Boron isotope constraints on deglacial deepwater formation and CO_2 release from the North Pacific

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Deep convective mixing is thought to play a key role in glacial-interglacial cycles in atmospheric CO_2 by providing a pathway for carbon between the deep ocean and the atmosphere. Such mixing is inhibited in the subpolar North Pacific by very low surface water salinity [1], and as a result the North Pacific is not typically thought to play a direct role in glacial-interglacial CO_2 change [2]. Here we challenge this assumption with new boron isotope and radiocarbon data, that track the behaviour of carbon in the deep North Pacific over the last deglaciation. We show that over the last deglaciation deep water formed to 3600 m in the North Pacific. This is supported by experiments with an earth system model, which show that deep mixing in the North Pacific can account for a significant proportion of atmospheric CO_2 rise during deglaciations.

[1] Warren (1983) *Journal of Marine Research* **41**, 327-347. [2] Sigman et al. (2010) *Nature* **407**, 47-55.

Early diagenesis of As and P in tropical deltaic systems

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In a comparative study of the diagenetic cycling of As in tropical shelf systems, vertical profiles of dissolved and solid phase arsenic were measured in the Guianas mudbelt, a coastal extension of Amazon delta deposits, and in the clinoform delta of the Gulf of Papua, Papua New Guinea. Both tropical systems are highly energetic, sedimentary depocenters with little anthropogenic contaminant input. Some of the highest concentrations of dissolved arsenic in the world are found in the French Guiana porewater samples, with maxima ranging from 5μM (375ppb) up to 13μM (975ppb). Mudbank As concentrations are typically higher than those found in the upstream Amazon delta (~2 – 4 μM). In contrast, porewater samples from the Gulf of Papua overall exhibited lower As maxima than Amazon-Guianas deposits, most often below 1μM, though in Bamu estuary sediments, concentrations exceeded 5μM. At most sites in the upper 10 – 15cm, dissolved arsenic and SRP appears to correlate with dissolved iron, suggesting concomitant release via dissolution of a solid Fe carrier phase, most likely Fe – oxyhydroxide.

In both the Amazon delta and French Guiana mudbank sediments, high As concentrations extend several decimeters downcore, in some cases showing little sign of attenuation (i.e. KS00-17 LC). In the Gulf of Papua, however, after reaching a subsurface maximum, there is little dissolved As remaining in solution with depth in most cores analyzed to date. Sequential solid phase extractions of French Guiana deposits indicate high amounts of As, reaching 300 nmol/g dry sediment. Solid phase As in the Gulf of Papua is ~10x lower than in the Amazon – Guianas mudbelt. Dissolved and solid phase phosphate were measured in several cores from Kourou – Sinnamary mudbank. Total solid phase phosphate (boiling aqua regia leach) measured between 10 - 19 μmol/g, and showed a marked correlation (r2 ranging from 0.7 – 0.95) with total solid phase iron downcore. Maximum dissolved P, SRP, ranged up to 150 μM. Total P at several Gulf of Papua sites were ~20 – 30 μmol/g.