Crystallographic investigation of coral skeletons under shifting ocean conditions

G. A. FARFAN[1]*, S. M. WEBB[2] , WALLER, R.[3], CORDES, E. E.[4] AND C. M. HANSEL[5]

[1]MIT-WHOI Joint Program in Oceanography/Applied Ocean Science & Engineering, Woods Hole, MA 02543 USA (*correspondence: gfarfan@whoi.edu)

[2]Stanford Synchrotron Radiation Lightsource, Stanford University, Menlo Park, CA 94025 USA (samwebb@slac.stanford.edu)

[3]Darling Marine Center, University of Maine, Walpole, ME 04573 USA (rhian.waller@maine.edu)

[4]Temple University, Philadelphia, PA 19122 USA (ecordes@temple.edu)

[5]Woods Hole Oceanographic Institution, Woods Hole, MA 02543 USA (chansel@whoi.edu)

Corals in both deep and shallow waters are critical biogenic engineers, creating hotspots of ocean biodiversity. Global shifts in ocean chemistry and temperatures have led to changes in coral calcification rates and impaired physiological processes. However, there are few studies on how these same stressors impact the structure and integrity of the coral skeleton – an essential coral component that provides physical support and critical refuge. Previously observed distortions in the skeletal morphologies of corals grown under low aragonite saturation and elevated temperatures may point to underlying crystallographic alterations, which could weaken skeletal architecture. Accordingly, we have taken a crystallographic approach to investigating stress-induced changes to juvenile and adult corals. We utilize X-ray diffraction, Raman spectroscopy and synchrotron-based calcium extended X-ray absorption fine structure spectroscopy to characterize the crystallographic structures of deep water corals *Lophelia pertusa* from the Gulf of Mexico and *Flabellum impensum* from Antarctica. In combination, these analyses indicate changes in crystallographic dimensions and a potential compression of the unit cell as a function of environmental conditions. These results confirm climate change induced structural alteration of the coral skeleton that may compromise skeletal stability and subsequent coral health.