Comprehensive study of the relationship between exsolved magnetite inclusions and host plagioclase crystal in gabbroic rocks

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Natural plagioclase crystals sometimes contain fine-grained magnetite inclusions. The magnetite bearing plagioclase are often appeared in plutonic rocks and are also appeared in lava flows. Natural remanent magnetizations (NRM) carried by the magnetite bearing plagioclase should play an important role not only in the paleomagnetic records of whole rock and single plagioclase crystal but also in the source of magnetic anomaly. Therefore, to elucidate crystallization mechanism of magnetite in plagioclase crystal and to understand origin of its NRM is of prime importance in paleomagnetism and rock-magnetism, while the mechanism has been poorly understood yet. In this study, to precisely determine the chemical species of Fe in the plagioclase crystals and to better understand the crystallization mechanism of magnetite, magnetic measurements combined with microscopic observation and synchrotron radiation study were conducted for single grain plagioclase crystals.

Plagioclase crystals were prepared from natural mafic-plutonic rocks. A gabbroic anorthosite from the northwestern part of the Duluth complex, a layered gabbro from the southern part of the Oman ophiolite, and a medium-grained gabbro from the Murotomisaki gabbroic Intrusion were crushed into mineral grains. The plagioclase crystals were collected under a stereoscopic microscope and used for the measurements after a hydrochloric acid leaching. The main series of measurements for the single grain plagioclase crystals were as follows: (1) To estimate a content of magnetic mineral in the plagioclase crystals, magnetic hysteresis loop was measured using an Alternating Gradient Magnetometer. (2) To investigate chemical compositions of the plagioclase crystals, microscopic observation was conducted using electron microprobes. (3) To investigate the average valence state of Fe, L_{III}-edge X-ray absorption near edge structure (XANES) measurement was performed at BL27SU of SPring-8. In addition to these single crystal measurements, low-temperature remanence measurements (field cooling remanence, zero field cooling remanence, and room temperature saturation isothermal remanence) were conducted for plagioclase grains using a Magnetic Property Measurement System. On the basis of measurement results, we will discuss a relationship between the content of magnetite and the Fe state in plagioclase crystal.

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