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Crystallography

Curvy Crystals

Researchers begin to unravel the mechanism behind lab-made shapely inorganic crystals

Sarah Everts

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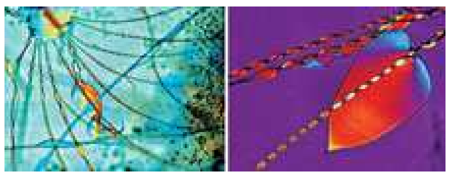
WHEN NATURE CREATES exquisite swirls in seashells, the assembly of inorganic ions into appealing shapes is guided by helper proteins or organic molecules. Surprisingly similar curvy crystals have been made in a beaker from barium carbonate and silica, but without the aid of scaffold or support. Now, researchers in Spain and Australia are taking a first stab at explaining how the curvy, "biomorph" crystals can be produced from only simple, inorganic ions.


Juan Manuel García Ruiz (Both)

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Viewed under polarized light, crystals of barium carbonate and silica formed in a beaker yield pretty pictures.

When Juan M. García Ruiz, a crystallographer at University of Granada, in Spain, first reported the existence of beaker-made biomorphs in 2003, the elegant inorganic crystals ignited a debate among paleobiologists. It turns out that some of the biomorph crystals look like 3.5 billion-year-old fossils from Warrawoona, Australia. Some paleobiologists believe the fossils are among the earliest records of microorganisms and thus provide an estimate of the origin of life on Earth.

The similarity fed concerns among paleobiologists that the Warrawoona fossils were perhaps the result of inorganic depositions and not early life, and it sparked controversy. García Ruiz' "experiments and interpretations are fascinating and significant," says Malcolm Walter, a paleobiologist and astrobiologist at the University of New South Wales, in Sydney. "But not all of my colleagues agree," he adds.

Now, García Ruiz, coworker Emilio Melero-Garcia, and Stephen T. Hyde, a mathematician at the Australian National University, in Canberra, are proposing a mechanisı for how these biomorphs might crystallize on their own. They argue that the deposition of alternating layers of silicate and barium carbonate rely on pH oscillations at the surface of the growing crystal (*Science* **2009,** *323,* 362).

To prepare the biomorph, barium chloride is first dissolved in an alkaline solution of silica. As CO_2 from the atmosphere dissolves into the solution, the pH drops, and barium carbonate begins to precipitate. Formation of barium carbonate crystals causes acidification of the solution, which leads to the amorphous deposition of silica. When the silica deposits, the pH rises again. As the pH slips up and down, alternating layers of barium carbonate and silica are deposited, Garcia Ruiz explains.

"The research is exciting but there is still a big mystery," comments Werner Kunz, a chemist at the University of Regensburg, in Germany. "What is the origin of curvatuı of the growing crystal when neither the silicate or carbonate is rodlike or chiral? How do such simple ions come together to form curving crystals?"

That's exactly "the problem we are trying to solve now," García Ruiz says.

Delightful Deposition

Catching the crystallization of barium carbonate and silica.