Molybdenum isotopes during magmatic differentiation

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This study presents the first evidence for the behaviour of molybdenum isotopes during magmatic differentiation. Molybdenum isotopic compositions, as well as rare earth elements (REE), have been determined for a sequence of lavas from Hekla volcano, Iceland, covering a compositional range from basalt to rhyolite (from 46 to 72 wt.% SiO_2), sequentially developed by magmatic differentiation from a cogenetic source. All samples are characterised by identical Mo isotopic composition with δ^{98}Mo approximating zero (with an average $\delta^{98/95}$Mo of -0.02±0.1‰ (2s.d.) relative to an Alfa Aesar standard solution (lot 011895D) [1]). This study therefore reveals that resolvable Mo isotope fractionation is unlikely to occur during such magmatic differentiation. This is conistent with the fact that Mo is consistently incompatible in this suite of lavas; the lack of fractionating phases therefore preserves the original basaltic parent magma composition.

Previous work [2] suggests that Pr and Mo are equally incompatible in basaltic systems. However, in this study it can be seen that Mo becomes more incompatible than Pr in silicic systems. Despite the fact that these are low ^{18}O magmas, hydrothermal processes and assimilation have had no effect on the Mo isotopic compositions.

Two additional volcanic samples from nearby unrelated volcanos were analysed and are indistinguishable from the Hekla data. This is consistent with a previous study which also indicates a similarity of Mo isotopic signature ($\delta^{98/95}$Mo~0.03±0.12‰) for riverine bedrocks from the vicinity of Vatnajökull glacier on Iceland [3]. Therefore, the Iceland crust appears to have a very homogeneous Mo isotopic signature (δ^{98}Mo~0±0.1‰). The insensitivity of the Mo isotope system to igneous differentiation means that it is especially well suited for studies of assimilation and water - rock interaction in magmatic systems.

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Thallium isotope geochemistry of early Cambrian black shales and Ni-Mo sulfide ores in South China

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Thallium has two stable isotopes: ^{203}Tl (29.5%) and ^{205}Tl (70.5%). The present-day oceanic residence time of Tl is estimated to be ~20 kyr, significantly longer than the mixing time of the oceans (about 1 kyr). Natural Tl isotopic composition shows a variation of about 35 ε^{205}Tl units in terrestrial samples.

In this study, we analyzed Tl isotopes for the early Cambrian Niutitang Formation black shales and the Ni-Mo sulfide ores from Zunyi, Guizhou province, south China. The Ni-Mo sulfide ore shows the highest Tl concentration (40.5 ppm) and the lowerest and negative ε^{205}Tl (-2.06), similar to seafloor hydrothermal fluid value (-1.9), but different from present-day seawater (-6.0). The black shales show smaller negative ε^{205}Tl near 0 (0 to -0.17). But the V-rich black shale has slightly higher Tl concentration (7.3 ppm) and lower ε^{205}Tl value of -0.6. The chert shows similar Tl concentration with the black shale, but significantly higher and positive ε^{205}Tl (-0.3 to 1.13). Good correlations are observed between ε^{205}Tl and Mo/TOC, Ni/TOC, and U/TOC.

In summary, the new data of Tl isotopes in black shales are useful tools: 1) To distinguish between oxic and anoxic marine deposits; 2) To indentify hydrothermal input of Tl (and other metals) for the early Cambrian black shales and polymetallic Ni-Mo sulfide bed in south China.

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