Coupled Zircon-Rutile U-Pb Chronology: LA ICP-MS dating and geological significance

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Significant technological development of mass spectrometers and laser ablation systems in the last decades have made U-Pb dating by Laser Ablation ICP-MS one of the most popular and successful isotopic techniques available to the Earth Sciences. The method allows fast sampling, high spatial resolution and good precision (with absolute U/Pb age resolution for zircon of ca. 2%, 2s).

A continuously improved understanding of the behaviour of the U-Pb isotopic system in different U-bearing mineral chronometers, in particular the mechanisms controlling retention versus diffusion of radiogenic Pb in response to geological processes, have opened new fields of application. Thermally-controlled Pb volume diffusion in rutile is effective at mid- to low-crustal temperatures (> 450 °C) hence the U-Pb rutile thermochronometer is ideally suited to constrain crustal cooling and exhumation (with a precision only slightly worse than zircon). In contrast, zircon growth generally occurs at higher temperatures where Pb diffusion rates in this mineral are negligibly slow at geological scales. The zircon U-Pb chronometer is thus an ideal time-tracker of igneous and metamorphic crystallization.

A growing body of research focuses on the combined application of LA ICP-MS U-Pb bedrock and detrital chronology of rutile and zircon from the same rock. In sediment provenance studies such an approach, particularly when complemented by lower-T thermochronometry data, allows a comprehensive isotopic characterization of the sources. Published examples from different geological settings will be reviewed, with an emphasis on the benefits of applying detrital zircon-rutile U-Pb chronology as a coupled provenance proxy [1, and references therein].

[1] Bracciali (2019), *Geosciences* 9, 467.