Can magnetic survey estimate locations of intrusions?

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The Geological Survey of Japan (GSJ), AIST conducted various magnetic surveys such as stinger-mounted helicopter-borne magnetics, helicopter-borne EM and magnetics and ground magnetics in the Usu Volcano area, Hokkaido Japan after its 2000 eruption to better understand the subsurface structure of the volcano (i.e. Okuma et al., 2010). Recently, 3D imaging method was developed (Nakatsuka and Okuma, 2014) and applied (Okuma et al., 2014) to the aeromagnetic anomalies of the volcano observed by the stinger-mounted helicopter-borne magnetics flown at an altitude of 150 m above terrain. The result revealed the subsurface distribution of basaltic somma lava but no information about magmas intruded during the recent eruptions in 1977-1978 and 2000 was obtained. This implies a difficulty to estimate locations of intrusions by a single magnetic survey and instead we proposed an alternative repeat survey (Okuma et al., 2013).
This time, we took a different approach to overcome the problem. We thoroughly reexamined the aeromagnetic anomalies observed by helicopter-borne EM and magnetics flown at an altitude of 70 m above terrain. Since the flight altitude of this survey is lower than that of the former one, a dipole of magnetic anomalies with a reverse polarity was found on the southwestern flank of the main edifice of volcano. To confirm the magnetic anomaly, we, then, conducted a ground magnetic survey along some profiles. As a result, a comparable magnetic anomaly was observed on ground. Whereas, the survey area is underlain by basaltic somma lava which shows high NRM intensities (6-10A/m) (Okuma et al., 2014). This suggests the existence of an intrusive body with a magnetization intensity lower than that of the somma lava. There are two possibilities which account for the magnetic anomaly. A hot magma of the recent eruptions might have intruded in the somma lava since some fumarolic activities were observed nearby during the ground magnetic survey. A cooled magma intruded during older eruptions is another possibility. Volcanic activities of the volcano changed from basaltic to dacitic after the formation of the main edifice. Since the NRM intensities of dacite is lower than that of soma lava (Nemoto et al., 1957), an old dacitic intrusion can account for the magnetic anomaly as well. Consequently, a repeat magnetic survey might play a role of judging if which hypothesis is more suitable by observing temporal magnetic changes.

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