Emerging understanding of anthropogenic interferences in the ecosystem silica filter

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The annual fixation of DSi into terrestrial vegetation is 60 to 200 Tmole, 10–40 times more than the yearly export of DSi from the terrestrial geobiosphere to the coastal zone and 3-6 times more than annual weathering of silicates. Ecosystems form a large filter between mobilization of DSi by silicate weathering and mobilization to rivers. A large reservoir of biogenic amorphous Si (mostly plant phytoliths) and pedogenically reworked amorphous Si (ASi) accumulates in soils. ASi is substantially more soluble than mineral Si. Still, ASi persistence and reactivity in soils, the dependence of the ASi turnover on ecological processes and ultimately the global relevance in Si budgets are poorly constrained [1]. A major challenge is presented by the difficulty to separate pedogenic and biogenic amorphous Si phases in the soil. This hampers quantification of the silicate weathering-related C-sink and accurate modelling of transport of Si to rivers and estuaries, where Si plays a crucial in phytoplankton productivity.

Human land management can cause abrupt shifts to the biogeochemical cycle in terrestrial ecosystems and their ability to sequester Si. Our results from a novel technique that allows for separation of biogenic and pedogenic ASi phases, shows that turnover rates of ASi in temperate cultivated soils are strongly reduced compared to forests and stocks of pedogenic ASi are depleted. Newly acquired analysis of Si isotopes in soil water also show this. This results in timescale dependent, 2-4 fold shifts in terrestrial Si mobilisation [2]. Human harvest of crop ASi has created a parallel anthropogenic Si cycle, which has received virtually no quantification so far [3]. Our observations show that intense domestic reindeer and cattle grazing alters physical and chemical reactivity of biogenic ASi (Si is a defense mechanism against herbivory) and can causes abrupt shifts in ecosystem ASi storage and cycling. The combination of experimental, field and modelling studies shows that land use has strongly altered mineral-soil-plant interactions.

[1] Struyf & Conley (2012), *Biogeochemistry*, 107, 9-18. [2] Struyf *et al.* (2010), *Nature Comm*, 1,129 [3] Vandevenne *et al.* (2012), Front Ecol Environ, 243-48.

Deep-sea coral amino acids illuminate ecosystem processes on South East Australia seamounts

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South-east Australian seamounts and their associated deep-sea ecosystems, are located in an oceanographically complex and climatically sensitive region. Across this region, Bamboo Corals inhabit a tremendous depth range (600-4000m) archiving surface processes by incorporating raining particulates into their banded skeletons. Bulk organic ^{15}N has previously been used to substantiate the region's shifting surface regimes in response to current climate change, but trophic enrichment was necessarily approximated, obscuring the ^{15}N-signal of the producers at the base of the foodweb [1].

In this study, we revisit the ^{15}N archive, instead using invididual amino acids (AA) to reconstruct ecosystem dynamics. We are able to capture and decouple, a centenary of trophic interactions from the ^{15}N-signal of primary production. Furthermore, as specimens were collected between 1000-3000m, we are able to explore deep-sea particle transformations and microbial heterotrophy that connects surface and deepwater ecosystems. By exploiting previously validated ^{15}N-AA patterns [2] and considering those in the ^{13}C-AA record, we propose likely mechanisms that could support the inexplicably high biomass that has been reported within the local bathyl zone [3].

Our preliminary results indicate that clear distinctions seen between depths in the bulk record naturally reflect the isotopic signature of the most abundant AA, glycine, as well as trophic complexity. Furthermore we find evidence of differing particulate processing histories, provenance and species effects that all have important implications for the future interpretation of records from deep-sea coral organics.

[1] Sherwood *et al.* (2009) *Mar. Ecol. Prog. Ser.* **397**, 209-218. [2] McCarthy *et al.* (2007) *GCA* **71**, 4727-4744. [3] Thresher *et al.* (2011) *Nat. Sci. Reports* **1**, 119.

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