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Aeromagnetic survey over Usu volcano -plannning and feasibility-

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1. Introduction We plan to conduct an aeromagnetic survey over Usu volcano in 2010 as a part of the Observation and Research Program for Prediction of Earthquakes and Volcanic Eruptions. Meanwhile, Hokkaido University has been monitoring the total magnetic changes on the volcano by grounded repeat surveys since 2003. Three areas (eruptive zone in 2000, summit caldera, and Showa-Shinzan dome) have been investigated. Currently, we detected clear magnetic changes from all of these areas. In this paper, we summarize the results from these ground surveys and show the outline and scope of the aeromagnetic survey plan.

2. Ground magnetic surveys Persistent magnetizing trend has been revealed in the 2000 eruption zone by the repeated ground survey which started in 2003. One of the equivalent sources is located at a depth of several hundred meters beneath the center of uplift due to the 2000 eruption. It implies the cooling magnetization of the intruded magma. As of 2010, these changes, decreasing their rate of change, are still ongoing. In the summit caldera, we started repeat magnetic surveys in 2008, by which magnetizing pattern probably due to the cooling at shallow parts beneath Gin-numa and I-craters. Cooling of the remnant intrusive body of 1977-78 eruptive activity is one of the candidates for the magnetic change. Likewise, Showa-Shinzan lava dome shows cooling magnetization pattern. The equivalent source is quite shallow, probably in the lava dome itself. It is surprising that cooling of an over 60-years-old lava dome can be detected by magnetic changes. Magnetic changes thus can be an important clue to understand the thermal history and heat budget of intrusive magma as well as the heat discharge estimation by fumarolic activity, steaming ground, and hot springs.

3. Advantages of aeromagnetic survey Recent progress of data processing and introduction of a helicopter and GPS has been pushing up the detection ability of aeromagnetic time changes. So far, aeromagnetic repeat survey reaches a practical level for the fields in which we expect a magnetic change over 10 nT. This technique has three major advantages compared to a ground survey. Firstly, extensive coverage is easily achieved in a short time even over the areas of severe accessibility from the ground. Secondly, a strong demand on the repeatability of sensor positioning is greatly mitigated in the air, since magnetic gradient is fairly small compared with the case on the ground. Thirdly, aeromagnetic dataset, if properly measured, can survive even for centuries to be used for comparison to a future survey. In contrast, detection of temporal magnetic changes through decades by ground measurements may encounter a severe problem because of the difficulty in keeping repeat stations or benchmarks alive for many years on an unstable volcanic edifice.

4. Outline and scope of the 2010 survey Geological Survey of Japan, AIST conducted an aeromagnetic survey over Usu volcano in 2000 (Okuma et al., 2001). Our survey in 2010 is planned for detecting time changes since the previous flight. Expected magnetic changes in the air of 100 m high above terrain have proven by the grounded surveys to exceed detectable limits in all of the three areas mentioned above. It would be possible to discuss the variety of cooling rate

and intrusive volume between the three areas by the magnetic changes. The forthcoming survey is designed to fly along EW direction, which is orthogonal to the previous one in order to make the most of the generalized mis-tie control method (Nakatsuka and Okuma, 2006). Spatial extent or shape of the above magnetic changes will be detailed by areal coverage. Anomalous changes which are currently unknown will also be screened.

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Keywords: Usu, volcano, aeromagnetic survey, geomagnetism, helicopter