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Cu-Zn isotopic variations in Precambrian and present-day mantle

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The isotopic compositions of transition metals have been shown in recent years to be sensitive to their environment (T, redox state, pH, coordination). The goal of the ongoing study is to compare Cu-Zn isotopic abundances of Precambrian samples with those of present-day samples to see if the former can be used as sensitive indicators of geological environments on the Early Earth. In addition, we investigated whether Cu-Zn isotopes are fractionated in mantle materials at high temperature. We report high-precision MC-ICPMS Cu-Zn isotopic measurements (as $\delta\%_{,}$ vs. JMC standard) on MORB glasses, OIB from the major geochemical end-members (EM1, EM2, HIMU), peridotite xenoliths and orogenic lherzolites (WR, minerals), glasses from Hawaï HSDP2 drilling, samples from the 2.1 Ga Bushveld Complex, and 3.8 Ga metagabbros and pillow lavas from Isua, Greenland.

MORB samples from the three oceans have constant Cu and Zn isotopic signatures. Cu isotopic data cluster around 0 $\%_{,}$, close to CI chondrite value, but lower than loess values. On the other hand, δ^{66}Zn for MORB cluster around 0.2-0.3 $\%_{,}$, close to marine particulates, sediments, loess, indicating no significant fractionation.

Zn isotopic compositons of OIB are more variable, due to either mineral fractionation or, less likely, source effects. For the Hawaiian HSDP2 series, a correlation of δ^{66}Zn with Cr content suggests involvement of a Cr-bearing phase, possibly spinel. δ^{66}Zn also seems related to the alkali index.

Samples from the oceanic and sub-continental mantle have different Zn isotopic signa-

tures. Olivine, ortho- and clinopyroxenes separated from peridotite xenoliths and orogenic lherzolites exhibit small fractionation with respect to each other, while spinels have isotopically heavier Zn (in a subcontinental setting) or lighter (oceanic setting).. Chromite from the Bushveld Complex has a depleted value identical to that of spinel from the Lanzo orogenic lherzolite. δ^{66}Zn in spinel might be related to the chemical compositon, and particularly the Fe^{3+}/Fe^{2+} ratio.

The least metamorphosed samples from Isua show both Cu and Zn enriched in heavy isotopes with respect to present-day values. The most metamorphosed (and altered) rock displays a Zn isotopic signature shifted to light values.