The Influence of Sea Surface Salinity and Temperature on Coral Geochemistry in the Makassar Strait

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Introduction

The Indonesian throughflow (ITF), located in the far western equatorial Pacific, annually transports surface and thermocline depth water from the western Pacific Ocean to the eastern Indian Ocean. The Makassar Strait is the main pathway. *Porites sp.* corals here have strong annual Sr/Ca and oxygen isotope signals. During the boreal winter monsoon buoyant, low salinity Java Sea surface water is driven by the wind into the southern Makassar Strait. This creates a north pressure gradient in the surface layer. This "freshwater plug" inhibits warm surface water from the Pacific Ocean from flowing south into the Indian Ocean and thus, the Indian Ocean cools. This plug is eliminated when the summer winds reverse and more saline Banda Sea surface water is brought in (Gordon 2003)[3]. This study has important implications not only for the Indonesian throughflow, but also oceans world wide, as the ITF is an important part of global thermohaline circulation (Gordon, 1986)[2].

Objectives

This study was conducted to determine if coral Sr/Ca and $\delta^{18}O$ at Kapoposang in the Makassar Strait could be used to reconstruct oceanographic and climatic conditions over time.

Methods

- A 0.8 meter *Porites sp.* coral from Kapoposang (KC4) in the southern Makassar Strait near S.W. Sulawesi (4˚41'S, 118˚55'E) was analyzed
- $\delta^{18}O$ and Sr/Ca were measured on 1mm-scale samples (~10-14 samples per year)
- The annual $\delta^{18}O$ peaks were used to construct a time series with 2 age control points per year.
- Time series then compared to climate indices such as sea surface temperature, sea surface salinity (SSS), SE Asian monsoon, and El Niño Southern Oscillation

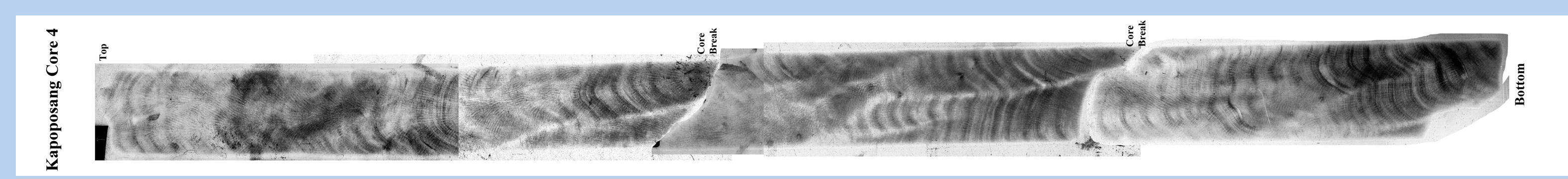

Figure 1: KC4 coral core X-Ray composite

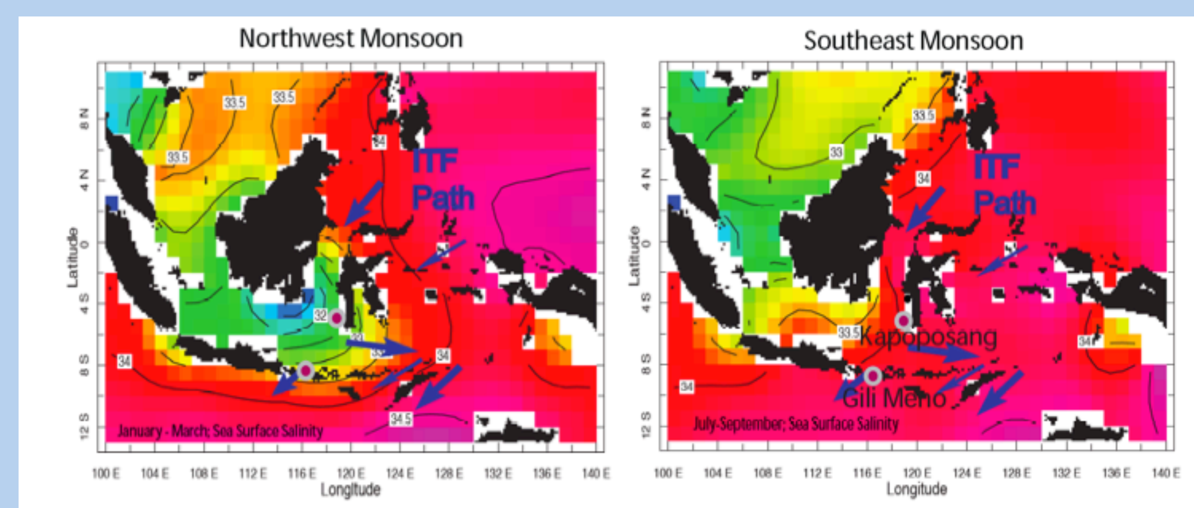

Figure 2: Sea Surface Salinity during the NW Monsoon (Jan-March) (left) and SE Monsoon (July-Oct) (Right). The study site at Kapoposang is indicated by a purple dot near SW Sulawesi in the S. Makassar Strait. Salinity data is from Conkright et al. (1998)[1].

