

Constraining the Nd isotopic composition of Antarctic Bottom Water formed in the Weddell Sea

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The Southern Ocean is a key region linking ocean circulation and global climate. Antarctic Bottom Water (AABW) ventilates much of the world's deep ocean as it propagates, together with Circumpolar Deep Water, via the Antarctic Circumpolar Current (ACC) from the Atlantic sector of the Southern Ocean into the Indian and Pacific sectors, and spreads northwards into deep basins. Proxy data from sediment cores suggest that during Late Quaternary glacial periods, increased volumes of AABW filled the deep ocean, perhaps enlarging the carbon reservoir of the world ocean and lowering atmospheric carbon dioxide. Much of the evidence for glacial circulation of deep and bottom water masses is based on stable carbon isotope ($\delta^{13}\text{C}$) records from benthic foraminifera. This proxy, however, can be interpreted as either indicating changes in water mass sources, biological productivity or air-sea gas exchange. This is especially problematic in the glacial Southern Ocean where all three of these controls are likely to have been dramatically different than today. Thus Nd isotopes have been utilized as a deep water source tracer to reconstruct the balance of North Atlantic Deep Water (NADW) and AABW in the global deep ocean. Here we constrain the Nd isotopic composition of AABW formed in the Weddell Sea, allowing us to more accurately determine past changes in the mixing ratio of NADW and AABW at other coresites. The Nd isotopic composition of reductive sediment leaches, foraminifera, and Holocene Fe-Mn coatings on dropstones were analysed from cores located along the flowpath of the clockwise flowing Weddell Sea gyre. These allow us not only to constrain potential temporal variability in the Nd isotopic composition of newly-formed AABW, but also to show how it acquires this Nd isotopic composition as it flows northwards along the Antarctic Peninsula.

Organomineralization drives early chimney edification at the hyperalkaline hydrothermal field of the Prony Bay (New Caledonia)

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The serpentinization process of ultra-mafic rocks by hydrothermal fluids at ultra-slow spreading ridges is recognized as a potential energy source for the development of (sub)surface lithoautotrophic microbial ecosystems. The hydrogen generated by the hydration of Fe²⁺-bearing silicates can reduce CO₂ coming either from mantle degassing or seawater forming methane and other light hydrocarbons similarly to methanogenesis. In the 2000's the discovery of the Lost City Hydrothermal Field (LCHF) hosted on ultramafic substratum near the Mid-Atlantic ridge changed our vision of how and where life can have emerged on Earth and on other planets [1]. It highlighted the importance of serpentinization for the abiotic production of prebiotic molecules and for the sustaining of deep microbial life.

The Prony Bay Hydrothermal Field, discovered in New Caledonia, presents strong mineralogical, geochemical and microbiological similarities with the Lost City Field. The low-temperature (40°C) hyperalkaline springs (pH 11) rich in hydrogen and methane discharge at shallow depth (0-50mbsl) forming carbonated chimneys that host peculiar microflora.

We used a combined geomicrobiological approach (SEM, XRD, Q-ICP-MS, CLSM and FISH) to track microbial cells within the mineralized edifice and to evaluate their impact on the carbonation and (bio)mineralization processes. Similarly to the LCHF [2] the mineralogy is here dominated by brucite and aragonite being replaced by calcite when ageing signing seawater incursions. Filamentous bacteria belonging to the Firmicutes phylum were found to initiate the mineral nucleation through organomineralization processes in active discharging conduits. Mineralized filaments appear ubiquitous in the early stages of the chimney formation, then being consolidated as the mineralization proceeds. It leads to peculiar morphologies whose diagenesis need to be further investigated to be then searched for in the rock record as biosignatures of primitive serpentinization-based ecosystems.

[1] Kelley *et al* (2001), *Nature* **412**, 145-149. [2] Ludwig *et al* (2006), *GCA* **70**, 3625-3645.