University of Genova

Department of Earth, Environmental and Life Sciences

Università degli Studi di Genova

STAT

Dottorato in Scienze e Tecnologie per l'Ambiente e il Territorio

Doctorate Course in Earth and Environmental Science and Technology

Earth Science Curriculum

Research Theme n. 4

Titolo: Eclogitizzazione della litosfera oceanica subdotta mediante l'idratazione di strutture fragili
Title: Eclogitization of the oceanic lithosphere by hydration of brittle structures

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Program description including the formation program abroad

Metamorphism drives to major changes in the mineralogy and rheology of the Earth's lithosphere, provided that reactions 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 large differential stresses. This is relevant to subduction of the oceanic lithosphere, where presence vs absence of fluids affects seismicity and rock eclogitization.

Hydration of oceanic plates 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, pressurized fluids bring to the brittle failure of rocks. Much less known is the evolution of the unaltered lithosphere from inner slab domains, which also host earthquakes likely caused by the build-up of high differential stresses. The petrologic-geochemical conditions during seismic failure of such unaltered rock domains are still poorly known, although their recognition is crucial for understanding how plate motion is accommodated at major plate boundaries and how metamorphism affects the rocks' rheology at depth. The Alps are an ideal playground to investigate such features, as they contain dry rocks that experienced deep subduction earthquakes.

This this project investigates ophiolitic peridotite and gabbro (Lanzo Massif, W. Alps) hosting brittle structures and seismic pseudotachylyte faults developed at high-pressure conditions due to seismicity at intermediate subduction depths. The aim is showing the role of such structures in driving fluid influx and eclogitization of unaltered domains of this fossil oceanic slab. The Ph.D candidate will study selected examples of extensive network of faults and fractures formed under high-pressure conditions, as potential earthquake records. Field work aimed at recognizing the main brittle structures will be closely coupled with high-resolution microstructural imaging and with petrological-geochemical analyses to constrain the ambient conditions of brittle brock deformation.

Financial support: PRIN/MUR funds available

Tutor's publications (max 3)

Scambelluri M., Pennacchioni G., Gilio M., Bestmann M., Plümper O., Nestola F. 2017. Fossil intermediate-depth earthquakes in subducting slabs linked to differential stress release. Nature Geoscience 10, 960–966.155 (2), p. 335-355, ISSN: 0016-7568, doi: 10.1017/S0016756816001163

Pennacchioni G., **Scambelluri** M., Bestmann M., Notini L., Nimis P., Plümper O., Faccenda M., Nestola F. 2020 Record of intermediate-depth subduction seismicity in a dry slab from an exhumed ophiolite. . Earth and Planetary Science Letters 548, art. N. 116490.

Toffol G., Yang J., Pennacchioni G., Faccenda M., **Scambelluri** M. 2022. How to quake a subducting dry slab at intermediate depths: Inferences from numerical modelling. Earth and Planetary Science Letters 578, art n. 117289