constants). Detailed mapping of the b-value has recently been performed beneath several volcanoes: Mount. St. Helens, Mt. Redoubt, Mt. Spurr, Mt. Etna, Mt. Pinatubo, Katmai volcanoes, Off-Ito, Kilauea, Mammoth Mountain and Long Valley. Strong and statistically highly significant contrasts in the b-value have been found on the scale of kilometers, defying the commonly held believe that volcanic areas generally exhibit a higher than normal b-value. Our more sophisticated 3D mapping instead reveals pockets of high b-value anomalies embedded in normal crust. High b-values are particularly concentrated in the vicinity of magmatic bodies, which is to be expected because the physical conditions near a magmatic body (high heterogeneity, high temperature gradients and high pore pressures) are all favoring high b-values. Thus we have proposed that high b-values near magmatic bodies area necessary, but not sufficient, condition. Consequently, spatial mapping of b presents a viable tool for structural investigations of volcanic systems. Temporal migration of high b-value anomalies have so far been found in two cases (Off Ito and Mammoth Mountain), possibly related to the movement of magma.

At Mt. Fuji, the limited data available to us to date (1991 to Feb. 2001, M > 0.3, about 450 earthquakes) show high b-values (b >1.8) between 11 and 14 km depth, about 5 km to the North of the summit, suggesting the existence of magmatic body nearby. Neighboring volumes to the south show a much lower b-value (b <1.2). We plan to update our mapping as new events become available and monitor the spatial and temporal evolution of the b-value distribution.