Isotopic fractionation of Cu in plants

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Knowledge of the copper cycle in the plant-soil-water system is needed in order to better constrain proper plant micronutrient nutrition, control pollution, and determine sustainable soil management practices. Here, we will report the Cu isotopic compositions of different components (seeds, germinated seeds, leaves, and stems) of the dicot, lentil (*Lens culinaris*), and of two monocots, Virginia wild rye (*Elymus virginicus*) and hairy-leaved sedge (*Carex hirsutella)*. The isotopic measurmeents were done by multi-collection inductively coupled plasma-mass spectrometry at Washington University following the procedure described in [1,2,3]. Our data are reported in permil deviation (δ^{65}Cu) from the standard, NIST 976. The isotopic compositions of these plants (δ^{65}Cu≈ -0.43,-0.41) are systematically enriched in the lighter isotope of Cu (^{63}Cu) in comparison to the soil in which they grow (δ^{65}Cu≈ +0.19), suggesting a preferential uptake of ^{63}Cu into the plant. Furthermore, different components within the plants themselves are isotopically fractionated. The shoots (stems, leaves and seeds) are systematically lighter than the underground parts of the plants and the Cu isotopic compositions of individual leaves become lighter in correlation with their heights on the plant. These results are similar to what has been observed for Zn isotopes, which are assumed to be transported through plants by means of diffusion and kinetic fractionation across cell membranes [4]. Because of this similarity, we suggest that the same transport mechanisms (diffusion and transport through cell membranes) are also responsible for the observed isotopic fractionation of Cu. Furthermore, the Cu isotopic variations measured in plants are similar in magnitude to the differences previously measured in various soils, and therefore should be taken into account in order to accurately interpret the isotopic compositions of Cu in soils.

[1] Marechal *et al*. (1999) *Chem Geol*, **156**, 251-273. [2] Moynier *et al*. (2006) *Geoch. Cosmo. Acta*, **70**, 6103-6117. [3] Moynier *et al*. (2010) *Geoch. Cosmo. Acta* **74**, 799-807. [4] Moynier, F. *et al*. (2009) *Chem. Geol*., **267**, 125-130.

ULVZ as repository for the enriched component in the Hawaiian source

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The origin, scale and location of mantle heterogeneities have been debated for over 50 years. Improved analytical precision for radiogenic isotopes, combined with statistical data analysis, allow for more detailed investigations into the geochemical variations of basalts related to mantle plumes and for modeling of the shallow and deep plume conduit and structure. Identification of two clear geochemical trends (Loa and Kea) among Hawaiian volcanoes [1, 2] in all radiogenic isotope systems [3], together with the recurrence of similar isotopic signatures at >350 kyr intervals, has implications for the dynamics and internal structure of the Hawaiian mantle plume [4] and for the scale of heterogeneities in the deep mantle. Recent isotopic data for over 850 samples from the shield, post-shield and rejuvenated stages on Hawaiian volcanoes indicate source differences between the Loa- and Kea-trend volcanoes that are maintained throughout the ~1 Myr activity of each volcano and that extend back in time on all the Hawaiian Islands (to ~5 Ma). Hawaiian post-shield and rejuvenated lavas have more Kea-like geochemical characteristics than the underlying shield lavas with only two exceptions. Loa-trend volcanoes have more heterogeneous compositions than Kea-trend volcanoes in all isotopic systems by a factor of ~1.5 and present an EM-component (most expressed in Ko'olau) as well as different geochemical trends with time (increase of Pb isotopic ratios in Loa). The Loa-Kea distinction reflects differences in the plume source, at the core-mantle boundary, where the Mauna Loa side of the Hawaiian plume samples a more heterogeneous source that may correspond to the northeast end of the Pacific ultra-low velocity zone (ULVZ). Kerguelen, an EM-I oceanic island, is located on the eastern end of the ULVZ African anomaly. We infer that these deep velocity anomalies at the CMB are the repositories for EM components brought to the surface by strong mantle plumes.

[1] Tatsumoto (1978) *Earth Planet. Sci. Lett*. **38**, 63-87. [2] Abouchami *et al*. (2005) *Nature* **434**, 3401-06. [3] Weis (2010) Abs V41F-01 Fall AGU Meeting. [4] Farnetani & Hofmann (2009, 2010) *Earth Planet. Sci. Lett*. **282**, 314-322; **295**, 231-240.