Rock magnetic study of natural zircon crystals: Implication for paleointensity experiment

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Geomagnetic paleointensity data provide critical information such as thermal evolution of the Earth [1]. Also a state of geomagnetic field closely relates to a surface environment [2]. It is pivotal to know the variation of geomagnetic field intensity throughout the history of the Earth. Until now we have not yet obtained, however, enough data to resolve billion-year-scale geomagnetic field variation and need to obtain more paleointensity data [3].

In this study, a feasibility of paleointensity experiment using single zircon crystal is discussed. Since river sand originates in rocks widely distributed in river basin, detrital zircons in the sand have various ages [4]. Therefore if the geomagnetic paleointensity can be measured using the single zircon crystal, we will probably obtain paleomagnetic data enough to resolve the long-term geomagnetic field variation.

Zircon crystals used in the present study were sampled from sands of Nakagawa River, Tanzawa Mountain. The Nakagawa River flows along bodies of tonalite, which is a representative rock of the continental crust. Using assemblage of 26 zircon crystals, a suite of rock magnetic measurements are conducted: isothermal remanent magnetization (IRM) acquisition, stepwise alternating field demagnetization (AFD) of saturation IRM (SIRM), and low-temperature cycle using Magnetic Property Measurement System (MPMS).

Magnetic properties of the zircon crystals are as follows: (1) the crystals contain nearly pure magnetite (Fe_3O_4), and they are in both single-domain (SD) and multidomain (MD) states; (2) intensity of SIRM is about $1x10^{-3}$ Am^2/kg ($1x10^{-3}$ Am^2/kg x 1 mg = $1x10^{-9}$ Am^2); and (3) SIRM has high-coercivity fraction up to 20 mT.

The SD magnetite contained in the zircon crystals has the potential to record the paleomagnetic information. The existence of MD magnetite suggests that stepwise-demagnetization after low-temperature demagnetization (LTD) is considered to be an efficient approach for paleomagnetic measurement. Taking into account above results, LTD/stepwise-AFD measurements of TRM and SIRM for zircon crystals are conducted. On the basis of the rock magnetic studies and the TRM/SIRM measurements, in this talk, a paleointensity experiment based on normalization by SIRM after LTD treatment will be discussed.

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