

THE OXYGEN ISOTOPE CLIMATE SIGNAL AND ITS RELATION TO SKELETAL EXTENSION IN *PORITES* CORALS

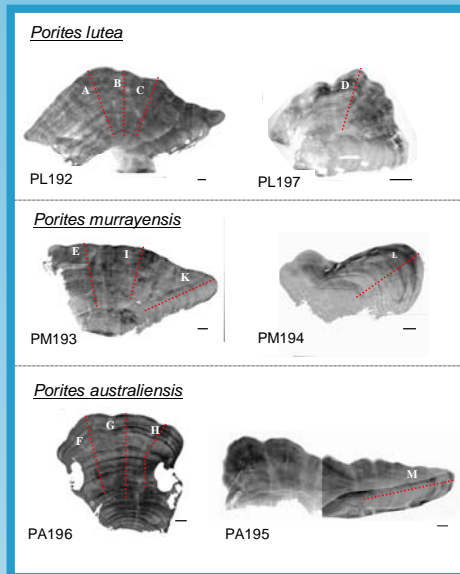


Fig. 1. X-ray photographs of ± 5 mm thick coral slabs of *Porites lutea*, *murrayensis* and *australiensis*. Dotted red lines indicate trajectories for drilling $\delta^{18}\text{O}$ time-series. Scale bars = 1 cm.

Coral skeletons consist of aragonite (CaCO_3) that has been precipitated throughout a colony's life - which may be up to several hundreds of years. The skeletal stable oxygen isotope ratios are negatively correlated to sea surface temperature (SST) and therefore widely used to reconstruct (paleo-)climate. Though temperature is the most important agent determining skeletal $\delta^{18}\text{O}$ ratios, other sources of variation - presumably of minor importance - may obscure the $\delta^{18}\text{O}$ climate information.

To investigate if and to which extent species specific "vital effects" or growth-related "kinetic effects" may influence the reading of the $\delta^{18}\text{O}$ climate signal, we compared a total of 12 replicate $\delta^{18}\text{O}$ time-series that were retrieved from different colonies and species of the massive coral *Porites* (Fig. 1). This approach is unique with regard to the number of replicate profiles. The comparisons on the 3 different scales of intracolony, intercolony and between species level provides unambiguous information as for the presence of species specific vital effects".

Corals were sampled at the same day and site at the pseudoatoll of Taka Bone Rate, Indonesia (Fig. 2). This site is situated at the western margin of the Western Pacific Warm Pool (WPWP). The replicate $\delta^{18}\text{O}$ time-series should all provide the same information with respect to environmental changes. Any variation between the $\delta^{18}\text{O}$ signal must therefore be of non-environmental origin.



Fig. 2. Sampling Location at Taka Bone Rate, Flores Sea, Indonesia [121°13'E; 6°32'S]

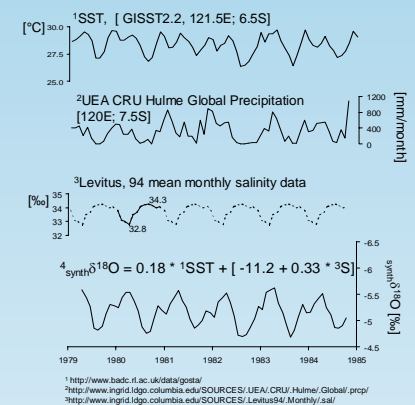


Fig. 3. SST, precipitation and salinity, retrieved from various databases. Synth $\delta^{18}\text{O}$ was calculated from the SST and salinity data.

