Geophysical Research Abstracts
Vol. 18, EGU2016-14371, 2016
EGU General Assembly 2016

Metasomatism-controlled nucleation and development of paired-shear zone: an example from the Neves area (Eastern Alps, Italy)

Gaétan Link (1), Philippe Goncalves (1), Pierre Lanari (2), and Emilien Oliot (3)

(1) Laboratoire Chrono-environnement, Université de Franche-Comté, Besançon, France (gaetan.link@edu.univ-fcomte.fr), (2) Institut für Geology, Bern Universität, Bern, Switzerland, (3) Géosciences Montpellier, Université de Montpellier, Montpellier, France

Ductile shear zones reflects the process of strain localization in the middle and the lower crust. Several studies have shown that shear zones are characterized by significant syn-kinematic changes in mineralogy and chemical composition linked to fluid circulation, little attention has been paid to the role of chemical processes on strain localization comparison to mechanical processes.
In the Neves area (Tauern window, Eastern Alps, Italy), a Variscan granodiorite is affected by an Alpine deformation, under amphibolite facies conditions. This deformation is characterized by the nucleation of single shear zones on inherited brittle structures, and paired-shear zones flanking a bleached zone developed to either side of the fractures and aplitic dykes (Mancktelow and Pennacchioni 2005). In this contribution, we focus our attention on the paired-shear zones developed on metasomatic halos surrounding fractures, which can give insights into interactions between fluid transfer, metasomatism, mineral reactions and deformation.

In the undeformated granodiorite, the mineralogical assemblage consists of quartz, K-felspar, saussuritized plagioclase and biotite. The metasomatic bleached zone consists of a mineralogical assemblage of quartz and feldspar (mainly albite). The central fracture is filled with epidote. The shear zone that nucleated on the wall of the bleached zone is characterized by the crystallization of new metamorphic phases at the expense of primary magmatic and secondary metasomatic phases: garnet on former plagioclase site, phengite in the foliation, epidote and Fe and Ti-oxydes. The P-T conditions of the ductile deformation stage, associated with metasomatism, are estimated at 520°C – 0,55 Gpa, based on growth chemical zonation of garnets. Garnet shows distinct morphology depending on its textural setting: euhedral garnet is characterized by a growth chemical zonation with an enriched-Mn core and an enriched-Fe rim, in the deformed metagranodiorite; atoll garnet, only presents in the bleached zone, is made of a Mn-rich core and a Ca-rich rim. The core of atoll garnets were formed during the bleaching event, then they have been partially resorbed during the development of the paired-shear zone that is coeval with a new metasomatic event. This latter forms the rim of atoll garnets, which are similar in compositions with euhedral garnets. The center of the shear zone, located at the interface between the granodiorite and the bleached zone, shows evidences of late brittle reactivation, with breakdown of biotite into chlorite, the cataclasis of garnet with crystallization of K-feldspar (or adularia) and epidote in the cracks, and crystallization of a large amount of Fe and Ti-oxydes. The temperature conditions of this reactivation – maybe linked to a seismic event – are estimated at $\sim$225°C.

Our results demonstrate that early fluid-rock interaction is responsible for the formation of a bleached zone and the development of viscosity contrasts, within an initially isotropic rock, sufficient to localize deformation. Furthermore, the transient brittle deformation is also associated with fluid and chemical mass transfer. This contribution shows that both ductile and brittle deformations are associated with fluid-rock interactions. Thus, understanding strain localization processes requires to take into consideration not only mechanical processes, like active deformation mechanisms, but also fluid-assisted chemical processes.