Geophysical Research Abstracts
Vol. 20, EGU2018-7789, 2018
EGU General Assembly 2018

Deformation of high-pressure metamorphic rocks: mutual constraints from 2D cm-scale thermo-mechanical models and petrological observations

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How rocks deform at depth during lithospheric convergence and what are the magnitude of stress levels they experience during burial/exhumation processes constitute fundamental questions for refining our vision of short-term (i.e. seismicity) and long-term tectonic processes in the Earth's lithosphere.
We here present a set of 2D numerical experiments of eclogitic rock deformation performed at cm-scale. The deformed medium is composed of two mineral phases: omphacite and garnet. We carried out a series of experiments for different background strain-rates and for a range of realistic pressure and temperature conditions. Results show that fracturing of the entire eclogite rock can occur under HP-LT conditions for strain-rates even smaller than those generally expected for seismic events. We also explore the ranges of parameters where garnet and omphacite are deforming with a different deformation style (i.e. frictional vs. viscous) and discuss our modelling results at the light of naturally deformed eclogitic samples. Finally, we show that in cases of fracturing, the first event of frictional strain localisation constitutes a precursor for ductile strain localisation and results from the conversion of the mechanical energy into heat (i.e. shear-heating).