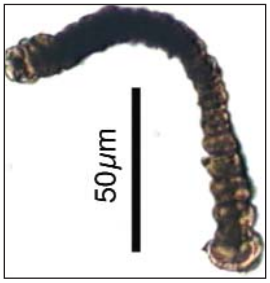
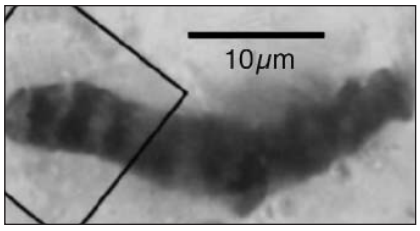
GEOCHEMISTRY

Minerals Cooked Up in the Laboratory Call Ancient Microfossils Into Question

Looks can be deceptive, researchers are finding as they search for traces of ancient as well as alien life. The wormy-looking shapes discovered in a meteorite from Mars turned out to be purely mineralogical and never were alive. And last year some researchers claimed that the textbook examples of the earliest known life on Earth—the 3.5-billion-year-old "Warrawoona" microfossils from Australia—are nothing more than suggestively shaped geologic detritus, not fossils (*Science*, 8 March 2002, p. 1812). Now, a paper in this issue of *Science* (p. 1194) strikes another blow for geology over biology: A group of researchers details how to cook up minerals in the laboratory that bear a striking resemblance to the Warrawoona microfossils.





Two peas in a pod? A lab creation (*above*) bears some resemblance to 3.5-billion-year-old microfossils (*right*).

The lab products "look remarkably 'lifelike,' " says organic geochemist George Cody of the Carnegie Institution of Washington's Geophysical Laboratory in Washington, D.C. That doesn't prove that paleontologists mistook inorganic minerals for fossils at Warrawoona, but it does remind everyone that "just because something looks familiar doesn't mean it's biogenic," says Cody. "A lot more thought has to go into biomarkers for ancient life."

The recipe for fossil-like minerals turns out to be rather simple: silica, carbonate, and barium in an alkaline medium with a dash of simple organics. Geologist and crystallographer Juan Manuel García-Ruiz of the CSIC–University of Granada, Spain, and his colleagues mixed the inorganic ingredients at near room temperature and, at certain dilute concentrations of ingredients, produced sheets adorned with filaments, all composed of barium carbonate crystals coated with silica. These synthetic filaments look enough like true microfossils to be mistaken as the products of life, the authors say. And the lab conditions are similar to those at the time of the Warrawoona fossils, they say, to judge by the abundant carbonate, silica, and barium sulfate found among neighboring rocks.

When García-Ruiz and his colleagues immersed the synthesized filaments in a brew of formaldehyde and phenol, then heated the mix, a brown coating of complex organic matter formed on the filaments. The Warrawoona fossils are also coated with dark, complex organic matter. García-Ruiz argues that heat-induced breakdown of iron carbonates, which could have happened at Warrawoona, is known to produce relatively simple organic materials. With time, he argues, these materials could combine into complex organics, much as happened in the lab.

"Our work affords a coherent, completely abiotic scenario for formation of the [Warrawoona] 'microfossils,' " says co-author Stephen Hyde of Australian National University in Canberra. "This means simply that we must rethink the criteria for detection of life, both here on Earth and elsewhere. Morphology and organic chemistry are evidently not enough."

Many researchers would agree. "Nine and a half out of 10 paleontologists would say that's a microfossil," says sedimentologist and paleontologist John Grotzinger of the Massachusetts Institute of Technology. One who wouldn't is William Schopf of the University of California, Los Angeles, who was first to publish on the Warrawoona fossils in *Science* in 1993 (30 April 1993, p. 640). "It's very interesting and ingenious work," he says. "At the same time, the resemblance is superficial." He sees walled-off voids in the Warrawoona structures where cells would have resided, whereas the lab structures are solid rods or, after etching with acid, hollow tubes. Hyde responds that the adsorption of organics onto a hollow tube—something the group hasn't attempted yet because of the tubes' fragility—could well create a structure that looks like a cell wall.

It's not surprising that the details of putative microfossils from Earth's earliest days are being debated, says paleontologist Andrew Knoll of Harvard University. "I think the synthesized microstructures look only moderately like real microfossils," he says. "Unfortunately, that is also the case for the Warrawoona structures." But it all may work for the good, suggests Grotzinger. The lab creations, he says, are "just annoying enough that paleontologists will go back to the field," in hopes of finding convincing examples of the real thing. **–RICHARD A. KERR**

CREDITS: J. M. GARCÍA-RUIZ *ET AL.*

PHARMACOGENOMICS

FDA Puts the Brakes on Roche's Gene Array Test

The U.S. government has blocked the sale of a new kind of DNA diagnostic test, putting up an unexpected barrier to the marketing of technology to distinguish genetic differences in how patients metabolize certain drugs.

The Geneva-based diagnostics firm Roche had billed its test, launched last June, as "the first wide-scale application of diagnostic microarray technology in the world," making it a milestone in genomic medicine. But in a letter released last week, the Food and Drug Administration (FDA) told Roche to stop selling the test and instead submit more data to support its claims.

The AmpliChip CYP450, which Roche developed with Affymetrix, detects mutations in two genes that can cause people to have serious side effects or fail to respond to some drugs (*Science*, 24 October, p. 589). In selling the chip to clinical labs as a component for their own tests, Roche compared it to genetic testing reagents, which aren't directly regulated by FDA. But in a 29 October letter, FDA said the AmpliChip requires a higher level of review because it is "of substantial importance in preventing impairment of human health" and uses "sophisticated" technology.

Roche "was testing the waters" by selling AmpliChip as a reagent while advertising it as a diagnostic, says regulatory analyst Ron Eisenwinter of Boston Healthcare Associates-Expertech. But the company denies that it was trying to avoid more intensive review. "We have always planned to seek FDA approval for in vitro diagnostic use," says Melinda Baker, spokesperson for Roche Molecular Diagnostics in Pleasanton, California.

The "big unknown" is how much data FDA will require, says Kathy Hudson, director of the Genetics and Public Policy Center in Washington, D.C. Under one scenario, gene chips might have to be clinically tested like drugs. But requiring quantitative data on every mutation tested for, notes Christopher Austin of the National Human Genome Research Institute, might not be "economically feasible."

The agency itself is struggling to sort out how to regulate these new tests, observers say. FDA officials expect to get plenty of advice this week at a Washington, D.C., workshop on pharmacogenomics. **–JOCELYN KAISER**