

High Spatial Resolution Petrochronology by Laser Ablation: Application to Complex Accessory Minerals

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Our ability to reconstruct the crystallization history of a given accessory mineral (i.e., geochronometers such as zircon, titanite, monazite, etc.)—and thus the geologic processes of its host—has increased severalfold over the past few decades; primarily through advances in precision, concurrent chemical analysis, throughput, and spatial resolution. In this contribution, we present a methodology that takes these advances a step further through the rapid characterization of a large number of accessory minerals at micron-scale resolution via laser-ablation inductively coupled plasma mass spectrometry. Our analytical setup employs an ultrafast washout laser (~1 ms; Element Scientific Laser) that can send individual, <5µm ablation pulses to either one or both of two instruments: a Nu Plasma 3D multicollector ICP-MS and a Nu Vitesse time-of-flight ICP-MS. Because either ICP-MS can measure at the sub-ms timescale, every pulse can be analyzed at 100's of Hz; 1D, 2D, or 3D analysis is possible, and data can be processed in a matter of minutes and hours, instead of days or weeks. We highlight the advantages of this methodology through examples of accessory phases in complex plutonic rocks and high-grade metamorphic terranes.