EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: Juvenile coral night and day growth: 3D tomographies of Sr distribution imaging both below and above the absorption edge	**Experiment number**: EV-442
Beamline: ID19	**Date of experiment**: from: 24/2/2022 to: 28/2/2022	**Date of report**:
Shifts: 9	**Local contact(s)**: Ludo Broche	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Tali Mass, University of Haifa, Israel.

Federica Scucchia, University of Haifa, Israel

Paul Zaslansky, Charite - Universitaetsmedizin Berlin

Report:

During our beamtime at ID19, we obtained high-resolution tomography data of skeletons of young corals grown under different conditions of strontium (Sr)-enriched seawater. We scanned a total of 10 samples using two different configurations, one to obtain structural features and one to individuate the Sr within the coral skeleton. Already from the end of the beamtime on the 28th of February, we started analysing most of the data collected (Table 1).

For the first configurations, we scanned the corals with 360° rotation and energy of 25keV, using a multilayer crystal and scanning at 4 different distances to obtain both absorption and phase contrast images. Up to 4000 projection images were acquired for different samples, scanned with a final pixel size of 0.6 µm.

For the second configuration, we switched to the use of the monochromator to scan all samples. By first calibrating the beam with a Sr-containing dentistry-related sample, we individuated the two energies required for Sr identification, 16.2keV and 16.0keV. Although we faced several issues related to sample movements and unexpected loss of flux during scanning with the monochromator, we successfully scanned all planned samples.

For the majority of the corals, we obtained highly-detailed reconstructions of the skeletons using the Tomwer software. The subtraction between the 16.2keV and 16.0keV scans reveal clear differences in absorption at the Sr edge, showing distinct locations of Sr within the complex scaffold of the coral skeleton (Figures 1 and 2). Further, more in-depth 3D analysis is planned to help us localise and quantify the Sr within the skeleton, which will help us better understand the dynamics of young coral skeleton growth during the diel cycle. Our results will provide details about the temporal (day and night) deposition of the mineral, and about the growth dynamics of the different mineral phases that exist within the coral skeleton.

Figures

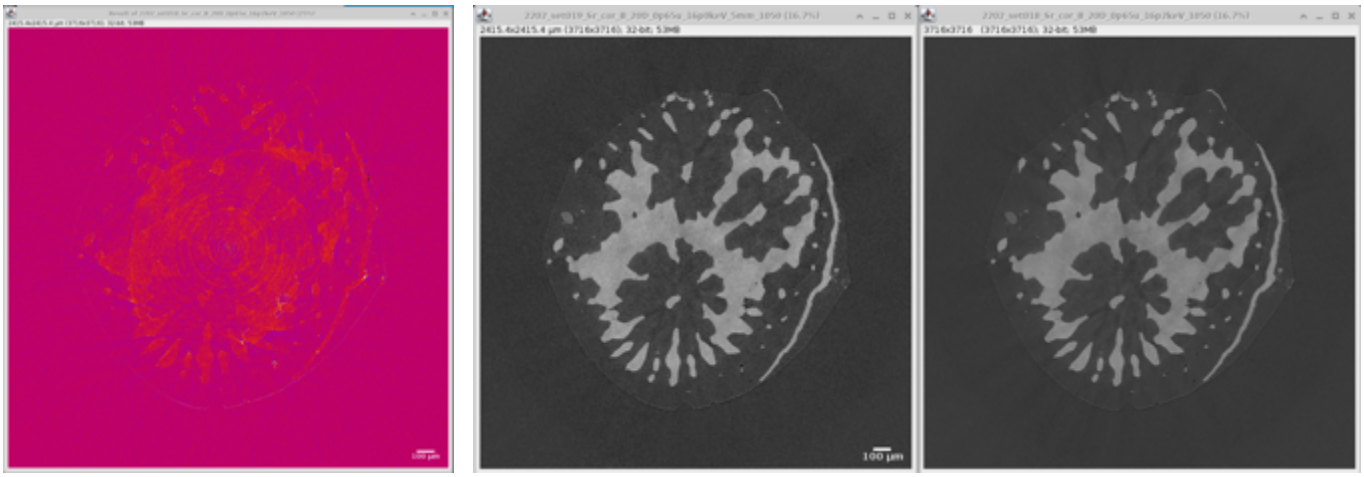


Figure 1: Comparison of absorption at 16000 vs. 16200 eV in an example coral sample.

