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Isotope tracer investigations of organic C and N cycling at chemosynthetic sites

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The cycling and burial of organic carbon in marine sediments is of interest both in terms of understanding this carbon sequestration term, and because organic detritus provides carbon and energy to benthic ecosystems.
Benthic C-cycling at hydrothermal vent and cold seep settings is particularly interesting due to the relative paucity of knowledge of the functioning of such ecosystems, and due to the occurrence there of chemosynthesis. Chemosynthetic ecosystems have an in situ source of fixed carbon, as well as photosynthetic organic detritus sinking through the water column. However, it is unclear to what extent sedimentary faunal communities rely on each of these carbon sources, and whether that varies with taxon. Further, the relatively high biomass and organic carbon availability resulting from chemosynthesis mean that the biological processes which drive benthic carbon cycling are unlikely to show the same patterns and rates as at non-chemosynthetic deep-sea sites.
In January-February 2011 isotope tracer experiments were conducted on recovered sediment cores at two diffuse hydrothermal venting, one methane rich, and one non-chemosynthetic background site in the Southern Ocean (Bransfield Strait and on the South Georgia margin). Pairs of cores were amended with either 13C and15N labelled algae, or 13C bicarbonate and 15N ammonia solution. They were incubated for 2.5 d under seafloor conditions, and time series water samples were taken. At the end of the experiments, sediment samples were preserved for extraction and isotopic analysis of fauna and microbial lipids.
Initial data show that respiration of algal carbon to CO_2 was more rapid at chemosynthetic sites compared to the background site. Chemosynthetic sites also showed evidence for the production and subsequent consumption/cycling of isotopically labelled dissolved organic carbon, which the non-chemosynthetic site did not. Faunal isotopic signatures indicate uptake of isotopic label into metazoans from both photosynthetic (algae) and chemosynthetic (bicarbonate and ammonium) substrates. Together, these data suggest that benthic C-cycling at chemosynthetic sites is more dynamic than that at otherwise similar, non-chemosynthetic deep-sea sites.