Software and protocols for improved accuracy of LA-ICP-MS analysis via quantification of matrix effects

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The deleterious impact of matrix effects and other elemental fractionation in LA-ICP-MS analytical results is well documented [1][2][3] yet management of the problem appears mixed. One mitigation strategy is to use matrix-matched calibration reference materials (RM) [4] and identical laser conditions on the RM and unknowns (Us), however in practice this approach is largely limited to U/Pb dating applications.

Our new protocol builds on previous work [5] and involves measuring Us in a single analytical session using a range of laser conditions selected to match physical constraints of each U such as sample geometry, material ablation threshold, or elemental abundance. Quantification [6] is performed using a single calibration RM and fixed laser conditions, selected to minimise measurement uncertainty. During the same analysis session, secondary RM(s) are measured to match the laser conditions on the unknowns, e.g. beam diameter, fluence, ablation mode: spot or line. When available, the secondary RMs are also chosen to exhibit a closer matrix-match to the Us. Results from the secondary RMs are used to estimate separate correction coefficient values for each set of laser conditions. Measurement of multiple secondary RMs under the same conditions allows the uncertainty in the correction to be estimated.

When matrix-matched RMs are not available, an additional matrix correction coefficient for each element can be added for each elements in cases where it can be independently determined. This coefficient can be quantified once and subsequently reused, provided all analytical conditions remain unchanged.

To facilitate adoption of this protocol new software has been written for reduction of LA-ICP-MS data. The software package “LADR” (pronounced “ladder”) is available for download from the authors’ website [7] and performs all necessary calculations, including estimation of a “bottom up” [8] uncertainty budget.

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