Direct dating of brittle and ductile deformation using U-Pb small scale isochrons

AXEL GERDES[1]

[1]Goethe University Frankfurt, 60438 Frankfurt/M, gerdes@em.uni-frankfurt.de

This study focus on the application of in-situ U-Pb isotope analyses of low-U (e.g., 0.001 to 5 ppm) minerals in thin/thick sections by laser ablation inductive coupled plasma sector-field mass spectrometry (LA-ICP-SFMS). For this rock forming minerals and mineral assemblages that (re-)crystallised and equilibrated during an event, containing low but variable amounts of U and μ ($^{238}U/^{204}Pb$) will be analysed. Instead of dating domains of single accessory phases, multiple analyses with variable U/Pb within mm- to cm-areas of a rock section will form a linear array in the $^{207}Pb/^{206}Pb$ vs $^{238}U/^{206}Pb$ space; the lower intercept with the Concordia is interpreted as crystallisation age and the intercept at the y-axis as the initial Pb isotope composition.

In contrast to conventional techniques based on accessory minerals, this method can be used to date rocks and processes that often cannot be dated as appropriate accessory minerals are absent and temperatures were below the closure temperature of common thermo-chronometers. At Goethe University it was applied to various rock types (e.g., mylonites, cataclasites, calcite slickenfibres, cherts, calc-silicates, calcite veins) formed during Archean to Neogene time. Small scale isochrones (SSI) ages generally agree surprisingly well with the known age, if available, of these rocks and geological processes. The potential of the method for dating brittle and ductile deformation will be demonstrated using various examples, e.g. from the Alps, the Upper Rhine Graben valley, and Mexico.