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Letter

Molybdenum isotopic fractionation in the Panzhihua mafic layered intrusion in the Emeishan large igneous province, southwest China

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Abstract

The large Mo isotopic fractionations between different geological reservoirs make this isotopic system a potentially useful tool for constraining the origins of magmatism. However, the effect of magmatic differentiation on Mo isotopes is still controversial. In this study, we obtained Mo isotope data for the Panzhihua gabbroic intrusion (i.e., including mineral separates of clinopyroxene, plagioclase, magnetite, and ilmenite). The whole-rock samples and mineral separates exhibit large Mo isotopic fractionations with $\delta^{98/95}$Mo values as follows: magnetite (–0.73‰ to –0.32‰) < clinopyroxene (–0.32‰ to –0.10‰) < ilmenite (0.06‰ to 0.36‰) < plagioclase (0.33‰ to 0.83‰). Iron-Ti oxides have Mo contents that are one order of magnitude higher than those of clinopyroxene and plagioclase. Mass balance calculations based on Mo isotopes and contents are consistent with an accumulated origin for the Panzhihua intrusion. Rayleigh fractionation modeling shows that the removal of magnetite and ilmenite results in significant Mo isotopic fractionation in the residual magma. Due to the low Mo contents of clinopyroxene and plagioclase, Mo isotopes are not significantly fractionated by the removal of these minerals. Therefore, our study highlights that fractionation of Fe-Ti oxides can cause considerable Mo isotopic fractionation; consequently, caution is needed when using Mo isotopes to infer magma origins.

Keywords: Mo isotope, fractionation, magmatic differentiation, Panzhihua intrusion, Emeishan large igneous province; Isotopes, Minerals, and Petrology: Honoring John Valley