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The use of geochemical properties as climate indicators from a Christmas Island (Indian Ocean) stalagmite

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Atmospheric circulation is largely driven by ocean/atmosphere interactions. Especially critical, are the relatively warm pools of water at the ocean surface. By far the largest and most important pool of warm water is the Indo-Pacific Warm Pool (IPWP) This expanse of water has local, regional and global significance and is important for modification of Pacific Ocean water masses, poleward oceanic heat transfer, generation and modulation of monsoon circulation, El Niño/Southern Oscillation (ENSO) interactions. Christmas Island (10^o30'S 105^o40'E), located $\sim$380km south of Java Head (Indonesia), within the IPWP, offers the rare ability to reconstruct proxy climate data from terrestrial archives in this vitally important region.

Stable isotope (δ^{18}O and δ^{13}C), trace element ratios (Mg/Ca, Sr/Ca and P/Ca) and lamination thicknesses are reported for the upper half of a stalagmite from Christmas Island. The stalagmite SC4 commenced growing around 1150 AD and was active at the time of collection in October 2004. The period reported extends from $\sim$1575 AD to 2004 AD. Micromilling at 50 μm increments for stable isotope analysis and in-situ Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS) analysis for trace elements yielded high-resolution, interannual geochemical data, which were used in conjunction with instrumental rainfall records to assess the usefulness of Christmas Island stalagmites as palaeoclimate archives.

Stalagmite δ^{18}O is highly correlated with local instrumental rainfall records, suggest-

ing that δ^{18}O is controlled by rainfall amount. Sr/Ca and P/Ca from LA-ICP-MS are negatively covariant with δ^{13}C and Mg/Ca but positively correlated with lamination thickness, here assumed to be a proxy for growth rate. Elevated Mg/Ca and δ^{13}C during periods of low growth suggests prior calcite precipitation and/or drip-rate variations are controlling factors. A positive covariance between Sr/Ca, P/Ca and lamination thickness is tentatively attributed to biological productivity above the cave. Results suggest that geochemical properties from Christmas Island stalagmites have a high degree of potential in the derivation of high-resolution palaeoclimate records.