Utility of $\delta^{18}O$ for paleotemperature determinations from Pleistocene (80 to 500 ka) corals: case study from the Ironshore Formation, Grand Cayman, British West Indies

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Fossil corals provide a unique opportunity for paleoclimate research if they incorporate seawater proxies into their aragonitic skeletons during growth. Corals, however, can only produce reliable environmental information if they have not been diagenetically altered, an issue that becomes increasingly likely as the age of the corals increase. This premise is assessed by examining *Orbicella annularis* collected from the Pleistocene Ironshore Formation (Units A-F) on Grand Cayman, which range from 80 to 500 ka in age. Although thin section, Scanning Electron Microscopy, and X-Ray diffraction analyses, can highlight obvious mineralogical changes, subtle diagenetic changes in the trace element content of the skeletons may escape detection. For corals from the Ironshore Formation, elevated Mg and low Sr concentrations provide evidence of subtle diagenetic changes even in corals that have retained their primary aragonitic skeleton. Thus, coral skeletons that are formed of > 90 wt% aragonite, exhibit no cementation, have Mg/Ca ratios < 12.0 mmol/mol and Sr/Ca ratios > 8.0 mmol/mol, and $\delta^{13}C_{VDPB}$ values > – 3.0‰ and $\delta^{18}O_{SMOW}$ values > 25.0‰ can be used for calculating surface seawater temperatures. Adoption of these criteria shows that the corals from Units D-F, have not undergone extensive alteration and can therefore be used to calculate sea surface temperatures (SST). In contrast, the corals from Units A-C have been altered and cannot be used for this purpose. Based on the $\delta^{18}O$-SST proxy, the calculated SST ranged from 20 to 32°C for Unit D (~125 ka), 14 to 27°C for Unit E (~104 ka), and 20 to 30°C for Unit F (~80 ka). The calculated SST and the corresponding temperature profiles are consistent with global SST reconstructions during the Pleistocene. The corals from Unit D record an overall increase in calculated SST consistent with elevated temperatures associated with Marine Isotope Stage (MIS) 5e, whereas the corals from Unit E and F record overall cooling consistent with the end of the peak interglacials of MIS 5c and 5a, respectively.

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