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Magnetization structure of Unzen graben determined from aeromagnetic data.

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1.Introduction

Unzen volcano has been formed in the Unzen graben in a N-S extensional tectonic stress field (Tada, 1984). This volcano is cut by EW-trending normal faults, such as Chijiwa-, Kanahama-, Futsu- and Fukae-faults. Although these E-W trending normal faults run in the middle of the Shimabara Peninsula, the northern and southern boundaries of the graben are not clear because volcanic rocks have almost entirely filled the depression.

In this study, we aim at clarifying the geological, tectonic, and geothermal subsurface structure of the Unzen graben which progressed with volcanic activity and has been related closely. First, we reanalyzed about regional spatial distribution of the central part of the Shimabara Peninsula by using the aeromagnetic data of Nakatsuka (1994) on August, 1991, and clarify about the feature of western Unzen and an eastern part. In addition, we give new knowledge for main fault which forms Unzen graben by using low-altitude aeromagnetic data on September, 2002. These data allow us to identify the extent of individual geologic units, depression of the fault, and the distribution of hydrothermally altered areas. Finally, we reveal 2.5-dimentional model for 3-dimensional interpretations and discuss about these results based on accumulated other geophysical data including drilling data.

2.Data Analysis

.2.1.Magnetization Intensity Mapping

In order to obtain information on the regional subsurface structure using the terrain corrected data, such as lava flows, pyroclastic flows, fructured and hydrothermally altered areas, we applied the magnetization intensity mapping method (e.g. Okuma, 1994; Nakatsuka, 1995;) by using data of Nakatsuka (1994).

2.2. Horizontal Gradients and Boundary Analysis

Next, we performed horizontal gradients and boundary analysis using low-altitude aeromagnetic data, in order to understand more detailed and localized feature of main faults.

2.3.Forward Modeling for Magnetic structure

We used 2.5 dimensional, foward-and-inverse magnetic profile modeling program (Webring, 1985). The total magnetization used in this forward calculation is a vector sum of the induced and remanent magnetization. A 2.5D foward-and-inverse modeling along profiles crossing the main anomalies showed was performed. All the selected profiles produced by slicing this terrain reduced-to-the-pole magnetic anomaly grids are assumed that both the magnetic field and the magnetization vector are vertical.magnetic

3.Summary

We conducted the magnetization intensity mapping, magnetic boundary analysis and forward modeling for the subsurface structure, in order to better understand a magnetic subsurface structure on Unzen graben.

The magnetization intensity map gives magnetization properties of volcanic rock such as lava flows, fructures and hydrothermally altered areas, or information on them of subsurface structure in the central part of the Shimabara Peninsula. Magnetization highs of 4.5 A/m predominate on the Older Unzen volcano exposed mainly around Saruba-Yama in the western Unzen region. As for the eastern Unzen region, magnetization highs of > 6 A/m predominated on Mayu-Yama volcano has exceeded further than magnetization intensity of other lava, reflecting the strength of NRM intensity. On the other hand, magnetization lows are distributed around along the eastern of the Chijiwa fault and on the circumference of Mayu-Yama. The results may be reflect the fan deposit of Younger Unzen in the shallow parts or altered volcanic rocks due to the extensive hydrothermal system.

Magnetic boundary analysis gave information on local tectonic trends related to volcanic activity. The correspondence of some gradients to faults and locations of hydrothermal altered area strongly suggests that the horizontal magnetic gradients represent subsidence of Chijiwa-fault (in the western region) and Fukae-fault, fractures and alteration.

Magnetic model was constructed from aeromagnetic anomalies, drilling data and the result of magnetization intensity mapping. These magnetic models shows that magnetization lows extend to near surface beneath Shimo-Dake, Unzen hot spring and the circumference of Mayu-Yama. The extents of these lows constrain the locations of modern and past hydrothermal activity in individual areas. In particular, as the feature of this whole area, these magnetic models also delineated as pointed out by the results of gravity data and MT data that Unzen graben has the feature of half-graben, that's the Chijiwa fault of the northern fault sedimented in the western Unzen region and the Fukae fault of the southern fault sedimented in the eastern Unzen region.