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The influence of salinity on trace metal and isotope ratios in inorganic and biogenic calcium carbonate

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Trace metal ratios in natural calcium carbonates are now widely used to reconstruct past ocean temperatures and as proxies for variables such as carbonate ion concentration and nutrient utilization. Although several studies have suggested the influence of salinity on such ratios, few have attempted to constrain the magnitude of such an effect. In this study, we present a systematic attempt to constrain the role of salinity in controlling trace-metal uptake into inorganic and biogenic carbonates, with an eye to both assessing the influence of salinity on established proxies, and to perhaps establishing a new proxy for salinity itself.

In a series of laboratory experiments, calcite and aragonite samples were grown inorganically under carefully controlled conditions in a seawater-like solution with salinity ranging from 10 to 50 psu. ICP analysis of resulting carbonates demonstrates a systematic variation of greater than 1% per psu for incorporation of elements such as U, Li, Mg, Sr, Ba, Cd, Na, and Zn. There is a strong dependence on mineralogy with, for instance, Li/Ca increasing markedly with salinity in calcite, but decreasing slightly in aragonite. Lithium isotopes measured on the same samples also show a systematic difference between the two minerals. Analysis of other metal isotope systems on the samples is underway.

In order to test for similar trace-element effects in biogenic carbonate, seasonal slices from a Pacific coral which experienced >1psu ENSO-related salinity changes have been sampled, and foraminifera from a strong salinity gradient in the Mediterranean have been picked. Analysis of trace element and isotope ratios on these samples will assess the variability of biogenic calcium-carbonate chemistry with salinity, and enable a direct comparison with that observed during inorganic mineral growth.

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Behaviour of suspended particulate matter (SPM) in a North Sea estuary: Implications for the fate of peat-derived carbon

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Rising temperatures and changing rainfall patterns threaten northern blanket peat, which globally contains 20% of the total soil carbon storage of 1.8×10^{18} g C. The documented increase in organic C in aquatic systems draining peatlands indicates an enhanced release of C from peats [1]. The efficiency of peat carbon cycling in riverine and estuarine systems will ultimately determine its fate - the proportion of this C that will be oxidised and released to the atmosphere as CO₂, buried in sediments and added to the large pool of dissolved organic carbon in the ocean.

SPM was collected from the Tyne Estuary (NE England), whose drainage basin includes large areas of blanket peat afforestation. The main organic fraction of the SPM was characterised using stable C & N isotopic and elemental ratios. Elemental concentrations (Al, Fe, Ti, Mn, Si, Ca, Mg, S, P) in SPM were used to characterise both biogenic and lithogenic input. The isotopic signatures, in conjunction with high C/N ratios, suggest a large input of peat-derived organic matter ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\text{C}/\text{N}_{\text{at}}$ of -27.7‰ , $+3.3\text{‰}$, 21.2) into the estuary during periods of increased winter discharge (144.6 m³/s, Feb-02). In contrast, under lower flow conditions experienced in the drier summer months (8.6, 7.3 m³/s during Jul-02, Jul-03) the relative input of terrestrial organic C decreases, and the POC is comprised of a greater % of autochthonous and marine-derived organic matter. Changes in the relative importance of the maximum turbidity zone plays a significant role in determining the extent to which labile riverine POC is potentially mineralised in the estuary.

References

- [1] Tranvik, L. J. and Jansson, M. (2002) *Nature* **415**, 861-862.