LA-ICPMS image mapping and its applications to geochronology

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LA-ICPMS image mapping is a rapidly-expanding field because of the detailed contextual information it can provide in diverse fields such as petrology, forensics, archaeology, and biology. This presentation reviews latest advances in LA systems (e.g., fast-washout cells which minimize signal smearing for rapid map acquisition), tools for quantitative data extraction from maps[1], recent applications in fields such as igneous petrogenesis, mineral exploration and imaging of biological tissues, and on-going challenges (e.g., temporal variation in signal intensity due to laser pulsing).

LA-ICP-MS U-Pb geochronology applications are presented where data are extracted from maps acquired at high repetition-rate (50–80 Hz) on a fast-washout LA-ICP-MS system (Photon Machines Analyte Excite coupled via an aerosol rapid introduction system to an Agilent 7900). The approach is applied to calcite[2] and zircon[3], and employs the Monocle add-on[1] for Iolite which enables quantitative data extraction with a variety of map analysis tools and scripts. Present approaches to U-Pb calcite dating suffer from large age uncertainties due to low U, high initial Pb, local open U-Pb system behaviour or the presence of different generations of carbonate. The advantage of U-Pb image mapping[2] is that it spatially links age information with compositional, textural or structural features (SEM images or elemental maps), while pixels on a map can be pooled into 'pseudo-analyses' using a parent/daughter ratio proxy (e.g. $^{207}Pb/^{235}U$, $^{238}U/^{208}Pb$) to retrieve the maximum spread of data points on isochrons or concordia. Portions of sample with chemically different detrital components, alteration zones or different generations of carbonate phases can be identifed and removed by defining exclusion criteria. The image mapping approach was also used to construct zircon U-Pb age maps[3] for constraining the fine-scale processes affecting U–Pb zircon systematics in samples with complex U–Pb zircon age data.

[1] Petrus et al. 2017 *Chemical Geology*, 463, 76-93. [2] Drost et al. 2018 *G3* [3] Chew et al. 2017 *JAAS*, 32, 262-276.