

## Insights on biomineralisation and the nature of 'vital effects' using Boron isotopes

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The boron isotopic compositions of foraminiferal and coral carbonate provide invaluable tools for the reconstruction of past CO<sub>2</sub> levels [e.g. 1, 2]. However, calibration studies in both foraminifera and corals have illustrated that many organisms do not conform fully to our theoretical understanding of the proxy and there is often (but not always) a biological imprint upon recorded values. In order to construct reliable palaeo-pH and CO<sub>2</sub> records, it is crucial that we understand, quantify and correct for biological influence or 'vital effects' when applying the proxy to any given organism [3].

Here we present the results of efforts to quantify the biological influence on the boron isotopic signatures of planktic foraminiferal and coral carbonates. Calibration (via MC-ICPMS) of both symbiont-bearing and non-symbiont-bearing foraminifera (from cultures, tows and sediments) provides insight into the influence of symbiont photosynthesis, symbiont-host respiration and host calcification on the microenvironment pH around the foraminifera and thus the recorded boron isotopic signature of calcite. In this way, biological and environmental signals can be disentangled and proxy records extended.

In addition, analyses of coral carbonate (*Siderastrea siderea*) cultured under controlled pH not only constitute a new species-specific δ<sup>11</sup>B calibration for palaeo-application, but shed light on the calcifying fluid pH of scleractinian corals when viewed in the context of recent pH micro-electrode measurements [4].

[1] Foster (2008) *EPSL* **271**, 254-266.

[2] Hönisch et al. (2004) *Geochimica et Cosmochimica Acta* **68**, 3675-3685.

[3] Pagani et al. (2005) *Geochimica et Cosmochimica Acta* **69**, 953-961.

[4] Ries (2011) *Geochimica et Cosmochimica Acta* **75**, 4053-4064.

## Groundwater evolution under permafrost conditions, South-West Greenland

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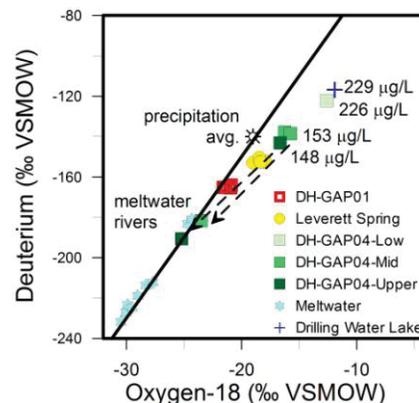
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The Greenland Analogue Project (GAP) aims to further the understanding of groundwater evolution due to the influence of a continental ice sheet and continuous permafrost. Geochemical and hydrogeological processes are being studied in the area around Kangerlussuaq, Greenland. Geochemical and isotopic (<sup>18</sup>O, <sup>2</sup>H, <sup>3</sup>H, <sup>37</sup>Cl, <sup>87</sup>Sr and <sup>34</sup>S and <sup>18</sup>O of SO<sub>4</sub>) tracers are used to interpret the flow and geochemical evolution of groundwater in this crystalline environment.

Three boreholes have been drilled since 2009. Two boreholes are equipped with groundwater sampling devices: DH-GAP01 intersects a talik beneath a large lake and DH-GAP04 provides 3 sampling sections beneath and adjacent to the ice.

Talik waters from DH-GAP01 and the first groundwaters sampled at DH-GAP04 appear to be geochemically similar in many ways, such as high concentrations of sulphate. High sulphate groundwaters are also found in other permafrost impacted crystalline environments in Northern Canada [1],[2]. GAP borehole waters are depleted in δ<sup>18</sup>O and δ<sup>2</sup>H compared to modern precipitation when a simple linear mixing model is used to calculate final compositions of DH-GAP04 based on the concentration of tracer in the samples (Fig. 1). Further sampling of DH-GAP04 is planned for 2012.

A spring located directly in front of Leverett Glacier, about 10 km south of DH-GAP01, yields groundwaters that are geochemically distinct from the waters sampled from the boreholes with elevated iron concentrations up to 14.8 mg/L.



**Figure 1:** δ<sup>18</sup>O vs δ<sup>2</sup>H for groundwaters and glacial meltwaters. Concentrations are the sodium fluorescein tracer used in drilling.

[1] Stotler et al. (2009) *J. Hydrol* **373**, 80-95. [2] Frape, Fritz & McNutt (1984) *Geochim. Cosmochim. Acta* **48**, 1617-1627.