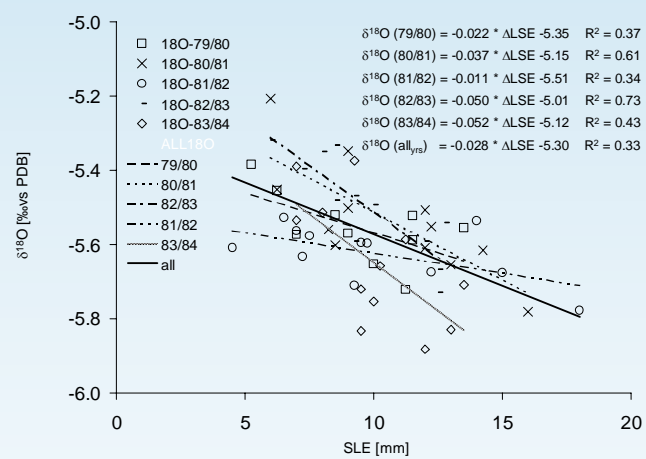


Fig. 4. Mean annual $\delta^{18}\text{O}$ signals versus yearly skeletal linear extension (SLE). Linear regression line between $\delta^{18}\text{O}$ and SLE. Regression function, with R^2 for the different years and for all samples

To avoid variation in the $\delta^{18}\text{O}$ time-series due to environmental conditions, we plotted the mean annual $\delta^{18}\text{O}$ signals versus yearly SLE for each year separately. Correlations between $\delta^{18}\text{O}$ and yearly skeletal growth were weak, but for all years consistently negative. We used the slopes of $\delta^{18}\text{O}$ versus SLE to correct the monthly $\delta^{18}\text{O}$ signals for the variation in SLE. This resulted in better correlations of the $\delta^{18}\text{O}$ time-series to environmental regimes and moreover reduced the differences between corresponding monthly $\delta^{18}\text{O}$ values (Fig. 5).

One prominent feature becomes evident: The coral $\delta^{18}\text{O}$ time series – when corrected for variations in SLE – uniformly depict the early stages of the 1982-83 ENSO event which was characterized by severe droughts in Indonesia and Australia (Fig. 5, right graphs).

Differences between time corresponding $\delta^{18}\text{O}$ signals were as high on an intracolony scale as on between species scale, indicating that variation between $\delta^{18}\text{O}$ time-series was not due to species-specific "vital effects" (Fig. 5, left graphs).

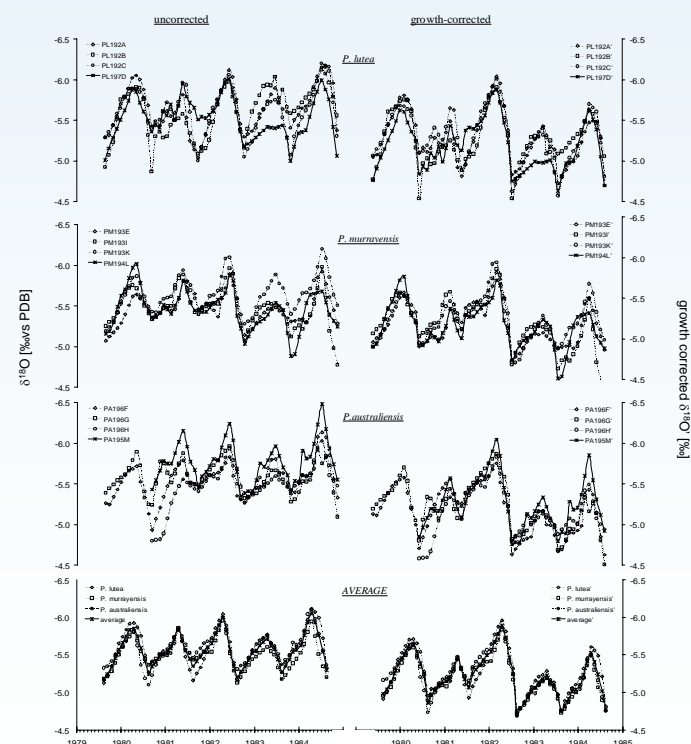


Fig. 5. Left side: Monthly interpolated $\delta^{18}\text{O}$ replicate time-series from the corals *Porites lutea*, (PL, colonies 192 and 197), *P. murrayensis* (PM, colonies 193 and 194), *P. australiensis* (PA, colonies 196 and 195). Mean monthly $\delta^{18}\text{O}$ of the 3 species investigated, and of all 12 replicate profiles (bottom, left). Right side: $\delta^{18}\text{O}$ time-series after correction for variations in SLE (see text) for single profiles and means.