

A synthetic calcite reference material for in situ U–Pb geochronology

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Recent years have seen a rise in applications of laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to in situ geochronology of a wide range of geological materials. Standardising such analyses relies on homogeneous matrix-matched primary reference materials (RMs) whose ablation, transport and ionisation characteristics ideally result in fractionating elements and isotopes in the same way as in the unknown sample of interest.

One of the current frontiers of LA-ICP-MS geochronology – U–Pb carbonate geochronology – suffers from a lack of such materials. Currently used natural primary RMs, even if homogeneous in age (e.g. [1]), are heterogeneous in U- and Pb-isotopic ratios. Consequently, raw results are corrected for elemental and isotopic fractionation to obtain a certain whole-sample isochron age of the RM rather than correcting signals from individual analytical spots, which is lengthy and adds uncertainty related to age homogeneity of the RM. The U–Pb carbonate geochronology community would thus benefit from homogeneous reference materials for wide distribution. Ideally, such a RM should match the ablation behaviour of the unknown carbonate and consequently all “matrix effects”, including the amount and depth progression of inter-element laser induced elemental fractionation (LIEF), can be corrected directly in a manner similar to standard zircon U–Pb geochronology.

We will present a method for preparing synthetic RMs that uses a natural rock starting material which is milled to nanopowder, homogenised, and recrystallised at high pressure and temperature using an internally heated pressure vessel. In this way, natural sample heterogeneity is removed through milling, while textural coarsening is aimed at generating ablation behaviour similar to that of unknown samples.

Data for our synthetic calcite material show that it fulfils the homogeneity and LIEF requirements of a primary RM for U–Pb. The ability to correct individual ablation signals makes it easy to use and significantly reduces the workload required for data reduction, while repeatability of secondary RMs is similar to that obtained with currently utilised RMs.

[1] Guillong et al. (2024), *GChron* 6, 465-474.