The good, the bad, and the ugly: assessing impact of skeletal density and transect quality on geochemistry in sub-fossil corals from the Galápagos Islands

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Coral geochemistry and skeletal density are well-established proxies for past climate and coral growth. Together, these proxies can reflect the influence of growth rate on geochemistry and identify growth rate responses to environmental change. However, questions remain regarding how best to generate and interpret paired geochemical and density records in corals where co-located density and geochemistry transects are unavailable. This study addresses three of these questions: first, how to generate reliable paired climate-density records given transects of varying quality (i.e., optimal-to-poor alignment with skeletal architecture); second, how density can be used to more effectively screen for growth impacts on geochemistry, especially in transects of varying quality; and third, how best to analyze single-path density records that do not directly overlap geochemical sampling transects.

This study presents paired geochemical (Sr/Ca; partial $\delta^{18}O$, Ba/Ca, and $\delta^{11}B$) and growth (density, extension, and calcification) records from sub-fossil *Porites* spp. from Wolf Island, Galápagos, spanning approximately 1700 to 1800. Although calcification rate is driven mainly by extension, we find that variations in skeletal density are critical to identifying how growth rate affects geochemistry. The results show that growth rate does not influence geochemistry in high-quality transects, but the correlations between geochemistry and density strengthen as transect quality decreases. In high-quality transects, we observe no statistically significant decrease in growth rate during pre-industrial El Niño events.