Advances in in-situ U-Pb dating of accessory minerals by LA-ICP-MS

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In-situ U-Pb geochronology is an important technique alongside single or multi-grain conventional TIMS methods in order to interpret intra-grain heterogeneity and link mineral chemistry and textural information to the age data. Ion microprobe (SIMS) methods routinely date zircon to reasonable precision to interpret multi-growth and over-growth events with an unsurpassed spatial resolution. Understanding of zircon reaction history and formation conditions is a growth area but by no means fully understood at the moment. Other accessory phases can be much easier to interpret in this respect and can also be more common and form larger crystals. Here, we discuss recent advances using LA-ICP-MS for U-Pb in-situ dating of petrologically instructive phases that are currently not routinely, or at least widely, measured by either SIMS or LA-ICP-MS. Titanite, allanite and rutile are all common phases in metamorphic, hydrothermally altered and igneous rocks and commonly form fairly large crystals that can be, or have the potential to be, texturally and chemically linked to the crystallisation/reaction history of the rock. We demonstrate how we can measure accurate Pb/U ratios from these phases from within polished thick sections using laser beams as small as 30μm in diameter, allowing petrographic context to be preserved. Precision on Pb/U and Pb/Pb ratios is within 1-3% (2σ). An accurate common Pb correction can be applied based on measurement of the ^{204}Pb isotope, corrected for isobaric Hg intereference, which is reduced by use of in-line gold traps on carrier gas (Ar and He) lines [1]. We use samples from the Norrbotten Fe-oxide-copper-gold mineralised rocks of northern Sweden as a case study to demonstrate how this method can help to resolve complex geologic histories. We also present trace element data collected by LA-ICP-MS adjacent to U-Pb laser pits, which further elucidate the growth history of the dated phases.

References

[1] Storey, C.D. *et al.* (2006). *Chem Geol* **227**, 37-52.