RESEARCH FIELD:
Geology, metamorphic petrology, geodynamics, metallogenesis

RESEARCH TOPIC:
Petrogenetic and metallogenic processes at convergent plate boundaries

PARTICIPANTS:
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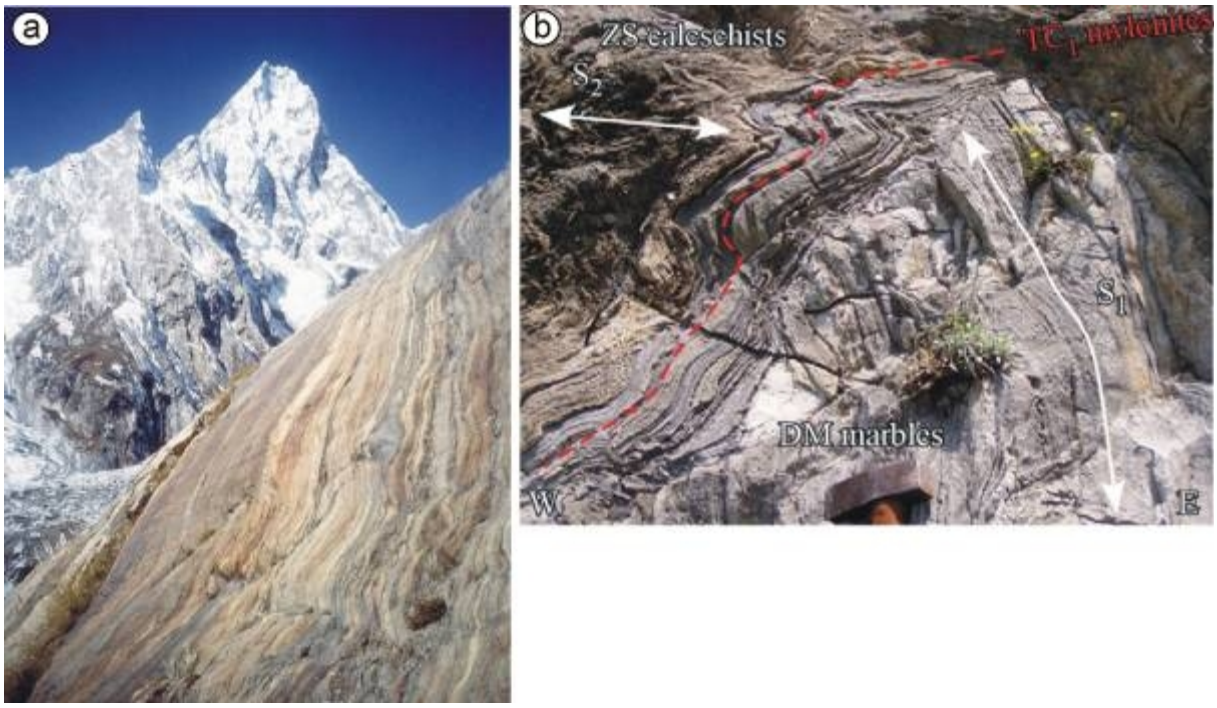
RESEARCH DESCRIPTION:
The research activity of the "*metamorphic petrology*" group focuses on the study and reconstruction of the petrogenetic processes occurring at convergent plate boundaries, especially those involving *collisional orogens* such as the Alpine-Himalayan belt. The main objective of the research is the reconstruction of the *metamorphic evolution* (Pressure-Temperature-time paths and *fluid-rock interactions*) experienced by both crust and mantle units during subduction at depth and the following exhumation and continental collision. Another goal is the reconstruction of the *metallogenic evolution* of the collisional orogens.
The group focuses his attention on the *Alpine-Himalayan orogen* (Western Alps; Himalaya; Karakorum), but is also involved also in the study of other collisional orogens older than the Alps-Himalaya (e.g. the Dabie Shan - Sulu belt in eastern China; the south-European Variscan chain in Sardinia and in the western Alps; the Caledonian Greenland chain).
Fieldwork and petrographic analyses are followed by other laboratory analyses (e.g. geochemistry; microtermometric and micro-Raman analyses on fluid inclusions and on mineral phases), and by thermobarometry, phase petrology and thermodynamic modelling.
The research implications include several topics of fundamental scientific relevance, such as:
(a) a better understanding of the tectono-metamorphic processes in collisional contexts, with consequences for the comprehension of the geodynamic evolution of actual and recent orogens;
(b) a better understanding of the effects of major orogenic events on atmospheric circulation and climate change at global scale;
(c) the recognition of the main factors controlling the formation and distribution of ore deposits;
(d) the possible valorization of geologic sites of particular interest ("geosites") from both a scientific and cultural point of view.

