Magnetic Structure of Stromboli Volcano, Aeolian Islands, Italy

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The Geological Survey of Japan, AIST and the Geological Survey of Austria (GBA) have been conducting aeromagnetic surveys over active volcanoes over the Aeolian Islands, southern Italy to better understand the subsurface structure of the area. Two helicopter-borne magnetic surveys were conducted over Stromboli Volcano and its surrounding areas on the Aeolian Islands, southern Italy in 2002 and 2004. Observed data from those surveys were merged and aeromagnetic anomalies for Stromboli Island and its vicinity were reduced onto a smoothed surface, assuming equivalent anomalies below the observed surface. The magnetic terrain effects were calculated for the magnetic anomalies of the study area, assuming the magnetic structure comprised of an ensemble of prisms extending from the ground surface to a depth of 3,000 m below sea level: the average magnetization intensity was calculated to be 2.2 A/m for the edifice of Stromboli shallower than 1,200 m below sea level by comparing the observed and synthetic data. Next, apparent magnetization intensity mapping was applied to the observed anomalies using a uniform magnetization of 2.2 A/m as the initial value. The apparent magnetization intensity map indicates magnetic heterogeneities among volcanic rocks which constitute the edifice of the volcano. The most remarkable feature of the magnetization intensity map is a magnetization low which occupies the center of the island where the summit craters reside, suggesting demagnetization caused by the heat of conduits and/or hydrothermal activity in addition to the thick accumulation of less magnetic pyroclastic rocks. By comparing topographic and geologic maps, it can be seen that magnetization highs are distributed on the exposures of basaltic-andesite to andesite lavas (Paleostromboli I), shoshonitic lavas with an eccentric vent and a shield volcano (Neostromboli), on the south, north and west coasts of the volcano, respectively. These magnetization highs further extend offshore, implying the seaward continuation of these volcanic rocks. 3-D magnetic imaging was preliminarily applied to the same magnetic anomalies as well as for the magnetization intensity mapping. The result implies the bottom depths of these magnetic structures are relatively shallow (shallower than 1,500 m below sea level at the maximum). A distinctive regional magnetization high is distributed on a saddle area between Stromboli and Basiluzzo islands and extends to the two submarine eruptive centers on the southwestern submarine edifice of Stromboli. A careful examination on the results of the 2-D and 3-D magnetic imaging implies that the saddle area is occupied by volcanic rocks from these eruptive centers and is also underlain by partially and/or completely concealed volcanic structures formed along a NW-SE direction conjugate to the main axis of regional tectonic trend in this area.