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Localized ductile deformation in the Rieserferner Pluton (Eastern Alps)

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In the Rieserferner Pluton (Eastern Alps, 32±0.2 Ma, Romer et al., 2003) the post-magmatic cooling and exhumation stages were accompanied by a series of solid-state deformations including jointing, quartz veining, dyke emplacement, localized (cm-dm) ductile shearing and brittle-ductile faulting.

The earliest stage of post-magmatic deformation includes the formation of pervasive steeply-dipping joints mainly arranged in two "conjugate" sets striking respectively E-W and NW-SE. These joints were extensively intruded by synkinematic aplite-pegmatite dykes and by quartz veins. Joints, veins and (locally) dikes were exploited as strike-slip ductile shear zones consistently with a WNW-ESE shortening. The mylonitized quartz veins are relatively coarse grained (mm-grain size) and show dominant dynamic recrystallization by grain boundary migration.

A later set of joints is shallowly dipping E and is also commonly filled with quartz (and local epidote) veins. Ductile shearing of these vein-filled joints resulted in localized tonalite mylonites and quartz mylonites with a top-to-east kinematics. The quartz mylonites are fine grained (10-20 [U+F06D]m grain size) and resulted from dominant subgrain rotation recrystallization. The foliation of associated tonalite mylonites is marked by biotite+plagioclase+white mica+epidote±sphene±garnet.

The "high-temperature" mylonites are crosscut by swarms of steeply-dipping fractures and faults striking N-S and showing a characteristic anastomosing-irregular pattern. These fractures are clustered in zones as large as 10 m and are associated with veins filled with calcite+white mica and with basic dykes (dated at 26 Ma: Steenken et al., 2000). Fluid-rock interactions along these fractures induced weakening and development of local low-temperature mylonites, where deformation mechanisms included pressure-solution and low-temperature plasticity of quartz. The orientation and kinematics of E-dipping mylonites and later low-temperature mylonites are consistent with an WNW-ESE extension.

The orientation and kinematics of the shear zones within the Rieseferner pluton record a change in the (regional?) shortening direction. The recorded deformation sequence of shearing and switch in orientation of stress field occurred between 32 and 26 Ma, concomitant to the onset of orogen-parallel extension in the Eastern Alps.

References

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