

Repeated aeromagnetic surveys in Shinmoedake volcano, Japan, by using an unmanned helicopter

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After the 2011 eruptions of Shinmoedake volcano in Japan, we conducted three repeated aeromagnetic surveys around this area, by using an autonomously driven unmanned helicopter. Shinmoedake volcano had sub-Plinian eruptions in the end of January 2011 and its vent was filled by uprising intrusive lavas. After that, some Vulcanian eruptions followed, and then volcanic activities were decreasing gradually up to the beginning of April 2011.

After these events, we conducted aeromagnetic surveys in the end of May 2011, the beginning of November 2011, and the end of October 2013. The Yamaha RMAX-G1 unmanned helicopter was used for our surveys, which was usually used to spray the agricultural chemicals to fields, and can make flights following the programmed tracks within about 1 m precision. Availability of precise flights are a great advantage for repeated surveys in order to detect easily the changes of circumstances, such as, geomagnetic changes due to volcanic activities by measuring at the same positions. Almost 85 km flights in total were made in every survey with a flight speed of about 10 m/s. Flight heights above the ground were almost kept in 100 m.

As the result of some data processing, we clearly detected the change of the magnetic fields around the vent of Shinmoedake, which has a kind of a dipolar pattern with positive changes in South and negative changes in North. This indicates a region around the vent got magnetization due to cooling. The intrusive lava is supposed to be the source of magnetization, and 2.0×10^7 Am² magnetization of lava is evaluated at the second survey (0.5yr) and 4.8×10^7 Am² is evaluated at the third survey (2.5yr), compared with the first survey. This means the magnetizing rate is almost related to a square root of the elapsed time and it leads to an implication the lava cooling is dominantly made gradually by thermal diffusion, not by other cooling processes such as thermal convection. The common thermal diffusivity of rocks, however, is too small by one order of magnitude to explain this cooling rate, and intrusion of water in lava, say, rainfall water, may play an important role to raise the effective thermal diffusivity to make the lava cool.