Copper isotope composition of planetary mantles

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Copper is a multi-isotope element that is both siderophile and chalcophile; thus it has the potential to reveal important insights into igneous processes, ore-forming events and planetary differentiation. Experiments and empirical analyses show that metal preferentially incorporates the *heavier* Cu isotope during metal-silicate equilibration, and sulphide the *lighter* isotope during sulphide-silicate equilibration [1,2]. This systematic behaviour, combined with the observation that Earth's mantle has a heavier Cu isotope composition than bulk Earth (defined by meteorites [3]) has been used to posit large-scale equilibration between bulk silicate Earth and a sulphide 'matte' during differentiation [1,4].

Despite its potential, the effect of sulphide formation and fractionation on Cu isotopes at mantle temperatures is still poorly constrained. Here we present data from terrestrial igneous suites where sulphide is a fractionating phase, as well as the first Cu isotopes analyses of the aubrite and acapulcoite-lodranite meteorite clans. Both these groups of meteorites represent samples from differentiated asteroids whose mantles experienced significant sulphide formation and removal [5,6].

Given known estimates of equilibration temperatures, as well as sulphide compositional chemistry, this new data will be used to better parameterise sulphide Cu isotope fractionation magnitude and sense, thereby allowing better understanding and quantification of the isotopic effect of sulphide fractionation. Furthermore, the results will also allow extrapolation towards temperatures relevant to Earth's differentiation and provide further insights into the relevance of the Cu isotope mismatch between Earth's mantle and bulk Earth.

References: [1] Savage P.S. et al (2015) Geochem Pers Lett, 1, 53-64; [2] Williams, H.M. and Archer C (2011) GCA, 75, 3166-3178 ; [3] Luck, J. et al (2003) GCA, 67, 143-151; [4] O'Neil H.S.C. (1991) GCA, 55, 1159-1172; [5] Keil, K. (2010) Chemie der Erde, 70(4), 295-317; [6] McCoy, T.J. et al. (1997) GCA, 61(3), 639-650.