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Improving the accuracy and precision of TIMS U-series ages of modern corals from the Great Barrier Reef, Australia

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The main limiting factor in obtaining precise and accurate Uranium-series ages of modern corals (e.g. since European settlement of northern Australia around 1850 AD), is the ability to constrain and correct for initial or non-radiogenic ^{230}Th. This is becoming particularly important in paleoecological research where accurate chronologies are required to pinpoint changes in community structure and the timing of mortality events in order to identify possible drivers. In this study, thermal ionisation mass spectrometry (TIMS) Uranium-series dating of 61 samples collected from living and non-living *Porites* spp. from the near shore region of the GBR was performed to spatially constrain initial ^{230}Th/^{232}Th (^{230}Th/^{232}Th$_0$) variability.

In the living *Porites* corals, the majority of ^{230}Th/^{232}Th$_0$ values were higher than the bulk-Earth value ($\sim 4.4\times10^{-6}$) generally assumed for non-radiogenic ^{230}Th corrections where the primary source of initial thorium is terrestrially derived. Despite samples being taken from regions adjacent to contrasting levels of land modification, no apparent difference was found in ^{230}Th/^{232}Th$_0$ between regions exposed to varying levels of sedimentation during runoff events. However, ^{230}Th/^{232}Th$_0$ variability is evident between reefs within each region. Overall, most samples across the entire region give ^{230}Th/^{232}Th$_0$ values in the range of $6\pm1\times10^{-6}$.

An examination of ^{232}Th/^{238}U versus ^{230}Th/^{238}U from living and non-living corals revealed mainly two components contributing to initial ^{230}Th in the non-living coral samples. High ^{232}Th concentrations found in the majority of non-living coral samples suggest that a significant amount of Th may have been incorporated into the coral skeleton through post-mortem non-carbonate sediment infiltration. The results of this study demonstrate that accurate U-series ages cannot be achieved where single non-radiogenic thorium correction values are used interchangeably for samples taken from different hydrological settings and for both living and dead *Porites*. For non-living corals, we propose the use of a specific correction value calculated based on ^{232}Th levels for individual samples to account for both terrestrially-derived detrital and hydrogenous Th. Furthermore, we have also developed a vigorous cleaning procedure to reduce the level of infiltrated sediment adhering to the non-living coral skeleton. Using both methods we are able to achieve precise and accurate U-series ages (up to ±1 year) for corals less than 200 years old.