In situ LA-ICP-MS U-Pb dating of fluorite

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Unconformity-related ore deposits are often resulting from multiple fluid flow events generating mineral dissolution-recrystallization, remobilization and precipitation [1,2]. Dating crystallization events in such complex systems is a challenge, especially in the absence of significant U-bearing phases. Fluorite Sm-Nd geochronology may provide robust age estimates, but errorchrones and imprecise ages may occur. The recent development of in situ U-Pb radiometric dating of common Pb-bearing minerals such as calcite and hematite using LA-ICP-MS offered the exciting possibility to precisely date multiple crystallization events in ore deposits [1].

Here, we present preliminary results on fluorite U-Pb dating from the world-class Pierre-Perthuis unconformity-related F-Ba ore deposit (southeast of the Paris Basin, France). Such research was motivated by the presence of a zonation in fluorite that cannot be individually sampled for Sm-Nd geochronology, and by the absence of calcite or other datable authigenic minerals. Fluorite crystals display a ca. 200µm-thick external growth band in which U concentration varies between 1 to 10 ppm. We have sampled and analyzed this U-bearing growth band by LA-ICP-MS (Sector Field) to evaluate the applicability of the U-Pb small scale isochron dating method [1] in fluorite [3].

Variable U/Pb ratios result in an excellent spread of data in a Tera-Wasserburg 207Pb/206Pb vs. 238U/206Pb diagram. Unanchored linear regression gives a common initial 207Pb/206Pb ratio of 0.810, MSWD of 1.3, and an age and uncertainty of 33.4 ± 1.4 Ma. Analytical precision and accuracy are limited by variable ablation rates in fluorite and by the absence of matrix-match external standards. However, this raw age appears consistent with a known fluid circulation phase during the opening of the European Cenozoic Rift System (ECRIS). We will discuss efforts to improve precision and accuracy of fluorite U-Pb dating.

References:

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