U-PB MICROGEOCHRONOLOGY BY LASER ABLATION ICP-MS: APPLICATIONS, LIMITATIONS AND FUTURE DEVELOPMENTS

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Among applications for laser ablation ICP-MS (LA ICP-MS) the microanalytical age dating of U-rich phases employing the U-Th-Pb decay scheme is still one of the most challenging in terms of the required spatial resolution, precision and accuracy. In recent years, the number of laboratories that perform microanalytical U-Pb-Th dating employing LA ICP-MS has increased rapidly. Accordingly, the actual number of the peer-reviewed publications applying this technique is rapidly increasing. However, the absolute number of publications is still low compared to studies using conventional techniques (e.g. ID-TIMS, SHRIMP). Furthermore, a significant number of the papers published over the last decade are dealing with various aspects of improving the technique, showing the need for further developments.

Zircon belongs to the key minerals for unravelling many processes during earth history. The U-Th-Pb systematic in most zircon grains is complex due to alteration processes, such as dissolution, recystallization and new zircon growth. A spatial resolution of 5 to 40 µm are commonly needed to resolve the different age pattern in complex grains. Up to date, only few studies have shown that they are capable to routinely analyse these subdomains in zircon and to precisely detect low Pb contents, which are relative common, e.g., for young zircons and detrital zircon grains. Therefore, many zircons are currently not amenable to microanalytical U-Pb-Th age dating employing LA ICP-MS.

I present a method for microanalytical U-Th-Pb age dating of zircon and a wide range of other U-rich mineral phases. The method is based on simple off-the-shelf technology (a Resonetics S155 excimer laser ablation system coupled to a Thermo-Finnigan Element II magnetic sectorfield – ICP-MS). The spatial resolution, limited by signal intensity of ^{207}Pb, is usually between 20 µm beam diameter and <20 µm ablation depth. A relative simple approach was used to correct for within-run U-Pb fractionation before normalisation to a repeatedly analysed reference zircon. The internal and external precision (over 4-8 hrs) generally achieved for the $^{206}Pb/^{238}U$ (0.5-1 %, 1-2 %, 1s) and the $^{207}Pb/^{206}Pb$ (0.5-1.5 % 1s) ratios is comparable to or even better as precision reported by other laboratories, although up to 30 times less material is consumed. The most important factor controlling the error is counting statistics in case of the $^{207}Pb/^{206}Pb$ ratio and the reproducibility of the ablation process and sample heterogeneity for the $^{206}Pb/^{238}U$ ratio. We will present data from a wide range of different studies currently performed in our laboratories. Analysed grains spanning a wide range of U-bearing minerals (e.g., zircon, baddeleyite, perowskite) demonstrating their natural complexity. The results of these studies will illustrate the abilities but also the outstanding challenges for microanalytical LA ICP-MS dating of complex minerals using the U-Pb-Th decay scheme.