Cu isotope signature of granites

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The Cu isotope signature of bulk earth is proposed to be
homogeneous (δ65Cu=0) based on measurements of sulphides
from mafic intrusions (e.g. Larson et al., 2003) and a limited
numbers of mantle-driven rocks (e.g. Archer and Vance,
2004). However, it has been reported that highly evolved
granite can have a Fe isotope signature remarkably different
(about 0.5‰ δ57Fe) from bulk earth values (Potirasson and
Freydier, 2005). As Cu is a trace element in most common
rocks, and is also multivalent, its isotopes are more likely to be
fractionated by Rayleigh (magma evolution) and redox
(weathering / sedimentation) processes than Fe isotopes. Here
we report our preliminary work to determine baseline values
of δ65Cu for various granite rocks and examine the Cu isotope
homogeneity of crust.

A chemical procedure, modified from Maréchal (1999),
was used to separate Cu from rock matrix. Quantitative
recovery (100.9±1.2%) with a low total procedural
background (2.65±0.66ng) for Cu has been achieved, allowing
Cu isotopic measurements on samples with as little as 10 ppm
Cu. Elution curves for peridotite, basalt and granodiorite
indicate that elution of Cu is not affected by the bulk
composition of rocks. Cu isotope ratios were measured with a
Nu Plasma MC-ICP-MS using solution nebulisation sample
introduction. Mass bias was corrected by both the sample-
standard bracketing and the Ni-doping methods. The long-
term external reproducibility of the measurements was 0.09‰
(2 sigma).

S-type and I-type granites from southeastern Australia
have been analysed. The S-type granites have a large range of
δ65Cu, varying from -0.40‰ to 0.37‰, while the δ65Cu values of
I type granites are less variable (from -0.05‰ to 0.26‰),
generally overlapping each other within error around zero (the
bulk earth value). However, samples of the mafic end member
(SiO2<55wt%) of an I-type granite suite show remarkable
heavy Cu isotope signatures (δ65Cu up to 1.56‰).

The distinguishable variation in Cu isotopic composition
of the S-type granite may reflect isotopic heterogeneity in the
sedimentary source region as a result of redox processes.
However, the possibility of Cu isotope fractionation during
magmatic and magmatic-hydrothermal processes cannot be
ruled out.

References
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