Geophysical Research Abstracts
Vol. 17, EGU2015-15381-1, 2015
EGU General Assembly 2015

Episyenites within the Tauern Window metagranitoids: unpredictable?

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The core of the Tauern tectonic window (Eastern Alps) consists of dominant pre-Alpine granitoids (∼295 Ma) that were metamorphosed and deformed during the Alpine orogenesis (at ∼30 Ma). Ductile deformation at peak conditions (550-600 ˚C and 0.5-0.7 GPa) was followed by cataclastic faulting (Pennacchioni and Mancktelow, 2007). Both deformation phases occurred in a fluid-rich environment with formation of veins filled with quartz-calcite-biotite-feldspar and quartz-chlorite-epidote-adularia-calcite, respectively. Faults are typically low displacement strike-slip structures (offset $<$ 1m) organized in en-echelon arrays at different scales with a stepping geometry consistent with the sense of fault slip (e.g. left-stepping for dextral slip). Fault stepovers include pervasive fracturing dominated by a set of antithetic faults (Pennacchioni and Mancktelow, 2013). These faults were locally exploited by episyenitic alteration which represented the "last" event of fluid-rock interaction in the Tauern metagranitoids. Episyenites within metagranodiorites have a macroscopic porosity in the range between 25 and 35% volume (determined by microtomography), mostly derived from dissolution of multi-mm-sized quartz. Recent glacier-polished outcrops provide a unique opportunity to investigate the relationships between episyenites and overprinted faults. Detailed field mapping of a selected outcrop indicates that episyenites: (i) are spatially linked to precursor faults and statically overprinted all previous structures; (ii) occur discontinuously along faults; (iii) have a thickness (of as much as a few meters) that does not correlate with either the amount of fault slip or the density of the fracture network; (iv) developed independently of rock type (passing "undisturbed" lithologic boundaries with conspicuous variations of quartz grain size of the protolith lithology). Although the faults in the studied outcrop are extensively decorated by relatively large volumes of episyenite, occurrences of episyenite in the Tauern granitoids are generally rare. This study indicates that there is not a simple way to predict the location and the extent of episyenite alteration from the geometry and fracturing patterns of the network of precursor cataclastic faults. The dominant quartz dissolution during episyenitization was accompanied and/or followed by: (i) pervasive substitution of oligoclase and chlorite/biotite of the metagranodiorite by albite and clay-minerals, respectively, and (ii) limited precipitation of new adularia, anatase, calcite, hematite and zeolite within pores. Isotopic data from calcite filling the episyenite porosity suggest a meteoric source of the fluids (δ^{18}O (SMOW) ≈ -2 ‰). In contrast, fluids synkinematic with previous episodes of fluid-rock interaction during faulting and ductile shearing had a deeper origin (δ^{18}O (SMOW) ≈ 8-9 ‰).

References

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