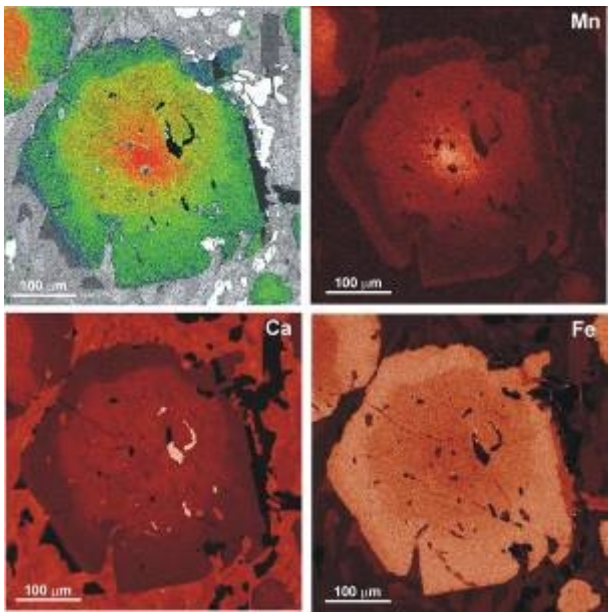
LABORATORIES OF THE DST IN USE:
SEM-EDS, micro-Raman, micro-XRF, ICP, thin sections

RESEARCH PRODUCTS:

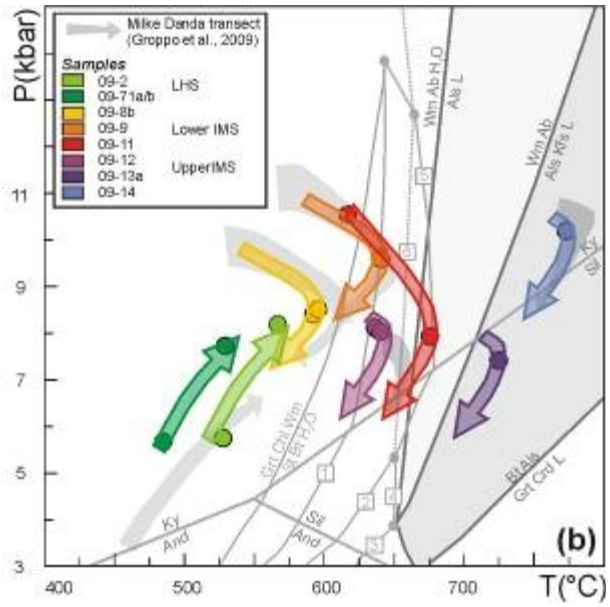
- Ferrando S. (2012). Mg-metasomatism of metagranitoids from the Alps: genesis and possible tectonic scenarios. *Terra Nova*, 24, 423-436.
- Ferrando S., Frezzotti M.L., Orione P., Conte R.C. & Compagnoni R. (2010). Late-Alpine rodingitization in the Bellecombe meta-ophiolites (Aosta Valley, Italian Western Alps): evidence from mineral assemblages and serpentinization-derived H_2-bearing brine. *International Geology Review* 52, 1220-1243
- Frezzotti M.L., Ferrando S., Tecce F. & Castelli D. (2012). Water content and nature of solutes in shallow-mantle fluids from fluid inclusions. *Earth and Planetary Science Letters* 351-352, 70-83.
- Gasco I., Gattiglio M. & Borghi A. (2011). New insight on the lithostratigraphic setting and on tectono-metamorphic evolution of the Dora Maira vs Piedmont Zone boundary (middle Susa Valley). *International Journal of Earth Sciences* 100, 1065-1085.
- Gasco I., Gattiglio M., Borghi A. (2013). Structural and metamorphic evolution across the Internal Crystalline Massifs vs Piedmont Zone boundary (Western Alps). *Journal of Geodynamics* 63, 1-19.
- Groppo C. & Castelli D. (2010). Prograde P-T evolution of a lawsonite eclogite from the Monviso meta-ophiolite (Western Alps): dehydration and redox reactions during subduction of oceanic FeTi-oxide gabbro. *Journal of Petrology* 51, 2489-2514.
- Groppo C., Rolfo F. & Indares A. (2012). Partial melting in the Higher Himalayan Crystallines of Eastern Nepal: the effect of decompression and implications for the “channel flow” model. *Journal of Petrology* 53, 1057-1088.
- Groppo C., Rolfo F. & Mosca P. (2013). The cordierite-bearing anatectic rocks of the Higher Himalayan Crystallines (eastern Nepal): low-pressure anatexis, melt-productivity, melt loss and the preservation of cordierite. *Journal of Metamorphic Geology* 31, 187-204.
- Proyer A., Rolfo F., Zhu Y.F., Castelli D. & Compagnoni R. (2013). Ultrahigh-pressure metamorphism in the magnesite + aragonite stability field: evidence from two impure marbles from the Dabie-Sulu UHPM belt. *Journal of Metamorphic Geology* 31, 35-48.
- Rossetti P., Gatta G.D., Diella V., Carbonin S., Della Giusta A. & Ferrario A. (2009). The magnetite ore districts of the southern Aosta Valley (Western Alps, Italy): a mineralogical study of metasomatized chromite ore. *Mineralogical Magazine* 73, 737- 751.



