

Estimation of a source model of crustal deformation related with the 2000 Miyakejima eruptive activity.

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1. Introduction

Regarding with the 2000 Miyakejima eruptive activity, various source models have been proposed on the basis of different data sets for various chronological stages. In order to understand the magmatic activity, gas emission of which has forced the residents of Miyakejima to evacuate from the island, it is crucial to establish a source model for all crustal deformation data available for us. For this purpose we tried to elucidate the source locations and geometries for the crustal deformation including GPS, tilt-changes and leveling through the period after the 1983 eruption up to now. The source models are estimated by using a genetic algorithm and by dividing the period from November 1983 to July 2003 into 8 epochs.

2. Results

Period 1 (Pre-eruption period, Nov. 1983 ~ Jun. 1999)

Crustal deformation can be explained by a spherical inflation source, about 9 km deep, in the southwestern part of the island and a vertical dike-shaped inflation source on the spherical source.

Period 2 (Dike intrusion period, Jun. 26, 2000 ~ Jun. 27)

Ueda et al. (2004) shows that the crustal deformation can be interpreted by three dike-shaped inflation sources and one dike-shaped deflation source. They concluded that there existed two phases of magma movement; a small intrusion at a depth range of 1~3km beneath the southwestern flank of the island from 18h30m to 21h on June 26, a large intrusion beneath the west coast, and deflation of a dike-shaped deflation source beneath the small intrusion, both of which started simultaneously at about 21h on Jun. 26.

Period 3 (Deflation period 1, Jun. 28, 2000 ~ Jul. 7), Period 4 (Tilt step period, Jul. 10, 2000 ~ Aug. 17), Period 5 (Deflation period 2, Aug. 24, 2000 ~ mid-Sep.)

Crustal deformation can be explained by a spherical deflation source, about 8 km deep, in the southwestern part of the island and a vertical dike-shaped deflation source on the spherical source. The dike-shaped source is directed to the summit. In Period 4, tilt steps were observed more than 40 times. Assuming a spherical inflation source, we can estimate the location of the sources at the southwestern part of the island 4~10 km deep.

Period 6 (Volcanic gas mission period 1, Oct. 2000 ~ May 2001), Period 7 (Volcanic gas mission period 2, Jun. 2001 ~ Oct. 2001), Period 8 (Volcanic gas mission period 3, Jan. 2002 ~ Jul. 2003)

Crustal deformation can be approximately explained by a spherical deflation source, about 3 km deep, beneath the summit. In Period 8, the spherical source in the southwestern part inflated.

3. Discussions

Systemizing the results of each period, we conclude that there exist not less than four sources beneath Miyakejima. One source exists in the southwestern part of the island. The depths of top and bottom are 3~5 km and 7~10 km, respectively. The lower part of it is spherical and the upper part is dike-shape. The dike-shaped part is directed to the summit. Since the source inflated about 0.1km³ in the pre-eruption period and deflated about 0.4km³ in the deflation period, it is probably a magma chamber related with the eruptive activity. One source is a spherical deflation source beneath the summit. The deflation has continued since Oct. 2000. Since it deflates during significant gas emission from the summit, the source might relate with the emission.

The other sources are intruded dikes in Period 2. One dike began to intrude to near the upper bound of the dike-shaped portion of the magma chamber, and another dike began to intrude beneath the west coast at 21h on Jun. 26.

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