FRACTURING, MINERALIZATION AND FLUID SOURCES FROM ALPINE FISSURES DURING LATE ALPINE UPLIFT, NORTHERN AAR MASSIF, SWITZERLAND.

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Alpine fissures in the Aar and Gotthard massifs are generally small hydrothermal systems, which formed during prograde and/or retrograde Alpine regional metamorphism. The fluids, fissure minerals and hydrothermally altered host rocks of the extensional veins are currently investigated in order to accomplish the following aims:

1. To understand the evolution of deformation, fluid composition, temperature and pressure during uplift and cooling in the Central Alps
2. To recognize the origin and pathways of mineralizing fluids
3. To document the mass transport from unaltered host rocks into Alpine fissures under continuously changing conditions.
4. Modeling fluid mineral-equilibria

In this study several mineralized fracture systems from the NEAT Cable-tunnel at Amsteg are investigated. They are situated in sericite schists of the northern Aar Massif. Several mineral growth stages can be correlated with different fracturing events and the corresponding fluid populations to constrain different possible fluid sources. This is done to document the evolution of pressure, temperature, deformation and fluid composition during uplift between 16 to 10 Ma ago.

The first deformation event is the formation of en-echelon WSW-ENE oriented meter-scale fractures, dipping slightly towards NNW. These fractures contain syn-kinematically grown (ESE-WNW oriented) fibre quartz of up to 8 cm in length. Fissure geometry of the en-echelon fissure systems and fibre quartz orientation indicate a top to the ESE shear movement. Fibre adularia, albite and sphalerite are associated with fibre quartz growth.

In some cases these en-echelon fractures are overprinted by a younger fracturing event, causing the fractures to widen to a size up to 20 cm. Chlorite, calcite and pyrite associated with prismatic quartz crystals of up to 10 cm long precipitated in these fractures.

Metallic shiny graphite on slickensides of 1 to >10m long is observed along pre-Alpine and Alpine foliation planes. They cut the previously described en-echelon fissure systems and open fractures. Their formation is probably contemporaneous with calcite precipitation in Alpine fissures.

First fluid inclusion investigations on Alpine fissures from the NEAT tunnel indicate that early H_2O rich fluids contain a small amount of salts and CO_2. An episodical increase in CO_2 is observed in secondary fluid inclusions, which may be related to late graphite slickenside planes. Aqueous fluids containing little CO2 and salts follow this episode. These results confirm preliminary studies by Mullis et al., 2000 and Mullis, 2002.

Stable isotope investigations on graphite bearing volcanoclastites (e.g. Schenker, 1986), on fluid inclusions, on graphite from slickensides, and on fissure carbonates are ongoing to determine the possible sources and migration pathways for these fluids.

References

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