Stable isotope fingerprinting of iron metabolism in higher plants

M. GUELKE[1], E. SCHEUERMANN[2], F. VON BLANCKENBURG[1], N. VON WIRÉN[2] AND R. SCHOENBERG[1]

[1]Institute for Mineralogy, University of Hannover, D-30167 Hannover (m.guelke@mineralogie.uni-hannover.de)
[2]Institute for Plant Nutrition, University of Hohenheim, D-70599 Stuttgart (scheuerm@uni-hohenheim.de)

The fractionation of stable iron isotopes by biological processes is currently a matter of intense debate. Our study is the first to show that higher plants fractionate stable iron isotopes during Fe acquisition and translocation in a significant and plant-specific manner [1].

To maintain an optimal iron supply plants have adopted two different strategies to acquire iron from the soil [2]. Strategy I plants reduce Fe(III) in the rhizosphere, as only Fe(II) can be transported across the plasma membrane of root cells. Strategy II plants acquire Fe(III) by complexation with phytosiderophores. In which form iron is translocated from roots to shoots is so far unclear [3].

Stable iron isotope compositions reflect these two uptake strategies when soils are Fe sufficient [1]. Reduction of Fe(III) in soils by strategy I plants results in the uptake of light iron compared to the available Fe in soils; complexation with siderophores by strategy II plants results in only minor fractionation. Furthermore, younger parts of strategy I plants get increasingly depleted in heavy isotopes from the first to the fourth leaf, while strategy II plants incorporate Fe of virtually uniform isotope composition throughout [1].

Here we report new results of changes in Fe isotopic compositions of strategy I (tomato, bean) and strategy II plants (oat) during growth in a nutrient solution environment under Fe-sufficient conditions. Older leaves of strategy I plants get increasingly enriched in heavy Fe isotopes whereas younger leaves become lighter while the plant grows (δ^{56}Fe = up to -3 ± 0.05 (2SD) ‰). In strategy II plants all parts of the plant incorporate similar isotope compositions during growth. These results now show that indeed younger leaves of strategy I plants receive a substantial proportion of their Fe from older leaves. Apparently differences in iron translocation mechanisms between strategy I and II plants exist. Inside the plant Fe is scavenged by complexing agents, e.g. nicotianamine in the cells or citrate in the xylem. Nicotianamine has the ability to bind ferrous and ferric iron. The current hypothesis is that strategy I plants change the Fe redox state during translocation. In contrast, Fe in strategy II plants remains in the ferric state but changes its ligands.

Under Fe deficiency plants mobilize Fe from phytoferritin in older leaves, which includes a reduction step. The challenge is now to assign Fe isotope labels to these redox changes during re-/translocation.

References

[1] Guelke M. and von Blanckenburg F., (2007), *Environ. Sci. Technol.* **41**, 1896-1901. [2] Roemheld V. and Marschner, H., (1986), *Plant Phys.* **80**, 175-180.
[3] Hell R. and Stephan U. W., (2003) *Planta* **216**, 541-551.

Further evidence for a two stage magmatic underplating event in the Ivrea-Verbano Zone, Italy

Z. GÜNES[1], U. KLÖTZLI[1] AND S. SINIGOI[2]

[1]Center of Earth Sciences, University of Vienna, Austria (zekeriya.guenes@univie.ac.at)
[2]Dipt. di Scienze della Terra, Universita' di Trieste, Italy (sinigoi@units.it)

Magmatites of the continental crust are essentially formed by two tectono-magmatic processes: In the course of subduction and by the way of "magmatic underplating". While subduction processes can be studied at many different places world-wide, the process of "magmatic underplating" can only be studied directly in the Ivrea-Verbano Zone (IVZ) of the Southern Alps (Italy). So our understanding of this not less important mechanism of crustal growth is still unsatisfactory inasmuch as reliable age data providing tight time constraints on the duration of the underplating processes are still missing. One of the major open questions still is, for instance, whether magma formation and emplacement is a discrete or a continuous event. The IVZ is interpreted as being a slice of the South-Alpine lower crust intruded by mantle magmas. Rocks of this zone have been grouped in two major units, the voluminous composite Mafic Complex (=Mafic Formation) and the high-grade paragneiss Kinzigite Formation. For the main intrusive body of the Mafic Complex in the Val Sesia and Val Sessera sections an intrusion age of 288 ± 4 Ma is postulated [1]. This speaks in favour of a short, discrete main underplating event in the Lower Permian. In addition, the age data indicate that a significant thermal event affected the country rock of the Mafic Complex around 310 Ma, the significance of which is not yet clear. "Strati-graphically" this thermal event seems to be most prominent in the lower most parts of the crust. We have investigated the Campello Monti and Monte Capio area (Val Strona). Here the Mafic Complex forms a composite intrusion which only in parts can be paralleled with the main intrusive body in the Val Sesia. Especially an amphibole-garnet-bearing gabbro strongly resembles the amphibole-gabbro of the lower mafic complex in the Val Sessera [1]. From the former a zircon LA-MC-ICP-MS U-Pb intrusion age of 331.5 ± 3.8 Ma could be determined. This new age is the first unequivocal evidence that an older magmatic event occurred in the lower part of the IVZ crust in the Middle Carboniferous. This substantiates that the underplating event in the IVZ indeed was a long lasting process with a duration of ca. 50 Ma but comprising a number of discrete intrusive phases of only a few million years duration. The geodynamic implications of this new aspect in the evolution of the IVZ in the framework of the Variscan orogeny, mainly the onset of crustal thinning already in the Carboniferous, remain to be investigated.

Reference

[1] Peressini G. *et al.* (2007), *J. Petrology*, in press.