

Isotope fractionation during Fe translocation in plants grown with an artificial chelate

M. GUELKE-STELLING^{1*} AND F. VON BLANCKENBURG²

¹KIT, Inst. for Mineralogy and Geochemistry, D-76131 Karlsruhe (*correspondence: monika.stelling@kit.edu)

²GFZ Potsdam, D-14473 Potsdam (fvb@gfz-potsdam.de)

The determination of the plant-induced Fe-isotopic fractionation with multiple-collector ICP-MS is a promising tool to better quantify their role in the geochemical Fe cycle and possibly to identify the physiological mechanisms of Fe uptake and translocation in plants.

We show here that half of the entire range of Fe isotope variations detected to date on this planet (-2.5‰ in $\delta^{56}\text{Fe}$) occurs when Fe is moved *within* a single plant. This finding extends that of an earlier study in which we found that strategy I plants, which rely on reduction of iron before uptake, were enriched in stable ^{54}Fe relative to ^{56}Fe when grown on soil. In contrast strategy II plants (grasses), which rely on chelation of Fe(III) by phytosiderophores before uptake, were slightly enriched in the heavier iron isotopes [1,2].

In our new study bean plants (strategy I) and oat plants (strategy II) were grown in a nutrient solution supplemented with Fe(III)-EDTA, and were harvested at three different ages. All parts of the plants during all growth stages were quantified for Fe amounts and isotope composition. Total bean plants, regardless of their age, were found to be enriched in the light iron isotopes by -1.2‰ relative to the growth solution throughout. However, during growth plants internally redistributed isotopes where young leaves increasingly accumulated the lighter isotopes whereas older leaves and the total roots were simultaneously depleted in light iron isotopes. For bean fruits, mass balance indicates that these obtain ca. 40% of their Fe from translocation within the plant (with $\delta^{56}\text{Fe} = -2.65\text{‰}$), and 60% from the roots. Given that not all of this fruit Fe can be supplied by older leaves, the roots apoplast plays a major role as intermediate Fe store. Both apoplast Fe and tissue-bound Fe is remobilised by reduction – preferring the light Fe isotopes. In contrast, during growth of the oat plants the initial isotope ratio obtained during uptake is maintained in all organs at all growth stages, including the roots. Hence it can be assumed that both uptake and translocation of Fe in strategy II plants maintains the iron's ferric state, or that Fe is always bound to high-mass ligands, so that isotope fractionation is virtually absent in these plants.

[1] Guelke & von Blanckenburg (2007) *Env. Sc. Techn.* **41**, 1896-1901. [2] Guelke *et al.* (2010) *Chem. Geol.* **277**, 269-280.

The nitrogen isotopic composition of a Proteozoic microbial community

NUR GUENELI* AND JOCHEN J. BROCKS

Research School of Earth Sciences, The Australian National University, Canberra, A.C.T. 0200, Australia
(*correspondence: nur.gueneli@anu.edu.au)

Nitrogen is an essential element for life, incorporated into fundamental components such as amino acids and DNA. The isotopes of nitrogen can be used to trace biogeochemical processes, yet, the use of this tool to reconstruct Precambrian environments is still in its infancy. Recent studies on nitrogen isotope fractionation in microorganisms [1,2] have significantly improved interpretations of paleorecords [3-5] and the use of nitrogen isotopes in combination with established biomarker techniques has now the potential to yield novel information about the succession of predominant primary producers through deep time.

The 1.64 Ga Barney Creek Formation (BCF), northern Australia, represents a marine succession deposited below wave base in the intracratonic McArthur Basin. The dolomitic shales of the BCF bear the oldest preserved, clearly indigenous molecular fossils [6]. Based on these biomarkers, the upper BCF marks a marine basin with anoxic, sulphidic, sulphate-poor and stratified waters inhabited by green and purple phototrophic sulphur bacteria (PSB) [7]. Evidence for these PSB disappears in deeper successions. However, it is currently under debate whether the lack of PSB derives from biological or thermal degradation, or a shift in ecological settings. Here, we will present ^{15}N and ^{13}C data in combination with biomarker analysis to test whether regime changes caused a shift in predominant primary producers in the McArthur Basin.

[1] Beaumont *et al.* (2000) *Org Geochem* **31**, 1075-1085.
[2] Granger *et al.* (2008) *Geochim Cosmochim Acta* **74**, 1030-1040. [3] Thomazo *et al.* (2011) *Geobiology* **9**, 107-120.
[4] Bauersachs *et al.* (2009) *Org Geochem* **40**, 149-157.
[5] Beaumont & Robert (1999) *Precambrian Res* **96**, 63-82.
[6] Summons *et al.* (1988) *Geochim Cosmochim Acta* **52**, 1747-1763. [7] Brocks *et al.* (2005) *Nature* **437**, 866-870.