Geophysical Research Abstracts
Vol. 16, EGU2014-2766, 2014
EGU General Assembly 2014

Fluid flow and mineral vein formation during accretion of the Infrahelvetic flysch units, eastern Swiss Alps

Armin Dielforder, Marco Herwegh, and Alfons Berger
Institute of Geological Sciences, University of Bern, Baltzerstrasse 1+3, CH-3012 Bern, Switzerland

The Infrahelvetic flysch units represent an accretion-collision assemblage comprising a <5 km thick sequence of carbonaceous shelf sediments and syn-orogenic turbidites, similar to trench-fill sediments formed at ocean-continent subduction zones. The sequence has been interpreted to consist of three thrust slices with different paleogeographic origin (Ultrahelvetic, South Helvetic and North Helvetic) that were originally accreted and thrusted on top of each other during northward propagation of the Alpine orogenic wedge up from middle Eocene time (1). After accretion, the Infrahelvetic flysch units were intensively deformed during the Oligocene-Miocene Alpine orogeny. The most pronounced feature associated with this deformation phase is the Glarus thrust, a large-scale out-of-sequence thrust that cuts through the Infrahelvetic flysch complex and places Helvetic nappes on top of the flysch units (2).
In the past, a number of studies have envisaged fluid flow along the Glarus thrust under peak metamorphic conditions (∼300 °C, 2–3 kbar) (3, 4). Based on structural and geochemical data from the Infrahelvetic flysch units focusing on fluid flow and mineral vein formation we propose for the first time that the oldest vein generations evolved already during early orogenic accretion of the thrust slices, i.e. prior to the development of the Glarus thrust. Early fluid flow is indicated by (a) soft sediment deformation structures like fluidized sandstone injections, and (b) mineral veins that formed prior to both folding and cleavage formation within the Infrahelvetic flysch units. Early mineral veins are restricted to clay-rich sediments only, but they occur in all three flysch thrust slices. They represent pure calcite veins and comprise veins of different orientations and fracture mechanics: (a) stripped bedding veins that lie subparallel to bedding and were formed by bedding-parallel slip, and (b) extension veins formed almost perpendicular to the stripped bedding veins. Cross-cutting relationships indicate that both types of veins were formed incrementally within a certain time interval. Stable isotope data of vein and matrix calcite suggest that the fluid was derived locally from the host rock without or with only little contribution of fluids derived from deeper levels of the subduction channel further downdip. In addition, absolute isotope values vary between different sampling sites indicating that there was no equilibration of the fluid within the thrust slices by pervasive fluid flow.

(1) Lihou, J., 1996. Structure and deformational history of the Infrahelvetic flysch units, Glarus Alps, eastern Switzerland. Eclogae Geologicae Helvetiae 89, 439–460.
(2) Milnes, A.G., Pfiffner, O.A., 1977. Structural development of the Infrahelvetic complex, eastern Switzerland. Eclogae Geologicae Helvetiae 70, 83–95.
(3) Rahn, M., et al., 1995. Alpine metamorphism in the North Helvetic Flysch of the Glarus Alps, Switzerland. Eclogae Geologicae Helvetiae 88, 157–178.
(4) Abart, R., et al., 2002. Oxygen, carbon and strontium isotope systematics in two profiles across the Glarus thrust: implications for fluid flow. Contribution to Mineralogy and Petrology 143, 192–208.