Reconstructing the past: How coral Sr/Ca and oxygen isotopes can be used to reconstruct past sea surface temperature and salinity in the Makassar Strait, Indonesia

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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 of the ITF and channels water from the Pacific Ocean into the Indonesian Ocean. During the boreal winter monsoon, low salinity South China Sea and 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 ITF mean temperature and the Indian Ocean thermocline is cooled (Gordon et al., 2003). This “plug” is eliminated annually when the summer winds reverse. More saline Banda Sea surface water is then brought into the southern Makassar Strait. For this study, 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. Stable oxygen isotopes ($\delta^{18}O$) and Sr/Ca ratios were measured at sub-seasonal resolution. Annual $\delta^{18}O$ peaks and fluorescent bands were used to create a near monthly resolution record of $\delta^{18}O$ and Sr/Ca variations extending from 2004 back to 1938 A.D. These time series was then compared to climate indices such as sea surface temperature (SST), sea surface salinity (SSS), and El Niño Southern Oscillation. It was found that this *Porites* sp. coral in the Makassar Strait has strong annual and interannual oxygen isotope signals, which are highly correlated to the SODA SSS data for this location. This supports the hypothesis that coral skeletal $\delta^{18}O$ at this location is primarily influenced by sea surface salinity in the Makassar Strait and thus can be used reconstruct SSS variability back to 1938. Coral Sr/Ca is less well correlated to the small 1.5°C annual cycle in the Makassar Strait and may be influenced by salinity or other unknown factors at this site. Singular Spectrum Analysis of the $\delta^{18}O$ time series indicates that interannual $\delta^{18}O$ variability is tightly coupled to the El Niño Southern Oscillation (ENSO). This result 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).