

PHD (XXX cycle) research projects proposed by G. Pennacchioni

- 1) Exhumed deformed granitoids: a proxy for deformation processes and rheology at depth in the continental crust

Simplified rheological models of the continental crust consider the experimental flow laws of quartz, as main mineral component of granitoids, to be representative of the mechanical behaviour at depth of the crust, in the ductile field. More realistic models must consider polymineralic rocks. We propose to use deformed granitoids exhumed from different structural levels up to the surface to investigate deformation mechanisms that were active at depth. Granitoids: (i) are relatively common worldwide; (ii) have a rather simple mineral composition including most of the rock forming mineral of the crust (quartz, feldspar and mica); (iii) have an isotropic structure. We will study both granitoid plutons emplaced at different depths that developed ductile structures during cooling at the host rock conditions, and metagranitoids (i.e., granitoids which were involved in metamorphism at different P-T conditions). Though granitoids have a simple mineralogy they contain compositional heterogeneities (e.g. dykes) with different mixtures of the mineral components and different grain size.

This study will involve field work and lab characterization of deformed rock samples with integrated methodologies (SEM, EBSD, CL, OC, EMPA, TEM, SIMS, image analysis). The study will aim at:

- a) Establishing the relative rheological behaviour of different compounds of quartz, feldspar and mica at different ranges of P-T conditions
- b) Determining the microstructural processes responsible for the different macroscopic deformation behaviours
- c) Understanding, in (meta-) granitoids (which are relatively simple and isotropic) the mechanisms of nucleation of ductile shear zone and the associated processes of strain localization vs progressive shear zone thickening.
- d) Evaluating the interplay, at the different scale, between crystal plastic processes and fracturing

These results will provide a new information to build new more realistic models of the rheology of the continental crust

- 2) The Tertiary pegmatite of the Central Alps

The largest field of Alpine pegmatite dikes is in the central Alps within the Southern Steep Belt (SSB) of the Alpine nappes and extends for about 100 km in an E-W direction and 15 km in a N-S direction north of the Periadriatic Fault, from the Bergell pluton (to the east) to the Ossola valley (to the west). Though the regional extension of the pegmatite field of the Central Alps has been outlined (Wenk, 1970; Burri et al., 2005), and there are many studies dealing with specific and local aspects of these pegmatites, an attempt to integrate the geochemistry, mineralogy, and field textural and structural features of pegmatites over a regional scale is still missing.

There are many advantages of studying pegmatites in the Central Alps:

- (i) pegmatite emplacement can be dated (e.g. U-Pb and Th-Pb on zircon, monazite and xenotime) and their relationships with the deformation structures of the Alpine nappe pile can place constraints on the tectonic and geological history of the this Alpine domain;
- (ii) on the other way, the relatively well-known geological setting of the Alpine chain can help in placing constraints on the environmental conditions of pegmatites which is often

a major unknown for pegmatites and for pegmatologists. The extension of the pegmatite field to cover a large area which encompasses different tectonic and magmatic units, (exposed over sections of thousands meters) will allow the influence of the host rock and level of structural emplacement on the mineral and textural characters of the pegmatite dykes to be investigated.

This study will involve field work and lab characterization of deformed rock samples with integrated methodologies (SEM, EBSD, CL, OC, EMPA, TEM, SIMS, image analysis). Dating of pegmatites with different radiometric methods (especially U-Pb and Th-Pb on monazite) will be an additional major focus of the study.