On the b value in the magnitude-frequency distribution of earthquakes near and around volcanoes

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There are many reports that show observation of large b values in seismic activity near volcanoes (e.g., Warren and Latham, 1970). We can consider several possible causes of the observation: high temperature as well as large temperature gradient in seismogenic zone, high degree of inhomogeneity in the crust and low stress drop in the fault motion. It has been pointed out that especially large b value is obtained for activities near magma chambers (Wiemer and McNutt, 1997; Wyss et al., 1997; Wiemer et al., 1998).

We investigated characteristics of the b value for seismic activities near Japanese volcanoes. The subject of the investigation is not confined to usual activities occurring around volcanoes, but include swarm activities such as the 1998 Hida swarm, the 2000 Usu swam accompanying an eruption and the 2000 Miyakejima swam as well as low frequency earthquakes that are observed within the edifice or in the bottom of the crust near volcanoes with depths of 30-40km. Followings are some results obtained so far:

1.Low frequency earthquakes that occur near Mt. Fuji have a high b value than high frequency earthquakes.

2.In the 1998 Hida swarm, the b value was comparatively large for the activity in the southern part near Yake-dake than that for the activity in the northern part where the largest earthquake occurred.

3.In the 2000 Miyakejima swarm, activities in the southeastern part of the swarm region showed large b values compared to those in the northwestern part where large earthquakes were observed. The triggered seismic activities around Niijima Island and south-off Miyakejima Island had further smaller b values. Especially large b value was obtained for activities in the central part of the swarm region.

4.Hypocentral distribution changed drastically at about 11 o'clock on 29 March in the swarm activity accompanying the 2000 Usu eruption. After that time large b value region was extended near the surface in the northern part of the seismic activity.

5.Low frequency earthquakes occurring in the lower crust have high b values. It is very rare to observe a low frequency earthquake with magnitude larger than 2.5. The b value is larger than that for low frequency earthquakes that are observed in the edifice of Mt. Fuji.

6.The b value for intermediate-depth earthquakes in the Pacific slab is large in the region just beneath the Volcanic Front.