Geophysical Research Abstracts
Vol. 18, EGU2016-13587, 2016
EGU General Assembly 2016

Metamorphic reactions, grain size reduction and deformation of mafic lower crustal rocks

Giulia Degli Alessandrini (1), Luca Menegon (1), Marco Beltrando (2), Arjan Dijkstra (1), and Mark Anderson (1)

(1) Plymouth University, School of Geography, Earth and Environmental Sciences, Plymouth, United Kingdom (giulia.deglialessandrini@plymouth.ac.uk), (2) Dipartimento di Scienze della Terra, Università di Torino, Via Valperga Caluso 35, 10125 Torino, Italy

This study investigates grain-scale deformation mechanisms associated with strain localization in the mafic continental lower crust, with particular focus on the role of syn-kinematic metamorphic reactions and their product – symplectites – in promoting grain size reduction and phase mixing. The investigated shear zone is hosted in the Finero mafic-ultramafic complex in the Italian Southern Alps. Shearing occurred at $T \geq 650°$ C and $P \geq$ 0.4-0.6 GPa. The shear zone reworks both mafic and ultramafic lithologies and displays anastomosing patterns of (ultra)mylonitic high strain zones wrapping less foliated, weakly deformed low strain domains.

Field and microstructural observations indicate that different compositional layers of the shear zone responded differently to deformation, resulting in strain partitioning. Four distinct microstructural domains have been identified: (1) an ultramylonitic domain characterized by an amph + pl matrix (grain size < 30μm) with large amphibole porphyroclasts (grain size between 200μm and 5000μm) and rare garnets; (2) a domain rich in garnet porphyroclasts embedded in a matrix of monomineralic plagioclase displaying a core and mantle structure (average grain size 45μm) (3) a metagabbroic domain with porphyroclasts of clinopyroxene, orthopyroxene and garnets (200μm average grain size) wrapped by monomineralic ribbons of recrystallized plagioclase and (4) a garnet-free ultramylonitic domain composed of an intermixed amph + cpx + opx + pl matrix (6μm average grain size). In these domains, each porphyroclastic mineral responds differently to deformation: amphibole readily breaks down to symplectitic intergrowths of amph + pl or opx + pl. Garnet undergoes fracturing (in domain 2) or reacts to give symplectites of pl + opx (in domain 3). Plagioclase dynamically recrystallizes in mono-phase aggregates, whereas clinopyroxene undergoes fracturing and orthopyroxene undergoes plastic deformation. The behaviour of the different phases and their relative abundance in the layers are believed to influence the deformation of the layers themselves. In symplectite-rich layers (domains 1, 4) deformation is localised, grain-size is below 30μm and phases are well mixed. On the other hand, in pyroxene or plagioclase-rich layers, deformation is less localised, the phases are less mixed and the grain size is larger (domain 2, 3).

These preliminary results suggest that syn-kinematic metamorphic reactions forming symplectites played an essential role in grain size reduction, phase mixing and strain localization. We speculate that the compositional domains with symplectites localized deformation more efficiently, by activation of grain size sensitive creep, most likely because those domains were originally more hydrated than the others. On the contrary, domains without symplectites accommodated deformation less efficiently, either through fracturing (clinopyroxene, garnet) or dislocation creep + recrystallization (orthopyroxene, plagioclase).