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# Mineralogical insights into coral trace element incorporation and stress response

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The coral paleoclimate community relies on the geochemistry of corals to help reconstruct climate parameters in the past. For trace element-based proxies, we apply an established relationship between a given trace element in the coral skeleton and a specific environmental variable to reconstruct changes in the coral's environment over its lifetime and extend the instrumental record back in time. However, there are a number of key assumptions regarding the factors influencing this relationship between environment and trace element content of the coral. As a living organism that precipitates new layers of its calcium carbonate (aragonite) skeleton via biomineralization, corals have the ability to alter their internal (i.e., calcifying fluid) chemistry to favor the rapid precipitation of aragonite. As such, the geochemical make-up and mineralogical structure of this precipitated aragonite can reflect changes in the internal chemistry of the coral. Therefore, the variability of trace element content throughout the coral's aragonite layers may not purely reflect changes in the coral's environment; it may be impacted by the coral's energy availability and calcification rate. Here, we use X-Ray Diffraction and Raman spectroscopic techniques to investigate how thermal stress from the very strong 1997-1998 El Niño event may have influenced the aragonite mineralogical parameters and geochemistry of a coral from Butaritari atoll (3°N, 173°E) via changes in the coral's calcifying fluid chemistry. We find that overall, aragonite unit cell size increased across the El Niño event, which correlates with greater concentrations of boron, magnesium, and lithium in the coral skeleton. We also find that the aragonite saturation state of the coral's calcifying fluid decreased across the event, suggesting a stress-related breakdown in the coral's buffering capacity. By establishing the relationship between coral calcifying fluid chemistry, aragonite crystal structure, and trace element incorporation, this study informs our understanding of the utility and limitations of coral trace element-based paleoclimate proxies, especially in a warming world.