

Studying weathering processes on the Earth's surface using simultaneous stable metal isotope and chemical composition analysis

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In the past decades, efforts have been made to develop novel isotopic tracers (e.g. Li, Mg, Si, Ca, and Fe) that fingerprint the distinct processes and elemental mass fluxes on the Earth's surface. These non-traditional, stable metal isotopes are explored as geochemical tracers to reveal detailed insight into the physiochemical reactions of an element. To advance our understanding of these processes, we require analytical developments that allow high-spatial resolution analysis of isotope ratios and the chemical composition.

Rock weathering involves dissolution and subsequent secondary mineral precipitation on a sub- μm scale, and produces large and variable Si isotope fractionation¹. Previous work based on silica precipitation experiments has shown that the chemical environment has a significant influence on silicon isotope fractionation². Thus, understanding silicon isotope fractionation in nature requires the characterisation of the chemical composition of the secondary phases.

The *in situ* analysis of isotope ratios and chemical composition can be implemented by combining LA-MC-ICP-MS with either a single collector MS or an OES. There are two feasible approaches, (i) LA split stream³, where the laser aerosol is splitted into the MC and the ICP-MS or (ii) rear-on OES, where the MC plasma is used as the excitation source for an OES⁴.

We are presenting a comparison of both methods using UV-fs-LA and a set of reference materials. In a case study we determined the silicon isotope- and chemical composition of secondary minerals. This method allows for the first time, interpreting silicon isotope fractionation in the context of the elemental composition of the precipitated phase.

1 Schuessler *et al.*, SAB, 2014, 98, 1–18.

2 Oelze, *et al.*, Chem. Geol., 2015, 397, 94–105.

3 Yuan, *et al.*, Chem. Geol., 2008, 247, 100–118.

4 Kaczmarek, *et al.*, Chem. Geol., 2014, 392, 32–42.