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Eclogitization of the oceanic lithosphere by hydration of brittle structures

MARCO SCAMBELLURI[1], GIORGIO PENNACCHIONI[2] AND ENRICO CANNAÒ[3]

[1]University of Genova
[2]University of Padova
[3]Università degli Studi di Milano

Presenting Author: marco.scambelluri@unige.it

Metamorphism causes major changes in the mineralogy and rheology of the Earth's lithosphere, provided that mineral reactions are triggered by fluid access. In absence of coupled deformation and fluid flow, the unaltered lithosphere remains long time stiff and metastable, thus sustaining large differential stresses. This is relevant to subduction of the oceanic lithosphere, where fluid presence *vs* absence affects seismicity and rock eclogitization. Hydration of oceanic plates mostly occurs in oceans, with formation of top-slab reactive rock volumes prone to deformation and accretion to the subduction interface. In such domains, pressurized fluids cause full rock eclogitization and seismic rock embrittlement. Differently, the behavior of the unaltered lithosphere from the inner slab is much less known, although these domains also host earthquakes and their eclogitization can drive the slab pull. Aim of this contribution is showing the role of brittle structures in driving fluid influx and eclogitization of unaltered domains of fossil oceanic lithosphere.

The ophiolitic gabbro-peridotite of the Lanzo Massif (W. Alps) largely escaped Alpine subduction metamorphic recrystallization due to poor oceanic hydration. This made these rocks dry, stiff asperities in the subduction complex, which locally developed pseudotachylyte-bearing faults at intermediate-depth depths and widespread meso- to micro-faulting. In the field, thin, flat-lying metric faults cause centimetre-scale offset of gabbro dykes: such faults contain a (sub)micrometric-sized "annealed" fault gauge of fresh olivine and pyroxene only locally overgrown by secondary chlorite. Cataclastic plagioclase is progressively altered into high-pressure zoisite+paragonite±garnet up to become the most intensively eclogitized mineral domain in the studied samples. The fault planes thus developed at dry conditions in the olivine stability field; localized access of externally derived fluids promoted fault hydration, massive plagioclase replacement by high-pressure assemblages and trace element influx/redistribution. This implies that subduction zone eclogitization is promoted by fluid access along pervasive fault discontinuities and reactive minerals. We discuss the deformation features of the Lanzo rocks in the frame of the rheology and seismicity of a subducting oceanic plate. They could be associated to minor slip events in domains of the Lanzo lithosphere close to areas of faulting and pseudotachylite formation during major regular earthquakes.