Comprehensive study of the relationship between exsolved magnetite and host plagioclase: implication for crustal magnetizations

Masahiko Sato[1]; Masashi Ushioda[2]; Ryoichi Nakada[3]
[1] Dept. EPS, UTokyo; [2] IEVG, GSJ, AIST; [3] JAMSTEC

Natural plagioclase crystals sometimes contain fine-grained magnetite inclusions, which are considered to be originated from exsolution at subsolidus condition. The exsolution process can crystalize and hold nearly pure fine-grained magnetite in deep crustal rocks, and natural remanent magnetizations (NRM) carried by the magnetite bearing plagioclase should play an important role 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 Sumail massif of the Oman ophiolite, two layered gabbro from the Haylayn Block 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 the average valence state of Fe, L_{III}-edge X-ray absorption near edge structure (XANES) measurement was performed at synchrotron radiation facilities. (3) To investigate chemical compositions of the plagioclase crystals, microscopic observation was conducted using electron microprobes. 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 and will evaluate the contribution to crustal magnetizations.