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Geochemical Records in Canadian Bamboo Corals, Potentials and Pitfalls

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Deep-sea gorgonian octocorals of the families Primnoidae and Isididae exhibit centennial-scale lifespans and in some species annually-secreted growth rings, which potentially provide high-resolution long term paleoceanographic records. We examined trace element and stable carbon (δ^{13}C) and oxygen (δ^{18}O) isotope variability in a live-collected 140 year old specimen of Keratoisis ornata (Isididae) from the southern Grand Banks of Newfoundland (700 m water depth) and in a late Holocene K. ornata form the Hudson Strait dated at ~1.1 ka BP (~200 yr life-span). Skeletal chronology was previously established through a combination of AMS-14C, 210Pb and bomb-14C dating and revealed a growth rate of 76 μm/yr. Hydrographic records from the Southern Grand Bank extend back to the early 20th century, overlapping with the coral record almost continuously over a period of 96 years. Focusing on the skeletal calcite fraction, trace elements were measured along parallel radii of axial sections using laser ablation ICP-MS, while δ^{13}C and δ^{18}O were measured on micromilled samples acquired at a spatial resolution of 100 μm. Trace elements and stable isotopes turned out to be strongly linked to microstructure, with strong differences between the juvenile and the adult skeletal portions. Isotopic values were relatively depleted in juvenile calcite bands, while trace elements were strongly enriched in Li, Mg and B. Only the heaviest δ^{18}O-values from the adult phase are in equilibrium with seawater δ^{18}O-composition and temperature, inhibiting the extraction of temperature time-series from ontogenetic transects. Bulk adult Mg/Ca-values at 4°C fit the temperature calibration for P. resedaeformis by Sherwood et al. (2005), as well as with the calibration for Lepidisis sp. by Thresher et al. (2010). Long-term temperature series are at present difficult to extract, because Mg/Ca show a similar systematic ontogenetic decrease in the Recent and the late Holocene K. ornata specimens. This leads to a reconstruction of an apparent 1°C drop across the last 96 years, which is opposite to the measured 1°C rise. Overall, our results demonstrate that further development is required to interpret geochemical patterns in gorgonian calcites as reliable environmental proxies.

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Thresher RE, Wilson NC, MacRae CM, Neil H (2010) Temperature effects on the calcite skeletal composition of deep-water gorgonians (Isididae). Geochimica et Cosmochimica Acta 74:4655-4670.