

Magnesium isotopic fractionation in chlorophyll-a

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Chlorophyll (Chl) is often used as a biomarker of photosynthesis and is an enormous contributor to the global carbon cycle. Biosynthetic processes fractionate isotopes of light elements and this led us to examine the isotopic composition of Mg in Chl, as another potential biomarker. Previous reports [1] of the Mg isotopic composition of commercial Chl-a and -b, from spinach, showed a difference to an international standard (DSM3 Std), but could not establish the degree of fractionation relative to the growth medium. Ra et al. (2003) [2] report large $\delta^{26}\text{Mg}$ fractionations in both Chl-a and -b, but did not detail the data in their abstract.

Here we detail the Mg isotopic composition of Chl-a, extracted from cultures of *S. elongatus*, and the culture medium [3]. After Chl extraction, the Mg was liberated from Chl and purified on cation-exchange columns, with a final yield of $100\pm 5\%$ Mg. Mg-isotopic ratios, $^{26}\text{Mg}/^{24}\text{Mg}$ and $^{25}\text{Mg}/^{24}\text{Mg}$, were measured relative to Cambridge 1 and DSM3 standards by a standard-sample-bracketing technique on an MC-ICP-MS (Nu Instruments Ltd). Figure 1 plots the average isotopic fractionation of Mg from 6 samples of Chl-a, 17 samples of the culture medium and the Cambridge 1 Std relative to the DSM3 Std. Figure 1 shows that there is a small depletion in the heavy isotopes of Mg in Chl-a relative to the culture medium ($\Delta^{26}\text{Mg} = -0.61\text{‰}$; $\Delta^{25}\text{Mg} = -0.30\text{‰}$). The heavy isotope depletion observed may be caused by chelation effects during the biosynthesis of Chl-a.

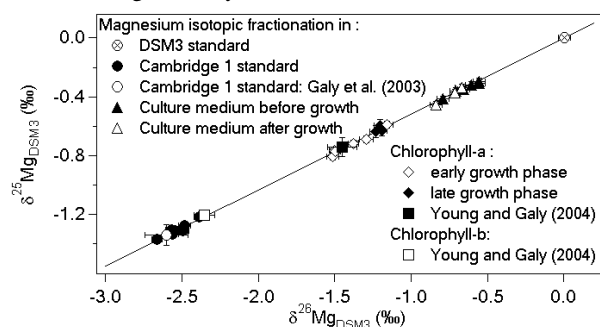


Fig. 1. Mg-isotope ratios relative to DSM3 Std. $\pm 2\sigma$.

References

- [1] Young E. D. and Galy A. (2004). *Rev. Min. & Geochem.*, **55**, 197-230.
- [2] Ra K. T., Masuzawa T., Shiraiwa Y., and Sawada K. (2003). *Geo. Cosmo. Acta*, **67**(18(Sup. 1)), A388.
- [3] Black, J., Yin, Q.-Z., and Casey, W. H. (2006). *Geo. Cosmo. Acta.*, submitted.