Cu isotopes suggest Cu reduction during acquisition in higher plants

DELPHINE JOUVIN1*, DOMINIK WEISS2, MATTHIEU N. BRAVIN3, PASCALE LOUVAT4, PHILIPPE HINSINGER5 AND MARC F. BENEDETTI6
1IDES – Université Paris Sud, Orsay, France
(*)correspondence: delphine.jouvin@u-psud.fr
2Department of Earth Science and Engineering – Imperial College, London, UK
3CIRAD, Saint-Denis, La Réunion, France
4Écologie fonctionnelle et Biogéochimie des Sols et Agrosystèmes – INRA, Montpellier, France
5Géochimie des Eaux, Université Paris Diderot – IPGP, Sorbonne Paris Cité, UMR CNRS 7154, Paris, France
6Géochimie & Cosmochimie, IPGP - Université Paris Diderot, Sorbonne Paris Cité, UMR 7154, Paris, France

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 63Cu (light isotope) but slightly enriched in Zn heavier isotopes compared to the nutrient solution, 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].


How are oceanic δ18O changes imprinted in ice core records?

J. JOUZEL1*, G. HOFFMANN1, A. LANDAIS1, B. STENNI2, V. MASSON-DELMOTTE1 AND C. WAELEBROECK1
1LSCE/IPSL CEA/ CNRS/UVSQ, CEA saclay 91191, Gif/Yvette (*correspondence: jean.jouzel@lsce.ipsl.fr)
2Department of Geosciences, University of Trieste, 34127 Trieste, Italy

The deuterium and oxygen 18 composition of a precipitation and thus its deuterium-excess, d = δD - 8 δ18O, depends, amongst other parameters, on the isotopic composition of surface waters in the oceanic source regions. As a result, the glacial-interglacial δ18O 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 δ18O, globally averaged in this case, influence the δ18O 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 δ18O oceanic record derived from foraminifera, on the one hand, and the d-excess and the air δ18O 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 δ18O records now available on nine terminations from the EPICA Dome C ice core.