Gallium isotope analysis and potential application

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Gallium (Ga) is a metallic element close to the non-metals in the periodic table and has special physiochemical characteristics and important economic value, thus is of great interest in many research aspects，such as, an analogue of the monoisotopic element aluminum (Al). Ga has two stable isotopes, ^{69}Ga and ^{71}Ga, with the abundances of 60.1% and 39.9%, respectively. The changes of species as well as the chemical bond (and lattice) under different geological conditions (pH, temperature, etc.) and some specific biological processes (the preferential uptake and accumulation) may fractionate Ga isotopes and thus induce different Ga isotopic signatures in diverse geological (and biological) reservoirs[1-2].

We developed a new two-step chromatographic (AG 1-X4 and Ln-spec resin, respectively) method to purify Ga from geological (biological) samples for precise measurement of Ga isotopic composition using MC-ICP-MS[3]. The separation method was carefully calibrated using both synthetic and natural samples and validated by assessing the extraction yield (99.8 ± 0.8%, 2SD, n = 23) and the reproducibility (2SD uncertainty better than 0.05‰, n = 116) of the measured isotopic ratio (expressed as $\delta^{71}Ga$). Our preliminary results showed large variation of $\delta^{71}Ga$ (up to 1.83‰) for variable geological and industrial materials, with higher values in industrially produced materials, implying potential application of Ga isotopes, for example, for distinguishing natural from anthropogenic sources. Moreover, the preliminary results of our adsorption experiments showed also significant fractionation, stimulating further study and application of Ga isotope system in earth science such as surface weathering, ocean biogeochemistry and even cosmogeochemistry.

1 Pokrovsky, O. S. et al. 2004. *Journal of colloid and interface science*, 279(2), 314-325.

2 Benézéth, P. et al. 1997. *Geochimica et cosmochimica Acta*, 61(7), 1345-1357.

3 Yuan, W. et al. 2016. *Analytical Chemistry*, 88(19), 9606-9613.