Rock-magnetic evidence for the low-temperature emplacement of the Habushiura pyroclastic density current, Niijima Island, Japan

Reina Nakaoka, Keiko Suzuki-Kamata

Kobe University, Japan

E-mail: renakaoka@gmail.com

The emplacement temperatures of juvenile and accidental fragments in the Habushiura PDC deposit were estimated by rock magnetic analysis to understand its eruption process. The Habushiura PDC was generated in a shallow-sea area during the early stage of the A.D. 886 eruption in Niijima Island, Japan. The Habushiura PDC deposit is exposed about 5 km and composed of about 20 beds. The beds show various characteristics and are divided into three lithofacies. Facies A is a massive lapilli tuff, Facies B shows grading and/or diffuse stratification, and Facies C is abundant in large pumice.

We collected 160 specimens from 11 beds divided into each of the lithofacies. Juvenile specimens have the high-temperature magnetic component whose directions are changed irregularly. In Facies A and C, some low-temperature components whose blocking temperatures are less than 300 ℃ show linearly stable magnetic components and are parallel to the Earth' s field. In this study, the magnetic components whose blocking temperatures are lower than 150 ℃ are not used for the estimation of the emplacement temperature due to the possibility of the replacement by viscous remanent magnetization. IRM acquisition test and thermal demagnetization of the composite IRMs confirm that the low-temperature components whose blocking temperatures are between 150 and 300 ℃ are partial thermal remanent magnetization acquired during cooling after deposition. Thus, juvenile specimens from Facies A and C are estimated to be emplaced at less than 300 ℃. Meanwhile, the beds of Facies B contain the juvenile specimens less than 150 ℃. Accidental specimens from all lithofacies show stable one- or two-component magnetization. The low-temperature components of two-component magnetization have blocking temperatures at less than 350 ℃ and are parallel to the Earth' s field. Two-component accidental specimens are estimated to be emplaced at less than 350 ℃ in any bed.

Morphological characters of ash components in the Habushiura PDC deposit indicate quench fragmentation of hot particles in direct contact with external water. Thus, juvenile specimens estimated to be emplaced at lower temperature than rhyolitic magma temperature indicate that effective cooling was occurred by interaction between high-temperature juvenile material and external water and ingestion of ambient atmosphere during transport. High-temperature emplacement up to 300 ℃ of juvenile specimen comprised in Facies A and C are thought to be due to small ratio of external water, relatively large size or short transport time. The emplacement temperatures of accidental fragments were up to 350 ℃, which is higher than juvenile fragments within the same bed, are considered to have been heated by magma around the conduit prior to explosions and cooled more slowly than juvenile fragments due to high thermal content.