Diatom-bound trace metals: A tracer for past changes in micronutrients availability?

LAETITIA E. PICHEVIN*, WALTER GEIBERT AND RAJA S. GANESHRAM

School of Geosciences, Grant Institute, West Mains Road, Edinburgh EH9 3JW, UK
(*correspondence: laetitia.pichevin@ed.ac.uk)

Micronutrient input to the ocean is considered to have played a modulating role on the marine carbon pump and global climate throughout the past. An appropriate proxy for micronutrient bioavailability in the surface ocean and uptake by the phytoplankton was hitherto lacking. Culture experiments have shown that diatoms incorporate elements such as Zn and (potentially) Fe into their frustules in proportion with their availability in the medium [1, 2]. Hence, diatom-bound metals concentrations could be used to track past changes in marine micronutrients availability. However, whether the signal recorded by the living diatoms is fully transferred to the sediment has never been tested. In order to measure the impact of diagenetic processes during settling and burial on the trace metals signal biologically incorporated into the frustules, we compared diatom-bound trace metals content in surface sediments, traps and in suspended particles collected in the overlying surface water. Both ICP-OES and the ion microprobe techniques were used. Our results suggest that for most of the metals considered in this study, diagenetic processes alter the recording of the signal with the notable exception of Zn and, potentially, Mg.

[1] Ellwood, M. J. & Hunter, K. A. Limnology & (2000) *Oceanography* **45**, 1517–1524. [2] Jaccard, T. Ariztegui, D. & Wilkinson, K. J. (2009) *Chemical Geology* **265**, 381–386.

Experimental investigation of garnet-cpx geobarometers in eclogites

J. PICKLES*, J.D. BLUNDY, R. SWEENEY AND C.B. SMITH

University of Bristol, Bristol. UK
(*correspondence: Joe.Pickles@bristol.ac.uk)

The development of accurate geothermometers has greatly helped in the understanding of metamorphic petrology and magmatic processes. The development of geobarometers applicable to eclogitic assemblages has previously not received the same attention. Here we present both empirical and thermodynamic models based on the partitioning of major and minor elements between garnet and cpx as determined experimentally in the P-T range 1-11 GPa and 800-1700 °C.

The cpx-garnet partitioning of Na, Ca and Ti are found to be strongly sensitive to pressure, with Dgt/cpx increasing with increasing pressure. The sensitivity of D_{Ca} to pressure increases with decreasing garnet mg#. An empirical model of D_{Ca} was derived from over 150 mineral pairs from experiments. For garnets with an mg#< 0.7 the following calibration is valid for pressures between 1 and 11 GPa and temperatures between 800 and 1300 °C.

The barometer is:

$$P = (\ln D_{Ca} - 4.48 + 1.26Si^{gnt} + 0.19Fe^{gnt} + 1.46Mn^{gnt} + 0.87Mg^{gnt}) * 4.17$$

Where D_{Ca} is the concentration of Ca in garnet divided by Ca in cpx and Si^{gnt} is Si in garnet, all in atoms pfu. This model is insensitive to temperature, thus avoiding errors associated with geothermometers. Based on the regression of the data we estimate that the model has a standard error of 0.5 GPa.

We also investigated a number of exchange reactions as potential barometers, including reactions involving silica and rutile. These exchange reactions show considerable compositional sensitivity at fixed P and T, testifying to non-ideality in garnet and cpx. Using a ternary asymmetric model we derive non-ideal interaction parameters for each mineral. We find that barometers based on the exchange of Ca between garnet and cpx provide the most robust barometers.