

## Iron isotope fractionation by the human body, animals and plants

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Recent advances in measurement of iron isotopes triggered a debate on the utility of this tool for tracing the presence of Fe-metabolising microbes in the environment. However, the work of Beard, Johnson, Bullen, Anbar, Matthews, Brantley, and others rapidly demonstrated that inorganic Fe isotope fractionation can be larger than that from microbial activity. We have studied the iron isotope composition of the human body and dietary Fe sources and found that mammals produce the largest natural Fe isotope fractionation observed to date.

After microwave decomposition and Fe purification, Fe isotopes were measured by a Nu Plasma MC-ICPMS. Results are presented as  $\delta^{56}\text{Fe}$  relative to IRM14 ( $2\sigma$  St dev = 0.1‰). Some plant products (wheat, rye, and spinach,  $\delta^{56}\text{Fe}=-0.1$  to  $-0.4\%$ ) are only modestly lighter than 40 samples of various soil types ( $\delta^{56}\text{Fe}= -0.1$  to  $+0.3\%$ ). Other plants (rice, lentils, green beans, soy beans, peas,  $\delta^{56}\text{Fe}= -1$  to  $-1.5\%$ ) are even lighter. Possibly these plants incorporate the mobilised Fe in soils which is sometimes as light as  $-2.5\%$ . Alternatively, iron is fractionated during uptake from the soil.

Interestingly, muscle tissue from seafood (shrimp, tuna) is relatively unfractionated ( $-0.2$  and  $-0.6\%$ ) but muscle tissue from land animals (beef, chicken, pork) is as light as  $-2$  to  $-2.6\%$ . Human muscle tissue is as light as  $-2.1$  to  $-3.3\%$ , while the human liver appears to contain heavier Fe than the rest of the body ( $-1$  to  $-1.6\%$ ). Human blood samples contain very light Fe throughout, where  $\delta^{56}\text{Fe}$  is  $-2$  to  $-3.1\%$ . The lightest natural Fe measured to date is human hair ( $-3.6\%$ ).

We explain the light Fe in mammals by preferential absorption of light Fe isotopes in the intestine. Only ca. 10% of dietary Fe is absorbed by humans, with the complementary heavy Fe excreted in feces. Fe absorption involves a series of steps, including reduction of Fe(III) to Fe(II) or binding of Fe by transport proteins. Both equilibrium and kinetic fractionation effects are possible. A slight difference between female blood (mean  $\delta^{56}\text{Fe}=-2.43\%$ ) and male blood ( $-2.75\%$ ) correlates with higher Fe losses/Fe absorption in females (1.3mg/day versus 1.0mg/day in males). However, mass balances suggest that the difference in  $\delta^{56}\text{Fe}$  is not caused by the difference in Fe turnover alone. Rather, each individual appears to absorb Fe with a unique Fe isotope fractionation factor, which tend to be more pronounced for males.

Given the residence time of Fe in humans is ca. 5 years, Fe isotopes represent a long-term fingerprint of biochemical Fe metabolism. The heavy isotopes offer considerable promise for medical applications.

### References

Walczyk, T. and von Blanckenburg, F. (2002), *Science* **295**, 2065-2066

## Plagioclase peridotites : subsolidus breakdown or trapped melt?

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About 20% of all abyssal peridotites contain plagioclase (Dick, 1989), but its origin has long been the subject of controversy. Hamlyn & Bonatti (1980) proposed a subsolidus breakdown of the spinel following the equation  $\text{cpx} + \text{opx} + \text{Al-sp} = \text{plag} + \text{ol} + \text{Cr-sp}$ . Other authors proposed that plagioclase crystallized from a trapped melt at low pressures (e.g. Dick, 1989).

During the AMORE cruise in summer 2001 very fresh peridotites were sampled in the amagmatic area at  $84^\circ 37.5' \text{ N}$  and  $004^\circ 13.9' \text{ E}$  (PS 59-235). This dredge haul contains about 30% plag-bearing and 70% plag-free peridotites. Their very low degree of alteration allows the compositions of all phases to be measured and so hopefully to distinguish between the two hypotheses.

This study is based on three samples, one plag-free as reference and two with different amounts of plagioclase. Both contain plag-opx-symplectite reaction textures surrounding cpx, one of these also includes spinel.

In sharp contrast to the homogeneous and relatively fertile plag-free sample, all phases of the plag-bearing samples show strong disequilibrium, producing a large compositional range.

Compositional maps of the plag-bearing samples reveal strong compositional gradients in cpx as strong aluminum depletion on the plag-cpx contact as well as enrichment of Ti and Cr along the rim, maybe because of cpx volume change.

The an-content of the plagioclase ranges from 76 up to 94 with highest contents in the symplectite structure. This suggests that the symplectite is a preexisting in-situ breakdown texture, and the subsequent plagioclase crystallization occurs in a system with a higher Na-activity.

In contrast, the  $\text{TiO}_2$ -content in most phases of the plag-bearing samples plots along two different trends with respect to Cr#, which could also be evidence for the presence of exogenous melts.

### References

Dick, H.J.B. (1989): In: D.A. Saunders & M.J. Norry (eds) (1989): *Magmatism in the Ocean Basins*, Geol. Soc. Spec. Publ. 42, 71-405.  
Hamlyn & Bonatti (1980): *EPSL* 48, 65-79.