

Depth variations of paleointensities in lava flows from Izu-Oshima revisited

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Reliable paleointensity data from lava flows are still difficult to be obtained compared to those from archeological materials. Since Nagata, Arai and Momose [1963] deduced paleointensities from basalt lava flows in Izu-Oshima volcanic island for the past 1000 years, the paleointensity data have been accepted as representing the vector secular variation of the geomagnetic field in Japan [Yoshihara et al., 2003]. Although the directional secular variation from Izu-Oshima is concordant with archeomagnetic data and historical geomagnetic model gufm1, the paleointensities of Nagata et al. [1963] and Yoshihara et al. [2003] gave discordant values to each other even for same lava flows by several tens of percent and to those from archeological materials.

I collected paleomagnetic drill cores or hand samples from vertical sections of several lava flows erupted during the past 700 years. At some sites I could find drill holes of Nagata et al. [1963] and Yoshihara et al. [2003] and retrieved drill cores next to the holes. The lava flows were relatively thin (usually lava thickness < 1 m) and the entire sections can be recovered. Especially I focused on upper and lower clinkers for sampling even if orienting device was not possible to use.

Thellier paleointensity measurements were performed using a fully automated magnetometer-furnace system tspin for about 150 specimens. I chose appropriate temperature steps for each specimen based on the thermomagnetic curve that was quite variable depending on the vertical position within a lava flow. Grain size inferred from hysteresis parameters also systematically changed according to the vertical position: smaller grain size in upper and lower clinkers and larger grain size in lava's interior.

I could not find linear segments on Arai diagrams for most of the measured specimens; Upward concave, two-segment or sigmoid curves are common. Exceptionally linear segments were observed for a small number of upper or lower clinker samples that have very high M_r/M_s (~ 0.5) indicating single domain grains. However, any samples from lava's interior of the same vertical sections did not show linear segments. Sometimes slightly upward concave curves seem to be straight, giving erroneously high paleointensities.

Drill cores collected near remnant drill holes of Nagata et al. [1963] and Yoshihara et al. [2003] did not provide any paleointensity data. These cores come from lava's interior and no linear segment was identified on Arai diagrams. Therefore the existing intensity secular variation from Izu-Oshima lava flows must be taken with great caution. This finding also suggests that Thellier paleointensity data from lava interiors need to be reexamined.

Keywords: paleointensity, geomagnetic secular variation, hysteresis properties, Curie temperature