

Calcification in coccolithophores: A biogeochemical study of polysaccharides from past to present

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The hallmark of biomineralization is the sophisticated control of mineral precipitation exerted by a variety of organisms across the tree of life. Unicellular, phytoplanktonic algae known as coccolithophores are amongst the most conspicuous calcifiers on the planet, with an estimated production of $\sim 10^{26}$ coccoliths/year. They are responsible for $\sim 50\%$ of deep sea carbonate burial, which forms the largest geological sink of carbon from the ocean/atmosphere reservoir [1]. Contrary to most organisms, where proteins make up the archetypal template, coccolithophores employ acidic polysaccharide(s) for regulation of crystal nucleation and growth [2]. The interaction of this polysaccharide with the carbonate chemistry of its intracellular calcifying compartment, the coccolith vesicle, is largely determined by its monosaccharide composition; particularly the carboxyl groups of uronic acid residues [3]. Here we report the isolation and characterization of coccolith-associated polysaccharides (CAPs), from modern day coccolithophores and their prehistoric predecessors preserved within sediment. Our analysis uncovered a distinct variation in the biochemical properties of these polysaccharides across the species/strains tested; suggestive that several components are key to dictating the architecture of coccoliths. By extending this analysis to fossil coccolithophores, we established that the recorded species-level pattern is conserved through time. We propose that these variations may represent an adaptive footprint that arose from the delicate interplay between this macromolecule, the chemistry of its crystallization compartment and vitally, the environment.

[1] Iglesias-Rodriguez *et al.* (2002) *Global Biogeochem Cy* **16**, 1100, doi: 10.1029/2001GB001454. [2] Westbroek *et al.* (1973) *Calcif Tiss Res* **12**, 227-238. [3] Borman *et al.* (1982) *Eur J Biochem* **129**, 179-183.