Synchrotron µ-XRF mapping of elemental distributions across coral skeleton micro-architecture

E. HENDY [1], A. LANZIROTTI [2], T. RASBURY [3] AND J. LOUGH [4]

[1]Lamont Doherty Earth Observatory at Columbia University, Palisades, NY, USA; ejhendy@ldeo.columbia.edu
[2]The University of Chicago – CARS, , Brookhaven National Laboratory, Upton, NY, USA; lanzirotti@bnl.gov
[3]Department of Geosciences, SUNY Stony Brook, NY, USA; erasbury@notes.cc.sunysb.edu
[4]Australian Institute of Marine Science, Townsville, Australia; j.lough@aims.gov.au

The trace elements incorporated into the aragonite skeleton of massive coral colonies can provide a wealth of information on past environmental conditions. Of critical concern in reconstructing environmental records from coral, however, is the potential for physiological processes during skeletogenesis to overwrite or distort the trace element signals. The highly resolved, *in-situ* mapping capabilities of synchrotron µ-XRF is an ideal tool to investigate differences in trace element partitioning that correspond to the fine-scale architecture of the skeleton.

This study was performed at Beamline X26A (NSLS, BNL) with the beam set at 16.5 keV to target elements up to Sr and a 10µm spot size. Sr, Ca, Br, Zn, Ni, Cu, Fe and Pb were mapped in 20µm steps (equivalent to daily growth rate) across the various skeletal structures that make up the corallite (the exoskeleton formed by an individual coral polyp), the dissepiments (horizontal basal plates that separate the tissue from vacated skeleton) and the coenosteum (skeleton formed between individual corallites). The width of a single corallite is mapped over a 3-year period of skeleton growth (16mm) including the skeleton within the tissue zone deposited just before collection.

The sample was sectioned from a healthy ~30 year old *Porites australensis* colony collected from Pandora Reef (18.48°S, 146.26°E) in the central Great Barrier Reef. This colony survived the February 1998 coral bleaching event that caused 30-60% coral morality. At the time of collection (August 2000) there were no signs that the specimen had bleached 2½ years earlier, however, x-ray images show a marked and sustained skeletal growth response with lower extension and calcification rates and higher skeletal density. The trace element distributions in skeleton deposited through this event were impacted by the stress event and associated changes in skeletal growth. The Sr/Ca of skeletal structures are compositionally zoned, and comparison is made with CT-X-ray tomography of skeletal micro-architecture and bulk analyses on milled samples. Br is selectively incorporated within dissepiments, and XANES is used to identify the Br species involved.