New insight into Emiliania huxleyi coccosphere formation

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Coccolithophores (single-celled calcareous algea) belong to the most important marine pelagic calcifiers controlling global carbon cycles. Their cells are surrounded by a "coccosphere" of interlocking calcareous coccolith-platelets, which are radial arrays of intricately shaped calcite crystallites embedded in a thin organic matrix sheath. For the abundant species *Emiliana huxleyi* (*E.hux*) we investigated the crystallites and the cells by TEM and HRTEM methods, with FIB sectioning[1,2] as well as by ultramicrotome sectioning and high-pressure-freezing/cryo-TEM techniques which preserve the structure of the soft biological parts. Unlike the calcite of foraminifera and multicellular organisms, the precisely shape-controlled calcite crystals of *E.hux* are not composed of an assembly of Ca-carbonate nanoparticles; the spokes of the coccoliths consist of two single crystals which display a few boundaries between mosaic blocks. We found a mean of 20 (but up to 30) coccoliths packed in up to four – not always complete - layers around the cells[2]. The vesicles in which the coccoliths grow are initially attached to the cell nucleus (!) and then migrate outward for exocytosis when the coccoliths are complete. From the images we obtained a cellular particulate organic carbon (POC) quota of 7.2(+/-2.1) pg/cell and a particulate inorganic carbon (PIC) quota of 5(+/- 1.5) pg/cell; implications on sinking velocity can also be made from the calculated cell density[2].

[1] Hoffman R et al. (2014) Nanoprobe crystallographic orientation studies of isolated shield elements of the coccolithophore species *Emiliania huxleyi*. Europ. *J. Mineralogy* **26**: 473-483 [2] Hoffman R et al. (2015) Insight into Emiliania huxleyi coccospheres by focused ion beam sectioning. *Biogeosciences* **12**: 825-834