

Deformation of monazite in an amphibolite-facies shear zone

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There is ample evidence in rock samples, that the chemical and isotopic composition of monazite readjust more easily than zircon. This difference in behaviour has been, in part, related with the deformation behaviour of monazite. This assumption implies, that monazite recrystallizes during deformation and therefore adapts its chemistry more easily than zircon. However, accessory phases play no role in the bulk strength of a rock where deformation concentrates in the major rock-forming minerals. In other words, the deformation behaviour of monazite depends strongly on the competence contrast between accessories and the predominant weak phases of the host rock.

We present here results obtained on an upper amphibolite shear zone located in the Central Swiss Alps, where strain localisation led to a strong grain size reduction of the major rock forming minerals quartz, feldspar, biotite, sillimanite, and garnet. In between these minerals variably shaped monazite grains occur. The average grain size of the monazites does not change with increasing shear strain, i.e. from the undeformed to the strongly deformed part of the shear zone. However, electron backscatter diffraction (EBSD) data indicate lattice compartments with different orientation within the same monazite grain. This may be explained either by subgrain formation or local bending of the lattice. Our data additionally show twinning as an important deformation process. Despite of indications for intracrystalline deformation, neither dynamic recrystallization nor brittle deformation has been observed. This is further underlined by the fact that in the studied samples some monazite grains behave as rigid clast inside the polymineralic matrix, indicating that monazite is stronger than the deforming matrix. Nonetheless, even the acquisition of few dislocations will enhance diffusion, and this is a key property for understanding the ages of monazite.

Thus, different types of monazite deformation (e.g., intracrystalline plasticity, cataclatic behaviour) may be the cause for the occurrence of a homogeneous (resetted) monazite population, or monazites containing older cores.