Rutile (Zr, U–Pb) in a metamorphic setting: An example from the amphibolites of the Bergen Arcs.

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As a common constituent of metamorphic assemblages, rutile is able to provide temporal and thermal constraints on reaction and deformation. By investigating the variability of Zr and U–Pb systematics with rutile microstructures, further constraints on the temperature and timing of amphibolite-facies metamorphism in the Bergen Arcs of southwestern Norway have been obtained. Porphyroblastic, strain-free rutile from leucocratic domains within a dynamically-hydrated amphibolite captures an initial rutile crystallization temperature of 861±45°C during flow of a high temperature Si-Na-Al hydrous fluid along a deforming, localized pathway. Rutile U–Pb ages of 437.4 ± 2.7 Ma and 409.1 ± 2.2 Ma obtained from strain-free and distorted grains reflect the minimum ages of the initial crystallization during syn-tectonic hydration and rutile deformation, respectively. Temperatures of rutile deformation between 620°C and 820°C are constrained by Zr concentration measurements on low-angle boundaries and shear bands. Small (< 150 μm) rutile grains in high strain zones record temperatures of ~600°C reflecting a late stage of rutile growth at mid-crustal conditions. The depletion of Zr and U at low-angle boundaries relative to strain-free areas indicates the formation of fast diffusion pathways during deformation and that in this environment volume diffusion has not controlled element re-distribution. This data highlights the importance of microstructural data integration during application of thermometers and geochronometers.