Creep, fail, and creep again at eclogite facies: interactions between metamorphism and deformation at the Hohl eclogite body (Koralpe, Eastern Alps, Austria)

B. Huet[1], A. Rogowitz[2], S. Schorn[2]

[1]GeoSphere Austria
[2]*Institute of Earth Sciences, University of Graz*
e-mail: benjamin.huet@geosphere.at

We present (micro)structural, petrographical, and chemical data from a series of low Mg – high Ti eclogite samples collected at the Hohl eclogite body (Koralpe, Eastern Alps, Austria). The eclogite mass is characterized by a pronounced foliation defined by the shape preferred orientation of the major minerals (average: 030/40) and mineral lineation defined by the shape preferred orientation of prismatic minerals (average: 324/18). In addition to omphacite, garnet, amphibole, epidote and rutile, minor euhedral quartz grains are present. Overall, grains show rather straight grain boundaries and uniform extinction. Thermodynamic forward modelling indicates that eclogitization occurred under fluid saturated conditions at about 1.8 GPa and 640 °C, which is slightly below the peak conditions.

The eclogite fabric is crosscut by a complex network of mineral veins characterized by coarse elongated crystals. These veins have a thickness comprised between a few millimeters and a few centimeters and contain the same assemblage as the host eclogite. In comparison to the host, they are enriched in quartz and epidote and depleted in garnet. Minerals composition is similar to the composition of the host eclogite indicating that veining occurred at eclogite facies conditions. One vein set is subperpendicular to the main foliation (average: 234/27) and the other is subparallel to it (average: 055/51). In both sets, the long axis of crystals is subparallel to the vein boundary and strikes NW-SE, which is compatible with crystal growth in the same tectonic regime as the eclogite fabric. Wing cracks indicate that the veins formed as shear fractures. Deflection of the eclogite fabric adjacent to the veins implies ductile reactivation of the veins as flanking structures and strain localization under top-to-the-W shearing. In consequence, the reactivated veins are characterized by undulatory extinction, twinning and subgrain formation in quartz, all being indicative of dislocation creep.

Our investigations document strong interactions between chemical (i.e., metamorphism) and mechanical (i.e., deformation) processes operating at eclogite facies and illustrate how metamorphic reactions dictate the deformation style of an eclogite. The microstructures of the eclogite host are interpreted as evidence of fluid-triggered syn-tectonic prograde eclogitization accommodated by diffusion and dissolution-precipitation processes. Ongoing prograde metamorphism resulted in progressive dehydration and minor melting of the already equilibrated eclogite. Subsequent increase in the pore-fluid pressure induced brittle failure and allowed precipitation of an eclogite facies assemblage in the vein. Finally, the quartz enriched veins localized ductile strain and deformed by dislocation creep. Hence, within the same tectonic event and without remarkable change of boundary conditions, eclogite can creep, fail and creep again.