Time-dependent model for volume changes in pressure sources at Miyake volcano estimated by geodetic data during 1979-2000(Part 2)

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An understanding of the magma supply system is important for middle- and long-range predictions of volcanic activities. The geodetic approach is adequate to estimate currently ongoing processes beneath active volcanoes. Studies on frequently erupting volcanoes suggest that magma is supplied to the magma chamber at almost a constant rate. However, volcanoes have many different types of eruptions. It is generally known that many volcanoes suddenly change their eruption types. The magma supply system and preparatory processes for these eruptions have not been extensively studied.

In Miyake volcano, the 2000 eruption accompanied by a huge dike intrusion was quite different from the previous eruption. In order to discuss the magma supply system to change the eruption type, we formulated a time-dependent model for the volume change in a spherical source and a dike beneath Miyake volcano due to the deformations detected from the precise leveling, sea level observations, and GPS data during 1979-2000.

As a result, in the preparatory interval of the 2000 eruption, the magma sources recovered nothing more than the volume ejected during the 1983 eruption. The special change in the magma supply to the magma sources beneath Miyake volcano could not be detected before the 2000 eruption. The existing magma sources associated with previous eruptions might not store enough magma for huge dike intrusion of the 2000 eruption. This result makes us believe that the 2000 eruption should have type and magnitude similar to the 1983 eruption, if only the existing magma sources induce to the 2000 eruption. In order to feed the dike with large amounts of magma, we propose a model with an episodic magma supply from another magma source.

Murase et al. (2006) proposed a model of three dikes in earthquake swarm area and discussed temporal changes in the dike expansion in the 2000 eruption. The three dikes are termed Miyake-side dike, central dike, and Kozu-side dike in the order of distance from Miyake volcano. The dikes may be divided into two categories based on the temporal changes. The Miyake-side dike belongs to one category.

The temporal changes in the Miyake-side dike seem to be inversely related to that of the source beneath Miyake volcano, and the total volume of the Miyake-side dike is estimated to be 0.8 km3. It was suggested that the magma was supplied to the Miyake-side dike from the source beneath Miyake volcano. The Kozu-side dike and central dike belong to the other category. The temporal changes in these two dikes seem to be similar. Magma seems to migrate from the bottom of the central dike to the upper part of the Kozu-side dike based on the spatial change. We believe that the primary magma supply switched from a source below Miyake Island to a source below the central dike.

The sudden change in the eruption style is likely to be caused by the huge magma supply from several magma sources.