

## **What are the sources and processes behind Si and Fe stable isotope compositions of igneous rocks?**

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A full use of stable metal and metalloid isotope composition in igneous rocks petrogenetic studies requires a correct understanding of the meaning of these new isotopic tracers. Since the finding made a decade ago that magmatic differentiation leads to measurable and systematic stable iron isotope fractionation, this area of geochemistry has been rapidly expanding. Whereas further studies confirmed the trend uncovered, additional interpretations were provided. Besides a possible redox effect linked with magma degassing that would lead to a residual granitic liquid enriched in heavy Fe isotopes, fractional crystallization and/or thermal diffusion were proposed as alternative explanations.

This isotope effect was further tackled through the examination of the stable isotope variations of other metals and metalloids on the same igneous suites. It was found that Li, Cu, Mg, Zn and Si show specific isotopic trends through differentiation. Such contrasted isotopic fractionation behaviours are likely related to the specific mineral hosts of the element of interest, to its position in the structure of silicic melts, and as to whether it is redox sensitive or can be easily mobilised by fluids exsolved in the course of a magmatic body evolution.

The case of silicon is particularly interesting. Whereas there is a general trend of increasingly heavy Si isotope signature with igneous differentiation, recent work has shown that these Si isotope variations cannot be interpreted in terms of simple fractional crystallization or magma mixing as with Fe isotopes. Compilations made at the planetary scale reveal that, besides a source effect for anatectic leucogranites and possibly andesites, those Si isotope trends are not so much influenced by the cumulative nature of the rock under consideration. In fact, and whereas recent atomistic computations show the influence of some metal cations in mineral structures on partition functions, the behaviour of silicon stable isotopes in igneous rocks is likely to be driven by a parameter that relates to the mean interatomic distance between Si and O atoms. This could be summarized as a relationship between Si isotope compositions and the polymerization degree of the silicic melts and minerals in which silicon is locked.