Seawater temperature and pH changes of Southern Ocean Water Masses reconstructed from the geochemistry of Antarctic cold-water corals

Paolo Montagna[1], Malcolm McCulloch[2], Julie Trotter[3], Vincenzo Ricca[1], Marco Taviani[1]

[1] Institute of Marine Sciences, National Research Council, 40129 Bologna, Italy; paolo.montagna@bo.ismar.cnr.it
[2] School of Earth and Environment, UWA Oceans Institute and ARC Centre of Excellence for Coral Reef Studies, The University of Western Australia, Crawley, WA, 6009, Australia;
[3] School of Earth and Environment and UWA Oceans Institute, The University of Western Australia, Crawley, WA, 6009, Australia.

<u>Abstract</u>

Waters south of the Polar Front become undersaturated with respect to aragonite and calcite, strongly limiting carbonate accumulation and preservation and hence the possibility to use calcium carbonate-precipitating organisms, such as foraminifera and corals, as paleoclimate archives. Cold-water corals are one of the few calcifying organisms that can cope with this corrosive environment, so are potential candidates for reconstructing temperature and pH records at high resolution (annual) over centennial timescales.
Trace elements and boron isotopes were measured by quadrupole and MC-ICPMS methods in four specimens of the deep-sea coral *Flabellum*, retrieved live from the Ross Sea and offshore Bouvet Island at depths ranging between 390 and 760m.
The temperature-sensitive elements (Li/Mg and Sr/Ca) and the boron isotope (□^{11}B) pH proxy show a consistent pattern between different transects within each specimen, with excellent reproducibility, suggesting minimal influence from 'vital effects'. Both the Li/Mg-derived temperatures and the □^{11}B-derived pH of the younger portion of the corals are consistent with *in-situ* instrumental values. Importantly, these corals record a general trend of decreasing pH over the past few decades, as well as both warming and cooling trends, which depend on the ambient water masses (High Salinity Shelf Water vs. Circumpolar Deep Water).
Specific geochemical signals encoded in the aragonite skeleton of the Antarctic corals are shown to be robust proxies for the physical and chemical properties of the water masses in which the corals grew. In particular, the Li/Mg and boron isotopic composition of the coral *Flabellum* vary with temperature and pH respectively, providing a new tool to reconstruct the variability of these key parameters in deep water environments.