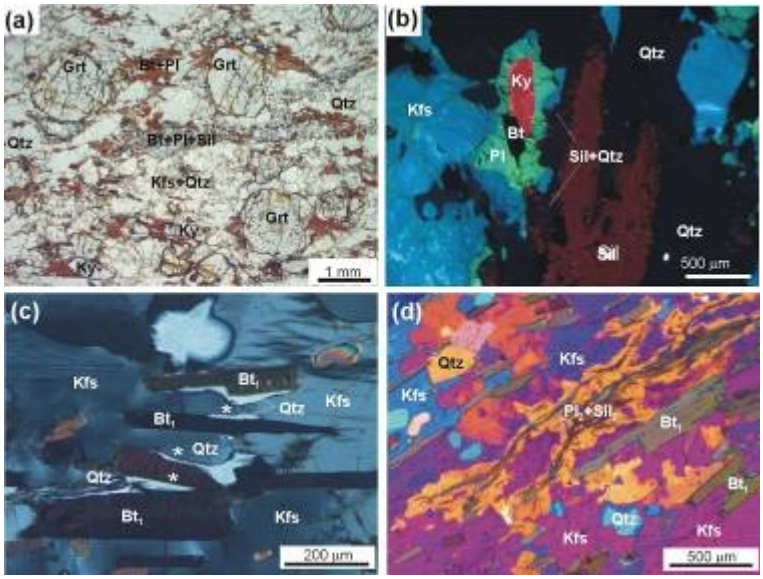
(a) The High Himalayan Cristallynes at the northeastern tip of Nanga Parbat-Haramosh Massif at Tisikar, northern side of upper Kutiah glacier. Blastomylonitic kyanite - garnet - bearing gneiss hosts kyanite - bearing leucosomes and metabasic dykes, here concordant with the metamorphic foliation. Peak in the background is the Korang Kar (6070 m). View looking west. *Rolfo F. (1998) PhD thesis, University of Torino, 157 pp.* (b) Oceanic crust rocks (Piedmont Zone calcschists) overlapping continental crust rocks (Dora Maira marbles) in the Susa Valley (western Alps). The tectonic contact between the two eclogitic units, defined by mylonitic foliation, cuts off the eclogitic foliation (S_1) in the continental crust. Subsequently, the mylonitic foliation is deformed by folds (axial surface defined as S_2) developing under upper greenschist to amphibolite facies conditions. *Gasco et al. (2013): J. Geodynamics 6, 1– 19*



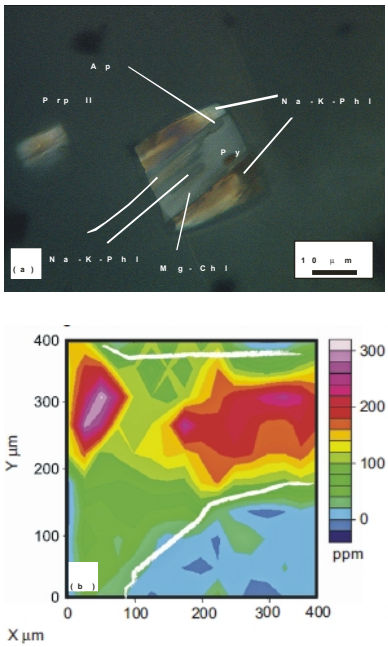
Major elements (Mn, Ca and Fe) X-ray maps of a zoned garnet crystal from an eclogite of the Monviso meta-ophiolitic massif. Colours in (a) have been obtained combining the Mn, Ca and Fe X-ray maps. In (b, c, d), brighter colours (from black to red and yellow) imply higher concentrations. *Borfecchia et al. (2012): J. Anal. Atomic Spectr. 27, 1725-1733*



P-T paths calculated for Himalayan samples (eastern Nepal) occurring from different structural levels within the Main Central Thrust Zone. *Mosca, Groppo, Rolfo (2012): J. Virtual Explorer 41, paper 2*



Microstructures of anatectic rocks from the Himalayas at the optical microscope. (a) Plane-polarized light. (b) Catodoluminescence image. (c) Crossed Polarized Light. (d) Crossed Polarized Light with first-order red plate. *Groppo et al. (2012): J. Petrology 53, 1057-1088; Groppo, Rolfo, Mosca (2013): J. Metam. Geol. 31, 187-204*



Study of ultrahigh pressure fluids in whiteschists from southern Dora-Maira Massif (western Alps). (a) Photomicrograph (Crossed Polarized Light) of preserved multiphase solid inclusions within garnet. (b) Synchrotron FT-IR absorbance map showing an increase in water content in the garnet surrounding multiphase solid inclusions. *Ferrando et al. (2009): J. Metam. Geol., 27, 739-756. Frezzotti et al. (2012): Earth Planet. Sci. Lett., 351-352, 70-83.*

GROUP CONTACT: Chiara Groppo