

Experimental verification of the age gap by paleomagnetic viscous remanence

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Erratic boulders emplaced by glaciers, tsunamis, floods and landslides are the geologic remnant of such events, and previous studies determined the emplacement age by radiocarbon and cosmogenic exposure dating techniques. Magnetic viscous dating is a powerful tool to reveal such emplacement modes and ages of erratic boulders because the component of viscous remanent magnetization (VRM) shows rotations of boulders and its thermal stability predicts the age since the boulders had displaced. This magnetic viscous dating is based on Neel's relaxation theory such as magnetic time-temperature relationship. Previous studies showed that the magnetic dating often is different from radiometric emplacement ages: "the age gap". To verify how this age gap occurs, we conducted a theoretical consideration and its experimental constraint on magnetic relaxation of artificial remanent magnetizations. In this presentation, we considered the effect of titanium contents on magnetic time-temperature relationship about basaltic boulders and found that the titanium content predicts younger age than Neel theory. Such consideration explains the results on basaltic boulders by Tyson-Smith and Verosub (1994) and Muxworthy et al. (2015). However, such consideration cannot explain the prediction of older age, such as coral boulders and low-titanium basaltic boulders by Borradaile (1996) and Sato et al. (2014). To overcome this problem, we conducted experimental verification by artificial partial thermal remanent magnetization as an analog VRM, and annealing. Our new experimental protocol provides us multiple unblocking temperatures of VRM from a sample, revealing the curvature of unblocking curves. These experiments also demonstrated the importance of defects on magnetic minerals for the age gap. To reduce the age gap, we need to select samples with magnetically simple property such as coral, and also to conduct an additional self-consistent experimental protocol with the theory of stretched exponential function (Sato et al. 2016).

Reference

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