nm-scale composition determination, quantitative EBSD measurements: implications of interfaces for bulk rock properties

KATHARINA MARQUARDT*[1], MARC DE GRAEF[2], JOANA POLEDNIA[1], FILIPPE FERREIRA[1], ULRICH FAUL[3], SARANSH SING[2], RALF DOHMEN[4]

[1]Bayerisches Geoinstitut, Universität Bayreuth, Bayreuth, Deutschland, (*correspondence: katharina.marqurdt@uni-bayreuth.de), joana.polednia@uni-bayreuth.de, filippe.ferreira@uni-bayreuth.de

[2] Materials Science and Engineering Department, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213-3890, USA, degraef@cmu.edu, ssaransh@andrew.cmu.edu

[3]Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139-4307, USA, hufaul@mit.edu

[4]Ruhr-University, 44801 Bochum, Germany, ralf.dohmen@rub.de

Improving our understanding of the relation between nm- to µm-scale phenomena and large scale geophysical observations requires careful laboratory experiments with comprehensive and quantitative description of the sample characteristics. Laboratory data are often obtained from samples with small grain sizes, where interfacial properties are strongly expressed and thus the scaling of these properties to relevant grain sizes must be quantitatively understood.

Here we present a quantitative study of nm- to µm-scale interfacial properties of olivine dominated rocks obtained through improved electron backscatter diffraction (EBSD) data. EBSD pattern indexing is enhanced by extending the previously proposed dictionary indexing (DI) approach[1] to multiphase geologic materials. The EBSD data are used to determine the grain boundary plane distribution and combined with energy dispersive X-ray spectroscopy (EDS) data measured in a transmission electron microscope (TEM).

The olivine grain boundary planes show a preference for low index planes, the principal crystallographic planes have the lowest energies resulting in crystal habits dominated by (001) planes, followed by (010) and (100) planes. However, the interfacial area distribution and thus the average crystal habit changes with different grain boundary compositions. We discuss the complex interaction of grain boundary compositon, grain boundary energy and grain boundary diffusivities.

[1] Chen, Park, Wei, Newstadt, Jackson, Simmons, De Graef, & Hero (2015) *Microsc. Microanal.* 21**,** 739–752.