Refractory lithophile element fractionation in chondritic meteorites

A. STRACKE[1]*, B. BOURDON[1], T. KLEINE[1], K. BIRBAUM[2] AND D. GÜNTHER[2]

[1]Institute of Isotope Geochemistry and Mineral Resources, ETH Zürich, Zürich, Switzerland. (*correspondence: stracke@erdw.ethz.ch)
[2]Laboratory of Inorganic Chemistry, ETH Zürich, Zürich, Switzerland

The bulk abundance of refractory lithophile elements in chondritic meteorites is known to vary between the different chondrite groups. Although significant refractory element fractionation is observed in the individual chondrite components (e.g. CAI and ultra-refractory inclusions), the bulk chondrites are generally assumed to have more or less invariable, CI-like refractory lithophile element ratios [1].

Here, we report high-precision trace element data in 20 bulk chondrites, determined by multi-isotope dilution ICPMS using the method adapted from [2]. Significant refractory element fractionation between the different chondrite groups is observed, especially between CV3, other carbonaceous chondrites (CI, CM) and ordinary chondrites (H, L, LL).

The CV3 chondrites analyzed for this study show group II-type CI-normalized rare earth element (REE) patterns with enrichment in the light REE (La-Sm) relative to the heavy REE (Gd-Lu) and positive anomalies for Tm and Yb. These patterns suggest an overabundance of a refractory component similar to group II CAI in CV3 chondrites relative to other carbonaceous chondrites, consistent with their elevated Al/Si ratios [1].

The unfractionated REE patterns and the lower REE abundance in the CI, CM and ordinary chondrites (H, L, LL) compared to the CV3 chondrites and their decreasing REE to main component element (e.g. Mg, Si, Ni, Cr) ratios indicate a lower abundance of the refractory component and a higher abundance of the main sequence Mg-Fe silicates.

The fractionated REE patterns in the CV3 chondrites arise from fractional condensation at high temperature [3] in the solar nebula. Their preservation at the bulk chondrite scale suggests that the various components in chondritic meteorites originated in different environments and were efficiently transported, but not entirely mixed in the solar nebula. Consequently, bulk planetary bodies may have REE patterns different from CI chondrites.

[1] Palme, H., (2000). *Space Sci. Rev.* **192**, 237-262. [2] Willbold, M. and Jochum, K. P., (2005). *Geostandards Newsletters* **29**, 63-82. [3] Boynton, W.V., (1975). *Geochim. Cosmochim. Acta* **39**, 569-584.

Decreasing oxygen in the oxygen minimum zone of the eastern tropical North Atlantic

LOTHAR STRAMMA, MARTIN VISBECK, PETER BRANDT, TOSTE TANHUA AND DOUGLAS WALLACE

Leibniz Institute of Marine Sciences, IFM-GEOMAR, 24105 Kiel, Germany (lstramma@ifm-geomar.de)

Biogeochemical model runs over centuries predict an overall decline in oceanic dissolved oxygen concentration and a consequent expansion of the mid-depth oxygen minimum zones under global warming conditions [1]. The data in the tropical oceans are too sparse for continuous oxygen time series, but recently an expansion of the oxygen minimum zones at some selected regions of the tropical oceans were reported for the last 50 years [2].

A new large German research initiative (http://www.sfb754.de) focusses on the changes in the oxygen minimum zone (OMZ). In the context of this research initiative a detailed survey of the OMZ in the eastern tropical North Atlantic south of the Cape Verde Islands was carried out in November and December 2008 with a total of 225 CTD-oxygen profiles recorded. This investigation of the OMZ revealed a deoxygenation leading to lower dissolved oxygen values for the absolute minumum and lower oxygen concentrations in the core-layer of the OMZ. At the same time the oxygen content increased in the upper part of the OMZ. While the record low oxygen minima would support an expanding oxygen minimum zone as described for the last 50 years for some tropical regions [2] the increasing oxygen content in the upper central water layer does not support a vertical expansion of the OMZ. The vertical variability in the oxygen changes suggest differential changes in the ventilation of different water layers of the OMZ. These more complicated pattern as well as the record low oxygen values of the OMZ core strongly recommend continuous future surveys of the oxygen changes.

[1] Oschlies, A., Schulz, K.G., Riebesell, U. & Schmittner, A. (2008) *Global Biogeochem. Cyc*les **22**, doi:10.1029/2007GB 003147. [2] Stramma, L., Johnson, G.C., Sprintall, J. & Mohrholz, V. (2008) *Science* **320**, 655-658.