Eclogitization of the oceanic lithosphere by hydration of brittle structures

Scambelluri M.*[1], Pennacchioni G.[2] & Cannaò E.[3]

[1] Dipartimento di Scienze della Terra, dell'Ambiente e della Vita, Università di Genova. [2] Dipartimento di Geoscienze, Università di Padova. [3] Dipartimento di Scienze della Terra "A. Desio", Università di Milano.

Corresponding author e-mail: marco.scambelluri@unige.it

Keywords: oceanic lithosphere, subduction, faulting, hydration, eclogitization.

Metamorphism is the driving force to major changes in the mineralogy and rheology of the Earth's lithosphere, provided that mineral reaction and growth are triggered by fluid access. In absence of coupled deformation and fluid flow, the unaltered lithosphere forms long-lived stiff metastable blocks able to sustain significant differential stresses. This is relevant for subduction of the oceanic lithosphere, where presence *vs* absence of fluids affects seismicity and rock eclogitization. Hydration of the oceanic lithosphere mostly occurs in oceanic settings with formation of top-slab reactive rock volumes prone to deformation and accretion to the subduction interface. In such domains, flux of pressurized fluids causes events of seismic failure by dehydration embrittlement. Much less known is the evolution of the unaltered lithosphere from inner slab domains, too deep to be tectonically exhumed to the Earth's surface. These domains also host earthquakes.

Here we describe peridotite and gabbro from the ophiolitic Lanzo Massif (W. Alps) that largely escaped Alpine subduction metamorphism due to poor pre-subduction oceanic hydration. This made these dry rocks stiff asperities in the subduction complex, which locally developed pseudotachylyte-bearing faults at intermediate-depth depths. Overall, subduction to eclogite-facies conditions led to widespread development of meso- (meter-scale) to micro-faults. Aim of this contribution is showing the role of such seismic brittle structures in driving fluid influx and eclogitization of peridotite and gabbro in unaltered domains of this fossil oceanic plate. In the field, thin, flat-lying metric faults cause centimetre-scale offset of gabbro dykes. From micro to nano-scale, faults contain a (sub)micrometric-sized "annealed" fault gauge of fresh olivine (only locally overgrown by secondary chlorite) and orthopyroxene. Cataclastic plagioclase is progressively altered into high-pressure zoisite + paragonite ± garnet.

This indicates formation of the fault planes in the olivine stability filed and concomitant, localised access of externally derived fluids that promoted hydration of the gouge assemblages. This implies that subduction zone eclogitization is driven by faulting followed by fluid access. 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.