Cu isotopes suggest Cu reduction during acquisition in higher plants

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Evidences from recent studies suggest that studying the natural isotope fractionation of metals in plants offers great potential to elucidate acquisition and translocation mechanisms. We conducted controlled hydroponic studies with lettuce, tomato, rice and durum wheat and tested the effect of copper (Cu) speciation and iron (Fe) supply in the nutrient solution. Next to Cu isotopes, we studied the zinc (Zn) isotopes since Zn is not sensitive to redox processes and a model of Zn isotopic fractionation in plants has been proposed [1].

Isotope fractionation patterns between nutrient solution, roots and shoots differ for Cu and Zn. Roots are enriched in ^{63}Cu (light isotope) but slightly enriched in Zn heavier isotopes compared to the nutrient solutions, suggesting that different processes occur for Cu and Zn at the root-solution interface. Different physical, chemical and biological processes can contribute to the isotopic fractionation during acquisition of Cu and Zn by plants. Abiotic processes, mainly complexation in the nutrient solution or adsorption onto root binding site, are expected to fractionate similarly for Cu and Zn. On the contrary, plant behaviour differs for Cu and Zn, as seen with the concentrations and isotopic ratios data.

The enrichment in light isotopes for Cu is associated with significant reduction of Cu at the root-solution interface, suggesting that this biogeochemical mechanism is predominant for the acquisition of this metal into plants. This is similar to mechanism of Fe uptake for strategy I plant species [2].

[1] Arnold T. *et al*. (2010) *Plant, Cell & Env*. **33**, 370–381. [2] Marschner H. Römheld V. (1994) *Plant & Soil* **165**, 261–274.

How are oceanic $\delta^{18}O$ changes imprinted in ice core records?

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The deuterium and oxygen 18 composition of a precipitation and thus its deuterium-excess, $d = \delta D - 8\ \delta^{18}O$, depends, amongst other parameters, on the isotopic composition of surface waters in the oceanic source regions. As a result, the glacial-interglacial $\delta^{18}O$ change of surface oceanic waters is imprinted in the ice core d-excess record with, in Central Antarctica, a 3 to 4 ‰ d-excess increase directly attributable to the oceanic source. In the same line, changes in oceanic $\delta^{18}O$, globally averaged in this case, influence the $\delta^{18}O$ composition of atmospheric oxygen directly through oceanic productivity and indirectly over the continent. Obviously there are many other processes, most of them however relatively well identified, which govern the $\delta^{18}O$ oceanic record derived from foraminifera, on the one hand, and the d-excess and the air $\delta^{18}O$ measured respectively in polar ice and entrapped air bubbles, on the other. In this context, we will compare the amplitude and time sequence of these three isotopic signals from one deglaciation to the next, thanks to the d-excess and air $\delta^{18}O$ records now available on nine terminations from the EPICA Dome C ice core.