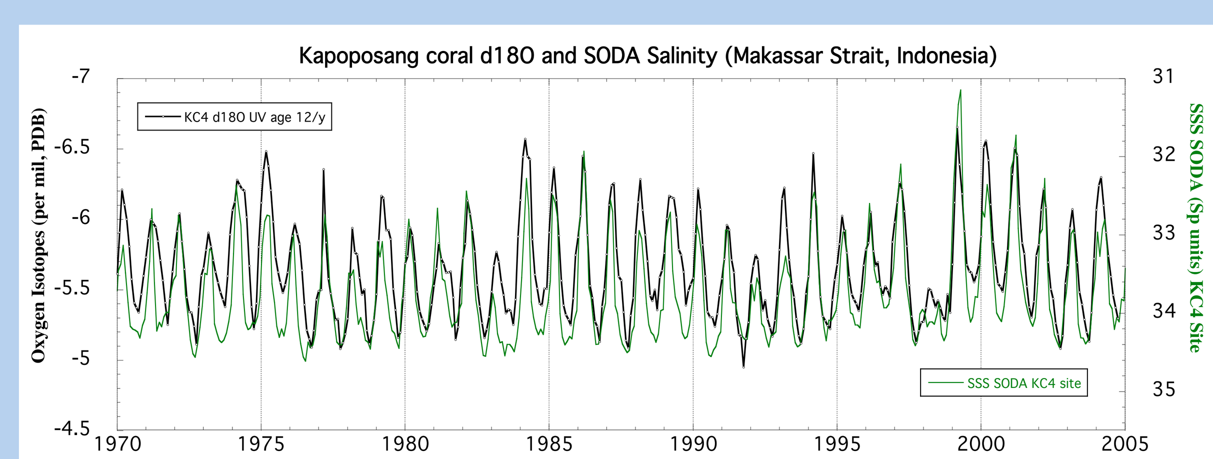

Figure 3: KC4 $\delta^{18}O$ plotted with SODA sea surface salinity from 1970 to 2005

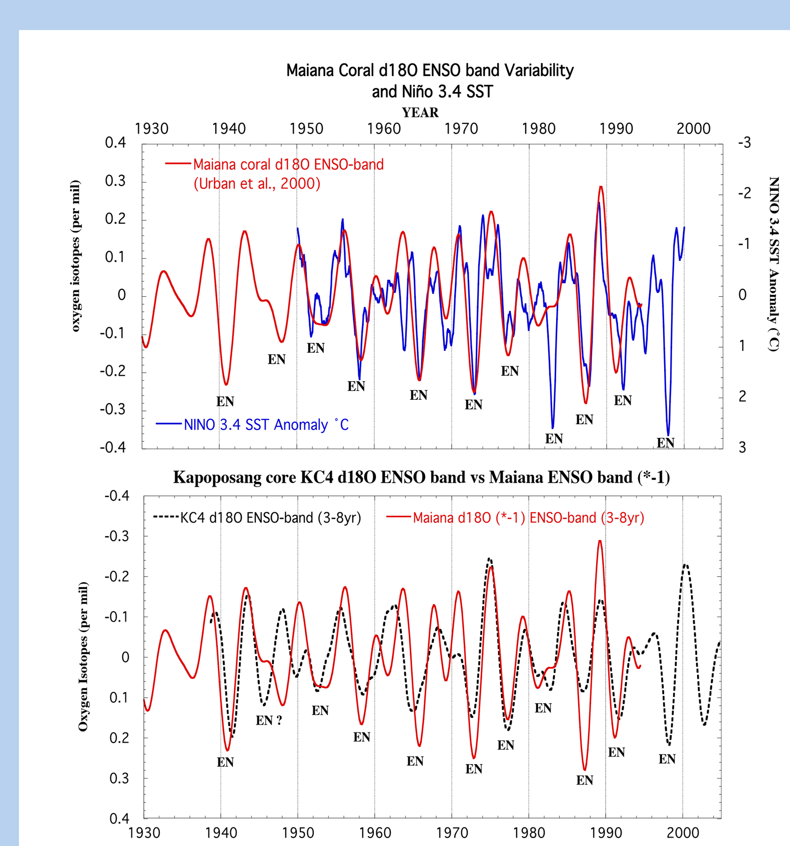

Figure 4 (Left): (Top) $\delta^{18}O$ ENSO-band (3-8 years) values from a Maiana coral in the Equatorial Pacific (Urban et al., 2000)[4] plotted with the NINO 3.4 sea surface temperature anomaly from 1930-2000. (Bottom) $\delta^{18}O$ ENSO-band (3-8 years) values from Maiana coral plotted with the $\delta^{18}O$ ENSO-band from the KC4 coral from Kapoposang, Indonesia.

Results

- KC4 coral core dates back to 1938
- KC4 coral skeletal $\delta^{18}O$ signal is highly correlated with SODA SSS (Fig. 3)
- Skeletal Sr/Ca influenced by more than SST alone
- KC4 $\delta^{18}O$ ENSO-band inversely related to Maiana $\delta^{18}O$ ENSO-band and NINO 3.4 SST anomaly

Conclusions

- KC4 coral $\delta^{18}O$ is a good proxy for SSS in the Makassar Strait
- KC4 coral Sr/Ca could be influenced by SSS as well as SST
- KC4 $\delta^{18}O$ ENSO-band shows an inverse interdecadal relationship with SST

Future Work

A 3.3 meter *Porites* sp. core from Gili Meno (GM5A) collected by Michael Moore in 1990 will be analyzed. Gil Meno is located east of Bali at 8˚15'S and 115˚30'E. Preliminary analysis dates this core back around 200 years.

References

[1] Conkright, M. E. et al. 1998: World Ocean Atlas 1998. CD-ROM Data Set Documentation.
Tech. Rep. 15, NODC Internal Report, Silver Spring, MD.

[2] Gordon, A. L., 1986: Inter-Ocean Exchange of Thermocline Water. *Journal of Geophysical Research-Oceans*, 91(C4): 5037-5046.

[3] Gordon, Arnold et al. 2003. Cool Indonesian throughflow as a consequence of restricted surface layer flow. Nature 425: 824-828

[4] Urban, Frank E. et al. 2000. Influence of mean climatic change on climate variability from a 155-year tropical Pacific coral record. *Nature*. 407: 989-993.

Acknowledgements

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