Modeling Calcium Carbonate Biomineralization Processes

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One of the most intriguing aspects of biomineralization is the means by which organisms can direct crystallization of *e.g.* $CaCO_3$ to produce a desired crystal phase and crystal shape. In general, rather complicated systems for producing assemblies of crystallites have been proposed for these *in vivo* systems. We have shown that small amounts of simple carboxylate-based organic ligands can be used to direct the crystallisation of $CaCO_3$ from aqueous solutions. The three isomeric benzenedicarboxylates direct this process in different ways, not just in terms of the crystal phase (calcite, aragonite or vaterite), but also leading to the formation of unusual crystal morphologies.

Furthermore, using the ligand 1,3-diamino-2-hydroxypropane-N,N,N',N'-tetraacetic acid (H_4hpdta), we observe the formation of "microtrumpets" (shown below) built up from nanoscale calcite crystals. These bear a striking resemblance to the coccoliths made by the coccolithophore *Discosphaera tubifera* and indicate that relatively simple molecules can mimic the crystal tectonics seen in biological systems.