Holocene records of chlorin N isotopes

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Nitrogen isotope ratios measured in sedimentary chlorophyll degradation products provide a diagenetically unaltered signal of the marine nitrogen cycle during deposition. Additionally, due to taxonomic differences in fractionation associated with chlorophyll biosynthesis, these records can be used to reconstruct the cyanobacterial contribution to buried organic matter. If diazotrophic cyanobacterial contribution to biomass increases during enhanced N_2 fixation, then chlorin N isotope records may provide an additional constraint on the importance of this source of N to surface waters in the geologic past. We reconstructed low resolution records of chlorin $\delta^{15}N$ values from the last glacial maximum to recent sediments in four oceanographically distinct settings. Samples were taken from ODP sites 1234 (Chile Margin), 1237 (Nazca Ridge, Peru), 1063 (Bermuda Rise), and core 17964 from the South China Sea. These four globally-distributed sites represent different nutrient regimes characterized by a wide range of modern P* values and potential rates of N_2 fixation. Chlorin $\delta^{15}N$ data were compared to new or previously published bulk N data to examine for diagenetic enrichment of bulk N (causing ^{15}N offsets to increase) or cyaobacterial contribution to export (causing ^{15}N offsets to decrease). Preliminary data show an average $\delta^{15}N$ offset of ~5-5.5‰ between bulk and chlorin N at all sites, suggesting predominantly algal export production irrespective of N_2 fixation regime and bulk values of $\delta^{15}N$.

Efficient preservation of terrestrial organic carbon offshore Taiwan: Implications for the global carbon cycle

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Photosynthesis on land produces terrestrial biomass and sequesters atmospheric CO_2 within living matter. Geological sequestration of CO_2 can occur if this terrestrial organic carbon (OC) is eroded and transported to marine sediments where accummulation rates are high[1], influencing Earth's radiation energy balance. Mountain rivers draining islands of Oceania have amongst the highest erosion rates of terrestrial OC and sediment[2,3] and it is of critical importance to understand its fate upon entering the ocean. Here we use radiocarbon ($\Delta^{14}C_{org}$, ‰), stable isotopes ($\delta^{13}C_{org}$, ‰) and OC content (C_{org}, %) to track terrestrial OC from Taiwan from river sediments to ocean sediment traps and box-cores collected from around the island. We account for fossil OC from sedimentary rock, while assessing the range of delivery mechanisms to the ocean by mountain rivers.

During floods at high suspended sediment concentrations, we observe efficient transfer of terrestrial OC (both fossil and non-fossil) to the deep ocean, and evidence for its longer-term presvervation in marine sediments. Large amounts of terrestrial sediment are also delivered to the surface ocean by rivers, dispersing OC over a larger area[3]. Marine sediments sourced by this mechanism have a positive relationship between $\Delta^{14}C_{org}$ and $\delta^{13}C_{org}$, and a negative relationship between $1/C_{org}$ and $\Delta^{14}C_{org}$. Employing end member mixing analysis and by modelling OC loss scenarios, we show that these are the product of mixing between marine OC and terrestrial OC (itself a fossil and non-fossil mixture) and that 80-100% of terrestrial OC is preserved in marine sediments, suggesting much higher burial efficiencies than previously hypothesed[2]. Our findings allow for a conservative estimate of recent CO_2 sequestration by terrestrial OC burial across Oceania, which comprises a significant proportion of global OC burial. We thus postulate that tropical mountain islands provide a strong coupling between tectonic uplift and the carbon cycle, one that is moderated by the climatic variability that controls terrestrial OC delivery to the ocean.

[1] Galy *et al* (2007) *Nature* **450,** 407-410. [2] Hilton *et al* (2012) *Global Biogeochemical Cycles* **26**, GB3014. [3] Kao & Milliman (2008) *Journal of Geology* **116**, 431-448.

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