丹沢複合深成岩体の道志ハンレイ岩中から分離した斜長石粒子の岩石磁気研究

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Rock-magnetic study on single plagioclase grains separated from the Doshi gabbro in the Tanzawa plutonic complex

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Data of the long-term variation of the geomagnetic field is essential for understanding the thermal evolution of the Earth. Plutonic rocks can be recording the time-averaged information of the geomagnetic field over their long cooling time, and therefore have potential for studying the long-term trend of the geomagnetic field evolution. So far, there have been a limited number of published paleointensity studies from plutonic rocks mainly because their main magnetic carriers are usually coarse-grained magnetic minerals. Such difficulty is considered to be avoided if silicate grains containing file-grained magnetic minerals are extracted from host plutonic rocks: recently, successful paleointensity data have been reported from silicate minerals such as feldspar, quartz, and zircon (e.g. Kato et al., 2018; Usui and Tian, 2017; Fu et al., 2017; Tarduno et al., 2007; 2010; 2014).

In this study, we performed a series of rock-magnetic measurements on single plagioclase grains separated from the Doshi gabbro, which has a potential to record the time-averaged paleointensity at about 5 million years ago. The Doshi gabbro unit is a part of the Tanzawa plutonic complex in the central Japan. Emplacement history and cooling history of the complex are well discussed in Tani et al. (2010) based on radiometric dating for an each plutonic body of the complex. The core and block samples were collected at central part of the Doshi gabbro unit.

We prepared 100 plagioclase grains of about 500 micrometer in diameter from a sample taken from the Doshi gabbro. We recognized tiny opaque minerals in the plagioclase grains by an optical microscope: the minerals are thought to be exsolved-magnetite phase. First, natural remanent magnetization (NRM) was measured on all the 100 grains, and NRM intensities except one grain was higher than $4*10^{-12}$ Am^2, and their average was $1.67*10^{-10}$ Am^2. We selected four grains and further conducted stepwise alternating field demagnetization experiments for NRM, anhysteretic remanent magnetization (ARM) and isothermal remanent magnetization (IRM). We could isolate characteristic components from high-coercivity intervals of NRMs in all the grains. The median destructive fields resulted in 55-75 mT, 50-60 mT, and 30-40 mT for NRM, ARM, and IRM, respectively.

About 10 plagioclase grains were aggregated for a low-temperature magnetometry. Temperature-variations of the zero-field cooling (ZFC) and the field cooling (FC) remanences exhibit clear decreases at 120 K with minor changes at ˜100 K. This implies that the magnetic carriers of the plagioclase grains are mainly Ti-poor titanomagnetite though some minor amounts of Ti-rich titanomagnetite are also contained. The FC remanence always outweighed the ZFC remanence for all temperature range.

In addition, anisotropies of ARMs were measured on selected 11 plagioclase grains. The obtained anisotropy parameters imply that the effect of anisotropy on paleointensity estimate would be similar to, or slightly smaller than that of plagioclase grains in the Iritono granite reported by Kato et al. (2018). According to Kato et al. (2018), results of about ten grains should be averaged to cancel out the anisotropy bias on paleointensity estimate.

Overall results suggest that the magnetization of the plagioclase minerals in the Doshi gabbro are mainly carried by an amount of single domain Ti-poor titanomagnetite, and could be suitable for paleointensity experiments. In addition to the rock-magnetic measurement, we are planning to conduct paleomagnetic and paleointensity experiments on the gabbro samples and its plagioclase crystals.