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Earthquake swarms accompanying magma activity in the Izu-Hanto-Toho-Oki region: Statistical property

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Reactivation of magma intrusion into the Izu-Hanto-Toho-Oki region started on 17 December 2009 and several accompanying phenomena were observed in and around the region: among them is the earthquake swarm continuing for the following several days. Because of frequent reactivation in the past, it allows us to suppose future swarms that lead to eruptions in this region. To scientifically forecast eruptive style, volume, and process in future, it is necessary to better understand the states of magma and surrounding crust in pre-eruption periods, using relatively high-quality dataset for the Izu-Hanto-Toho-Oki region. The method we consider is a statistical basis: mapping spatiotemporal variability of the frequency-magnitude distribution of earthquakes. The cumulative event-size distribution is commonly described by the Gutenberg-Richter law: $\log N = a - bM$, where N is the cumulative number of earthquakes of magnitude M or greater, and a and b are constants. The constant b or "b-value" is typically 1, but varies from region to region and from time to time (e.g., Wiemer and Wyss, 2002). In the laboratory, b has long been known to be inversely dependent on differential stress (Scholz, 1968). If this dependence holds in the region of magma intrusion, then measurements of spatial and temporal changes in b could act as a "stressmeter" to help image of this intrusion. The seismic network constructed in the eastern part of the Izu Peninsula has long been maintained by Earthquake Research Institute (ERI) to continuously monitor events. Then, ERI staff members accurately relocate the events for the last two decades. Thus, this region is a good test field if we use such dataset. In this talk, we present first results based on the ERI dataset to show that b , which is high at early times of a swarm, decreases with time and then approaches a time-independent constant around $b=1$. We then discuss toward better understanding of the current and past process of magma intrusion into the Izu-Hanto-Toho-Oki region.

Keywords: earthquake, volcano, magma, Izu-Hanto-Toho-Oki, statistics, earthquake swarm