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 measurements 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 (δ65Cu) from the standard, NIST 976. The isotopic compositions of these plants (δ65Cu= -0.43,-0.41) are systematically enriched in the lighter isotope of Cu (65Cu) in comparison to the soil in which they grow (δ65Cu= +0.19), suggesting a preferential uptake of 65Cu 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.