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# Advances in U-Pb LA-ICP-MS geochronology using high-repetition rate, low-dispersion laser ablation cells

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Recent advances in laser ablation (LA) and inductively-coupled-plasma mass spectrometry (ICP-MS) permit precise isotopic analysis with <10μm laser spot sizes and sub-ppm detection limits, while modern low-dispersion (fast-washout) LA cells now achieve single-pulse response at the millisecond level. Such approaches have transformed LA-ICP-MS mapping which yields a wealth of spatial information on the petrogenesis of igneous, metamorphic and sedimentary rocks and ore mineral formation [1]. This presentation focusses on coupling low-dispersion LA cells to quadrupole ICP-MS systems for U-Pb geochronology, both for conventional spot ablations and extracting U-Pb data from LA-ICP-MS multi-element maps. A key issue in employing low-dispersion LA cells is imaging artefacts (spectral skew) caused by interaction between the laser repetition rate and the total sweep-cycle time, particularly when coupled to a sequential Q-ICP-MS analyser. Running at high repetition rates enables faster scanning while minimizing temporal variations in signal intensity caused by laser pulsing.

For spot ablations, the optimum combination of repetition rate, sweep-cycle time and washout along with new data reduction protocols are explored to see how fast a zircon can be dated (*cf*[2]) to acquire very large (>1000) detrital zircon datasets. Similarly, for LA-ICP-MS multi-element mapping experiments, we explore the latest innovations in data reduction and image-processing packages [3] for the interrogation and extraction of quantitative data from LA-ICP-MS maps. The combination of high-repetition rates (>100Hz) and low-dispersion LA cells facilitates smaller laser spot sizes and faster laser scan speeds and thus rapid acquisition of high-resolution U-Pb maps. These approaches are applied to zircon [4] to constrain fine-scale processes affecting U-Pb systematics in complex polyphase zircons. For U-Pb dating of carbonate [5,6], samples with variable initial Pb concentrations and/or heterogeneous genetic origins also benefit from this mapping approach as areas with sufficient spread in $^{238}U/^{204}Pb$ ratio(μ) can be targeted, while simultaneous imaging of diagnostic trace elements (Fig.1) allows identification and exclusion of zones with alteration or detrital contamination.

[1]Chew et al. (2021) *Chemical Geology*, 559,119917. [2]Chew et al. (2019) *GGR*, 43,39-60. [3]Petrus et al. (2017) *Chemical Geology*, 463,76-93. [4]Chew et al. (2017) *JAAS*, 32,262-276. [5]Drost et al. (2018) *G*$^3$, 19,4631-4648. [6]Roberts et al. (2020) *Geochronology* 2,33-61.