

Preliminary paleomagnetic results of the Holocene tephra layer at Kusatsu-Shirane volcano, Gunma, Japan

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Summary

The ring of fire in Japan has 111 active volcanoes. Some have erupted frequently and caused serious loss of life and damages. Understandings past volcanic eruptions are essential for minimizing future losses. This paleomagnetic study aims to date the tephra layers at the Kusatsu-Shirane volcano at Gunma, Japan. This is an active volcano that had a phreatic eruption with one casualty in 2018. Paleomagnetic analysis of 54 specimens from 10 tephra layers has isolated a stable characteristic remanent magnetization (ChRM) component in each layer after removal of a secondary viscous remanent magnetization. When the observed ChRM directions are compared to the composite paleosecular variation record from Lake Biwa in Japan, the tephra layer appears to record the secular variation and the observed ChRM direction of the bottom layer is in agreement with the direction of Lake Biwa's paleosecular record at ~4800 yr. BP ¹⁴C age.

Method

Four to six specimens were collected using 7 cm³ non-magnetic plastic cubes from 10 tephra layers in an outcrop near a local roadside crossing the Kusatsu-Shirane volcano area, yielding 54 specimens in total. Each specimen was oriented in situ with a magnetic compass. Paleomagnetic and rock magnetic measurements were done at the University of Toyama.

Results and Conclusions

Based on temperature dependence of magnetic susceptibility, stepwise isothermal remanent magnetization acquisition analysis and Day plot analysis for selected specimens, the major magnetic mineral in the specimens is likely pseudosingle-domain titanomagnetite. The characteristic remanent magnetization (ChRM) directions of individual specimens were determined using orthogonal vector plots (Zijderveld 1967) and principal component analysis (Kirschvink 1980) after alternating field demagnetization in 12 steps up to 60 mT. The observed

ChRM directions were averaged following Fisher (1953) for each tephra layer. The ^{14}C age of the bottom tephra layer is ~4849 yr. BP (Ishizaki pers. comm. January 2020). The observed site mean ChRM directions are compared to the composite paleosecular variation curve (BIW) for Lake Biwa in Japan, which ranges from 7767 BC to 1683 AD (Ali et al. 1999). The observed ChRM directions show a similar trend as the upper part of the BIW composite curves in declination and inclination, and the ChRM direction of the bottom layer shows good agreement with the BIW composite curves around ~4800 yr. BP. These results suggest that the observed ChRM directions are reliable for age dating at this study area. Further, comparison of the peaks between the observed ChRM directions and the BIW composite curves date two younger previously-undated eruption events in the Kusatsu-Shirane area.

References

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