

A common matrix method for precise and accurate isotope ratio measurement by MC-ICP-MS

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Non-spectral matrix effects are difficult to identify in MC-ICP-MS isotopic data. In theory they can be corrected by the use of some form of external element normalization. However, this is only reliable if the external element (E) chosen to monitor instrumental mass fractionation (f) responds to sample matrix in a similar manner to the analyte element (A), i.e. $f(E)/f(A)$ is constant. Recent experiments on a Nu Plasma [1] have shown that matrix can cause significant $f(Tl)/f(Pb)$ variation in MC-ICP-MS Pb isotope ratio measurements resulting in inaccuracy ranging from -150 to +120 ppm/amu.

Matrix also resulted in a finite signal enhancement response that plateaued out beyond a given matrix concentration; suggesting that other matrix effects might also be finite. To test this, a common matrix of Mg was added to both matrix-doped Pb(Tl) standards and their bracketing undoped standards. In the presence of the common matrix, variation in $f(Tl)/f(Pb)$ ratio between matrix-doped and undoped standards was almost completely eliminated. The external reproducibility of pooled matrix-doped and undoped data with a common matrix was similar to single session external reproducibility of pure standards (20–60 ppm/amu).

Our experiments indicate that in order to reduce the variation between $f(E)/f(A)_{\text{samples}}$ and $f(E)/f(A)_{\text{standards}}$ the common matrix should be added both to samples and standards, i.e. matrix must be matched. This is in contrast to other MC-ICP-MS matrix addition methods [2, 3] in which variable matrix is added to a standard to generate mass bias variation. However, a similar approach has been used [4] to improve the accuracy of quadrupole ICP-MS Pb isotope ratio measurements.

Addition of a common matrix to samples and standards may provide a viable alternative to thorough purification in the effort to improve precision and accuracy in MC-ICP-MS isotope ratio measurements.

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$^{143}\text{Nd}/^{144}\text{Nd}$ and $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in speleothems from Israel as tracers for dust provenance in the Eastern Mediterranean, and NE Sahara

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Previous studies on the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of the carbonate fraction of Eastern Mediterranean (EM) speleothems from central and northern Israel 40-60 km east of the EM Sea coast line [1,2] show glacial-interglacial cyclicity. Glacial values range between 0.7082-0.7085 and interglacial values between 0.7078-0.7082. These Sr isotopic ratios were thought to reflect an increased contribution of marine spray and Saharan dust during glacials and increased host-rock weathering during interglacials. $^{87}\text{Sr}/^{86}\text{Sr}$ of speleothems from the Negev Desert, Israel (NE corner of the Saharan Desert) deposited during interglacials fall within the range typical of glacial values ~0.7082-0.7085 measured in EM speleothems, perhaps due to higher dust supply to the desert from the nearby shelf.

In this study, we explore for the first time the potential of the Nd isotopic composition incorporated into the carbonate fraction in speleothems for tracing the dust provenance. The speleothems studied here were those for which Sr isotopic compositions had previously been measured. The Nd isotopic composition of the carbonate host rocks was also measured and gave an ϵ_{Nd} of -4.9 in the desert and -5.0 to -5.2 in central Israel. ϵ_{Nd} of speleothems from the EM (central Israel) vary slightly between -3.0 and -3.3, which is about 2 ϵ_{Nd} different from the local host rock composition. Desert speleothems and an LGM sample from the EM have less radiogenic ϵ_{Nd} values from -4.8 to -5.9. ϵ_{Nd} values of ~-3 suggest a dust source located in the SE corner of the EM Sea. Possibly, the dust was derived from exposed shelf areas in the Mediterranean near the Nile plume [cf. 3]. On the other hand, ϵ_{Nd} values in the range of ~-5 to -6 suggest a more significant Saharan component during the LGM and in the desert region of Israel during the glacials and interglacials.

While the relatively small changes in Sr isotopic composition suggest that the Sr system may be buffered by the carbonate host rock, the Nd isotopic compositions appear to shed better light on the dust provenance.

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