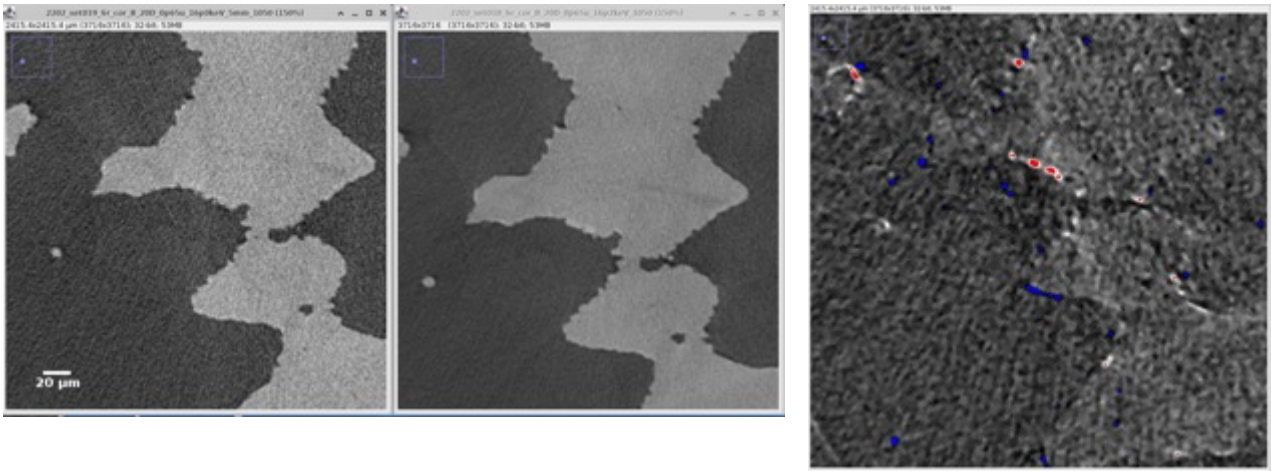
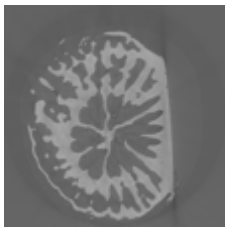
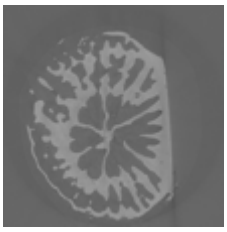
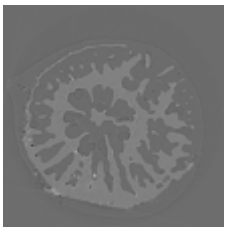
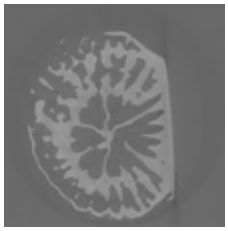
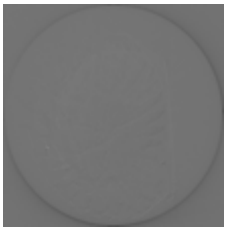
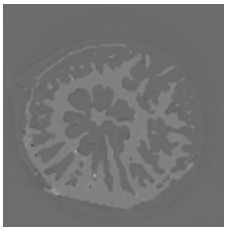


Figure 2: Comparison of absorption at 16000 vs. 16200 eV (left and central images) and difference between the two energies (right image) showing regions of high (red) and low (blue) Sr signal.

Table 1: Initial processing of the data obtained at ID19. Example tomographic slices obtained by imaging the corals with different energies (16.2, 16.0 and 25keV) and at different sample-to-detector distances (5mm and 9mm).

16.2keV	16.0keV	subtraction 16.2-16.0keV	25keV
 2202_set018_Sr_cor_B_20D_0p65u_16p2keV_5mm_3000prj_0p5s_0001	 2202_set019_Sr_cor_B_20D_0p65u_16p0keV_5mm_3000prj_0p5s_0001		
 2202_set020_Sr_cor_B_20D_0p65u_16p2keV_9mm_3000prj_0p5s_0001	 2202_set021_Sr_cor_B_20D_0p65u_16p0keV_9mm_3000prj_0p5s_0001		
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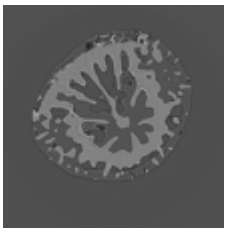
 2202_set038_Sr_cor_Q_20N_0p65u_16p2keV_9mm_3000prj_0p5s	 2202_set039_Sr_cor_Q_20N_0p65u_16p0keV_9mm_3000prj_0p5s		
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