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Experimental study on remanent magnetization acquisition mode of pumice fragments in Habushiura pyroclastic-flow deposit

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Paleomagnetic measurement of volcanic rock collected from a number of volcanic deposits has been used for estimation of the emplacement temperature and eruption style (Hoblitt and Kellogg, 1979; McClelland and Druitt, 1989). The remanent magnetizations of volcanic rocks erupted relatively new are the thermal remanet magnetization (TRM). However the acquisition mechanism of the TRM is difficult to understand in detail. In this study, we carried out experiments to reveal how juvenile fragments collected from Habushiura pyroclastic-flow deposit was acquired the TRM.
Habushiura pyroclastic-flow deposit was formed by phreatomagmatic eruption in the early stage of the A.D. 886 Mukaiyama eruption of Niijima, Japan. Juvenile fragment of this pyroclastic-flow deposit is biotite rhyolitic pumice. The partial thermal remanent magnetization (pTRM) with blocking temperature lower than 200 to 300 degree C orient close to Earth's magnetic field at the time of eruption after progressive thermal demagnetization of juvenile fragments in the deposit. Meanwhile pTRM with blocking temperature upper than 200 to 300 degree C shows no straight line and changes the direction of the magnetization during progressive thermal demagnetization. As the remanent magnetization with blocking temperature upper than 150 degree C is assumed primary magnetization because this deposit was formed relatively recently (eruption in A.D. 886). Also samples heated up to 700 degree C and cooled in the Earth's magnetic field in resting state are confirmed to have single magnetic component parallel to the Earth's magnetic field.
In the experiment, juvenile fragments cored into standard cylindrical specimen (diameter of 24 mm, height of 24 mm) for measuring magnetization are used. Specimens are heated up to 700 degree C using a furnace with a residual field of < 10 nT and cooled in the Earth's magnetic field (47,000 nT) at room temperature (25 degree C). For consideration of transportation and deposition mechanism of juvenile fragments in Habushiura pyroclastic flow, specimens are cooled in following motions: (A) axis (horizontal axis mounted east-west) rotation 180 degree after 75 second; (B) repeat axis (horizontal axis mounted east-west) rotation 180 degree in every 15 seconds; (C) repeat change in direction irregularly in every 15 seconds; and (D) move from side to side and up and down in the cardboard tube (diameter of 80 mm, height of 100 mm). All motions are continued until specimens are cooled to room temperature.
Compared with remanent magnetization intensities of juvenile fragments ($0.3\text{-}1.2*10^{-7}Am^2$), those of (A) and (B) are high (A; $1.1\text{-}2.8*10^{-7}Am^2$, B; $1.2\text{-}2.1*10^{-7}Am^2$) and those of (C) and (D) are approximate (C; $0.5\text{-}0.9*10^{-7}Am^2$, D; $0.1\text{-}0.7*10^{-7}Am^2$). Progressive thermal demagnetization shows that each specimen has remanence reflected each motion in cooling. Specimens (A) have a two-component remanence because they acquires high-temperature component (D=0.1, I=-20.2) before rotation and low-temperature component (D=37.3, I=29.7) after rotation. Specimens (B) have a one-component remanence (D=343.2, I=-3.3) because vertical components come out even and horizontal components are added continuously toward north. Specimens (C) and (D) show no straight line and change the direction of the magnetization during progressive thermal demagnetization because remanence is added irregularly. As remanences (C) and (D) have similar characteristics to those of juvenile fragments from Habushiura pyroclastic-flow deposit, it is

expected that juvenile fragments in Habushiura pyroclastic flow were changed in direction irregularly in cooling. Remanences of juvenile fragments change the direction more widely than those of (C) and (D), which indicates that juvenile fragments were moving more complex and violent than motion (C) and (D).