論　説

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三宅島の3次元磁気構造と2000年噴火によるその変化

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3D Magnetic Structure of Miyakejima Volcano before and after the Eruption in 2000

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A magnetic inversion algorism for constructing a 3D-magnetic structure of a volcanic edifice was developed and applied to the airborne magnetic anomalies of Miyakejima Volcano surveyed in 1987, 1999, and 2001. The method consists of two steps. First, a uniformly magnetized terrain model is assumed for calculating the mean magnetization intensity, and the residual field was calculated by subtracting the terrain effect. In the second step, the magnetization deviations (ΔJ) from the mean value are calculated for each prismatic block constituting the three dimensional volcanic edifice, by the refined Conjugate Gradient iteration method under the condition of $-10\,\mathrm{A/m} < \Delta J < 10\,\mathrm{A/m}$. Characteristics of the derived 3D-magnetic structures are summarized as following four features. (1) Miyakejima Volcano has rather uniform magnetization, whose non-uniform magnetization is less than 10〜20% of total bulk-magnetization(total summation of the product of block volumes and magnetization intensities). (2) A nearly N-S trending magnetic basement is estimated at the deeper part of the volcano. (3) Relatively weak magnetization zones are estimated beneath the eastern coastal zone and its offshore area, and beneath the western flank of the edifice. (4) A relatively high magnetization zone is estimated beneath the northern offshore area. Comparison of the 3D-magnetic structures derived from surveys in 1987 and 1999 made apparent that the zone of relatively weak magnetization intensity had spread wider from 1987 to 1999, with the most demagnetized zone at the base (0 m〜300 m b.s.l.) in about 750 m southeast from the center of the crater. The 3D-magnetic structure in 2001 indicates the demagnetized zone is considerably restricted in comparison with that in 1999. This feature may suggest that the thermal demagnetization has been depressed after the eruption in 2000. These results suggest that the detection of demagnetization process associated with volcanic activity might be promising by conducting repeated airborne magnetic surveys.

Key words: 3D magnetic inversion, magnetic tomography, Miyakejima, magnetic anomaly, airborne geophysics

1. はじめに

三宅島はわが国における最も活動的な火山の一つで，1940年の噴火後はほぼ20年周期で噴火をくりかえしている（宮崎，1984）．山体はおもに玄武岩質の溶岩や火砕堆積物で構成され，2000年噴火前には，雄山山頂で海抜813 mの標高を有していた．海底地形では，その基底は水深約300 m付近にあり，標高0 m付近は3合目付近に相当する（海上保安庁水路部，1995）．2000年の噴火では，6月27日に西側山腹で最初に海底噴火が確認されたが，7月8日以降は山頂噴火に移行し，8月18日の噴火のあと，8月29日の火砕流を伴う噴火が発生した．この一連の噴火では火口での陥没が確認された．その後，山頂部の陥没は拡大し，直径1.7 km，深さ500 m以上に至っている（中田・他，2001）．

三宅島のような玄武岩質の火山では，顕著な磁気異常を伴うことが知られている．磁気異常の源である磁性鉱物はキューリー点温度では磁化を失うため，火山内部の熱的変化は磁気異常の変化を生じることが予想される．このことから，火山の磁気異常を把握し，その変化を観測することは火山活動を監視するための有力な方法のひ

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