Preliminary estimations of the exsolved magnetite content in crustal rock and its contribution to the crustal magnetization

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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. The plagioclase crystals were prepared from natural mafic-plutonic rocks. 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. The plagioclase crystals used in this study showed the Fe valence state of 2.5–2.9, and it was confirmed that there was inverse relationship between the magnetite content and average valence states of Fe. Combining the empirically obtained relationship with calculations of the plagioclase crystallization from the melt and the Fe partitioning between plagioclase and melts, we will discuss the content of the exsolved magnetite in crustal rock and its contribution to the crustal magnetization.