Geophysical Research Abstracts
Vol. 17, EGU2015-11803, 2015
EGU General Assembly 2015


# Mantle strain localisation induced by grain size reduction due to chemical unbalance between olivine and clinopyroxene

Jacques PRÉCIGOUT (1), Holger STÜNITZ (2), and Nicole LE BRETON (1)

(1) Institut des Sciences de la Terre d'Orléans (ISTO), UMR/CNRS 7327, Orléans, France (jacques.precigout@univ-orleans.fr), (2) Department of Geology, University of Tromso, Tromso, Norway

Mantle strain localisation plays a key role for the lithosphere dynamics. Though, its origin in the viscous regime remains unknown. Based on experimental data, we show that chemical unbalance between clinopyroxene (Cpx) and olivine (Ol) can trigger viscous strain localisation in the conditions of the lithospheric mantle. Using a solid-medium Griggs-type apparatus, we performed direct shear deformation at 900°C, 1.2 GPa and 2.10-5 s-1, on mineral aggregates composed of 70% Ol (Fo91) and 30% Cpx (diopside). During deformation, the strain-stress curve is characterised by a peak of differential stress around 900 MPa, followed by a weakening of several hundred of MPa until a plateau is reached. This weakening correlates with intense strain localisation within the sample where grain size has been strongly reduced, particularly within fine-grained layers of two-phase material. The grain size in these layers is far below one micron. Microprobe analyses indicate that Ol and Cpx compose these layers, as well, but their composition differs from the starting material, and especially for Cpx. Indeed, while starting Cpx have XMg (Mg/(Mg+Fe)) between 0.970 and 0.982, the XMg of deformed CPx ranges from 0.925 to 0.970. Furthermore, the XMg in Cpx systematically decreases as strain increases. We then performed PerpleX calculations that give the theoretical compositions for Ol and Cpx considering our bulk composition at 900°C and 1.2 GPa. Our results show that the compositions of starting Cpx have significantly shifted towards the theoretical equilibrium during deformation, highlighting a chemical unbalance between Ol and Cpx at the onset of deformation. We attribute the nucleation of new Ol and Cpx to this chemical unbalance, which probably promoted strain to localise as a result of grain size reduction and coeval change of deformation mechanism from dislocation creep to diffusion creep.