Geophysical Research Abstracts
Vol. 17, EGU2015-8712, 2015
EGU General Assembly 2015

Magnetic anisotropy and magnetite textures from experimental shear deformation

Jessica Till (1) and Bruce Moskowitz (2)

(1) GeoForschungsZentrum (GFZ Potsdam), Germany (till@gfz-potsdam.de), (2) Institute for Rock Magnetism, University of Minnesota, Minneapolis, MN, USA (bmosk@umn.edu)

Magnetite is a common accessory mineral in crustal rocks and exerts a dominant influence on the magnetic anisotropy of rocks when present. Therefore the deformation behavior of magnetite strongly determines how magnetic fabric develops with increasing strain in a deforming rock. Here we show results from experimental deformation of magnetite-silicate aggregates in high-temperature transpressional shear experiments (1000-1200°C) under moderate shear stresses (10-130 MPa) using a gas-medium deformation apparatus. Anisotropy of magnetic susceptibility, shape preferred orientation (SPO) of magnetite, and electron backscatter diffraction (EBSD) were each used to characterize the magnetite deformation fabrics and intragrain microstructures. Magnetic anisotropy and SPO each increase strongly with increasing strain, which ranged between 100-300%. An interesting feature of the deformation fabrics is that both magnetite SPO and magnetic fabric intensity are stronger at higher temperatures, indicating that strain partitioning between magnetite and the plagioclase matrix decreases at higher temperatures. Although flow laws for magnetite predict it to be weaker than dry plagioclase at the experimental conditions, the temperature-dependence of the fabric strength indicates that magnetite is more viscous than the "wet" plagioclase used in the experiments. In contrast to the magnetic and shape fabrics, crystallographic preferred orientation (CPO) of magnetite is very weak in all deformed samples. In EBSD orientation mapping of individual particles, incipient subgrain boundary formation is evident in magnetite grains, indicating that dislocation creep processes were active in magnetite despite the lack of a well-developed CPO. The weak magnetite CPOs are primarily attributed to multiple slip systems acting in parallel. These findings support the observations of previous studies that crystallographic textures in cubic minerals such as magnetite may be inherently weak or slow to develop and that CPO alone is not always a reliable indicator of deformation mechanisms.