

In situ Fe isotope analysis of Cr-rich iron oxides using pure chromium metal for isobaric interference corrections by femtosecond LA–MC–ICP–MS

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Iron oxide minerals, such as hematite and magnetite, are commonly found in a wide range of geological environments. Their Fe isotopic composition acts as a potent geochemical tracer, finding applications across various realms of Earth sciences. However, natural iron oxide minerals often have a high Cr content up to percentile levels, necessitating correction of isobaric interference caused by $^{54}\text{Cr}^+$ on $^{54}\text{Fe}^+$ to ensure accurate and precise in situ Fe isotopic compositions. In this study, a pure chromium metal with homogeneous isotopic compositions was examined within the analysis sequence to obtain the fractionation factor of Cr (β_{Cr}) for isobaric interference correction. A femtosecond laser ablation system combined with wet plasma conditions was used to decrease the matrix effect. We synthesized a series of magnetite and hematite samples with simple matrix as well as natural magnetite samples with complex matrix to evaluate the feasibility of Cr interference correction. By employing our proposed correction method, the deviation caused by the isobaric interference of $^{54}\text{Cr}^+$ was effectively eliminated. The corrected $\delta^{56}\text{Fe}$ values for hematite and magnetite samples, even with a Cr/Fe ratio of as high as 1.27, exhibited good agreement with the reference values within the long-term reproducibility uncertainty of 0.10‰. These results indicate the robustness of Cr interference correction in obtaining accurate Fe isotopic compositions of Cr-rich iron oxides.

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Key Words: Fe isotope; interference correction; Cr-rich iron oxides; LA–MC–ICP–MS