ESRF	**Experiment title:** X-ray tomography of diatoms	**Experiment number**: EV242
Beamline:	**Date of experiment**: from: 03/2017 to: 03/2017	**Date of report**: 21/08/2017
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Report:

Diatoms are algae that produce transparent cell walls made of silicon dioxide hydrated with a small amount of water ($SiO_2 + H_2O$). As silica is the main component of glass, they are often called "algae in glass houses". The cell wall is called a frustule and consists of two halves called valves. Since silica is impervious, diatoms have evolved elaborate patterns of perforations in their valves to allow nutrient and waste exchange with the environment. These valve patterns can be quite beautiful and are also helpful for classifying diatoms.

Diatom frustules are characteristically highly ornamented, forming an amazing range of forms. The shape of the diatom frustule is species specific. Two major groups are recognized within the diatoms: 1) *Coscinodiscophyceae*, or centric diatoms that are cells with radial symmetry (about a point) and 2) *Bacillariophyceae*, or pennate diatoms that are cells with bilateral symmetry (about a line).

Here we have focused our attention to a specific centric diatom : Cosinodiscus sp.. Our major interest was to image in 3D this diatom in order to get a full description of its 3D architecture. This was achieved by using 3D- Holotomography at the ID16-B beamline of ESRF. With this technique we have investigated the frustule topography of Cosinodiscus sp. With the 3D array of this object we have determined many morphologic properties of the diatom such as the pores size , the domain walls and the shape of the outer and inner frustule membranes. With a better understanding of the diatom frustule structure from the nanometer scale up to whole cell we can foresee that we will have a powerful tool to unravel some key physical properties of porous biosilica membranes and thus anticipate potential technological applications.

A typical 3D Holotomography image of the whole diatom is shown in Fig.1 A. With the 3D image of the diatom one can immediately appreciate the magnificence of this centric diatom. The inner layer exhibits a honeycomb-like structure called areolae in which large holes known as foramen are observed. The full size of the diatom is 75µm and its thickness varies in the range 1.35 to 1.5µm. The size of each foramen varies from one to one another. As a result, the foramen pattern does not exhibit a perfect honeycomb structure.

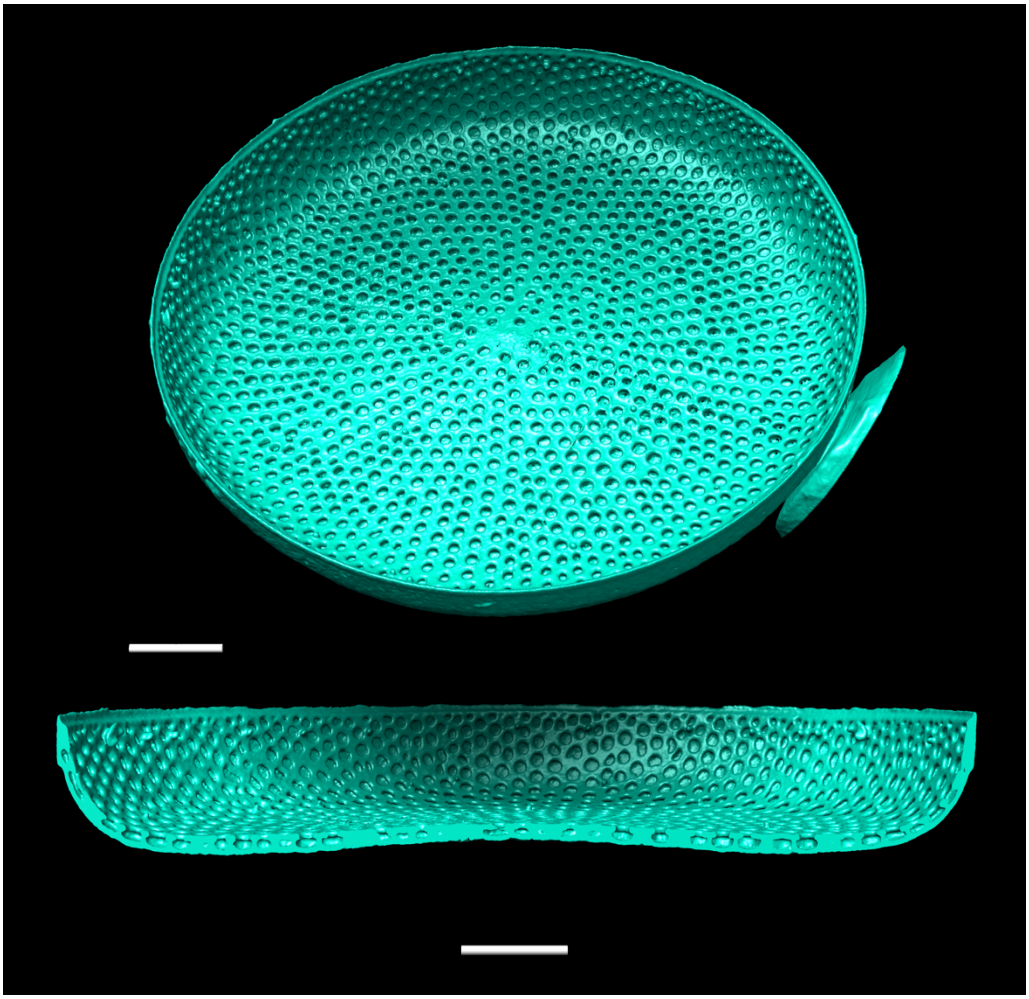

Figure 1: 3D representation of the diatom structure showing the presence of holes (foramen) in the inner part of the frustule.

An evaluation of the foramen radius was made after binarisation of the axial section of the diatom. It was found that the distribution of foramen radii was mainly bimodal with a main mode located at R_1=0.68±0.06µm and a minor one located at R_2=0.57±0.12 µm (see Fig. 2c)

The full analysis of the data collected during this run is presently in progress.