Meteorite still holds inklings of life

The quarry is dead. The burning question remains: Did it ever live? Although the answer remains elusive, the hunt for fossils of primitive life in a potato-shaped rock from Mars still holds promise.

That was the view of several, though by no means all, of the scientists at the annual Lunar and Planetary Science Conference in Houston last week. They met to discuss and debate whether the Martian meteorite ALH84001 contains remnants of minuscule bacteria, possible biological coatings, biologically generated minerals, and organic compounds suggestive of life (SN: 8/10/96, p. 84).

Believed to have solidified on Mars soon after the birth of the solar system, ALH84001 is the oldest known rock from the Red Planet and the only known Martian meteorite to contain measurable amounts of carbonate. Although Mars now resembles a frigid desert, the planet is thought to have once had an atmosphere rich in carbon dioxide and a climate wetter, warmer, and more hospitable to life.

Many of the features suggestive of life in ALH84001 are associated with the carbonate deposits, and several critics have argued that the carbonates were deposited at temperatures far above the boiling point of water—conditions hostile to life as we know it.

Two reports presented at the conference refute some of those claims. John W. Valley of the University of Wisconsin-Madison and his colleagues used an ion microprobe to measure the ratio of two isotopes, oxygen-18 and oxygen-16, in a sample of the meteorite no bigger than a grain of rice. They find that the ratio varies from place to place within the tiny sample. The fluctuation, says Valley, indicates that the carbonates were deposited during a process that did not achieve equilibrium. Such a process is far more likely to occur at low temperatures, probably below 100°C, he asserts.

Harry Y. McSween Jr. of the University of Tennessee in Knoxville, one of the proponents of a high-temperature scenario, says if Valley's report is confirmed, he may have to revise his calculations.

However, asserts Laurie A. Leshin of the University of California, Los Angeles, "high temperature isn't dead yet." Like Valley, she and her collaborators measured the ratio of the two oxygen isotopes, but they did so in a group of carbonates whose concentrations of calcium and some other chemical constituents varied more widely. Her team discovered that the isotopic oxygen ratio decreased in proportion to the amount of calcium. Leshin says that such behavior can occur either at high temperatures or over a range of temperatures from well below to well above the boiling point of water.

Attacking the issue from a different point of view, Joseph L. Kirschvink of the California Institute of Technology in Pasadena and his coworkers detailed their arguments that the rock has not been heated to more than 110°C for at least 4 billion years (SN: 2/8/97, p. 87). Otherwise, his team would not have found such dramatic differences in response to an applied magnetic field between adjacent fragments of the rock.

Kirschvink's newly reported findings also reveal that ancient Mars had a magnetic field, a feature that dovetails with—but does not prove—a biological origin for magnetic minerals, known as magnetite, in the rock. On Earth, some bacteria produce magnetite, which enables them to use the planet's magnetic field as a guide in navigation. The presence of a magnetic field on early Mars suggests that bacteria there produced magnetite for the same reason. Kathie L. Thomas-Keprta of Lockheed Martin Engineering & Sciences in Houston, a member of last August's discovery team, notes that the magnetite in ALH84001 has a similar shape and size to biologically generated forms of the mineral in terrestrial samples.

In another development, Andrew Steele of the University of Portsmouth in England and his collaborators say they have ruled out the possibility that the proposed nanofossils—tiny worm-shaped and ovoid features seen by Thomas-Keprta and her colleagues in the carbonate deposits as well as in terrestrial sediments—are artifacts of the gold coating that each sample receives before it can be sliced and viewed under an electron microscope. Using an atomic force microscope, which records tiny surface features by placing a needle in direct contact with a sample, Steele detected the same features in uncoated rock, although they were not limited to the carbonate regions.

Steele plans to use the same method to look for fossilized cell walls, which would represent a major breakthrough in the search for primitive life in the meteorite. Researchers have already begun searching for bacterial DNA in the rock.

Keprta-Thomas says it's unclear whether DNA could have been preserved for several billion years in the meteorite. "We know what the dinosaurs fossilized as, we can put the bones together and envision the skin. But [DNA from] bacteria is a whole new ball game." —*R. Cowen*

New glucose test on the way for diabetes

California researchers have designed a glucose-sensing polymer to measure a diabetic's blood-sugar concentrations—inside or outside the body.

Because it does not trigger an allergic response, this new sensor holds out the prospect of implants for long-term glucose monitoring. It would prove especially valuable if teamed with automatic systems for insulin delivery. The sensor could also make glucose monitoring through finger-prick blood tests affordable throughout the nonindustrialized world, says Frances H. Arnold of the California Institute of Technology in Pasadena.

To limit complications that can result in blindness, amputation, and kidney failure, people with diabetes must carefully monitor concentrations of glucose in their blood and then fine-tune their diet or insulin administration to ensure that blood sugar does not become elevated for long periods.

Most glucose monitors rely on bacterial enzymes, which can break down in hot environments. They also vary in sensitivity from batch to batch, which necessitates expensive calibrations by manufacturers. These factors have put regular glucose monitoring beyond the economic reach of the millions of diabetics in developing countries, Arnold observes. In the April Nature Biotechnology, her team describes what it hopes will prove a better alternative.

The group has engineered a stable, porous polymer and impregnated it with copper. The metal binds glucose when exposed to a blood sample modified to have a high, or strongly alkaline, pH. Each glucose molecule that binds to this material gives up a proton, lowering the pH of the blood sample. If glucose concentrations in the blood fall, so will the number of glucose molecules bound to the sensor; each released molecule grabs a proton, raising the blood's pH. Thus, monitoring blood sugar becomes as simple as assaying pH, says Arnold.

The idea of measuring glucose via pH is not new, observes George S. Wilson of the University of Kansas in Lawrence in an accompanying commentary. Earlier attempts at harnessing pH were thwarted by the blood's capacity for neutralizing acids. He notes that the new polymer avoids this problem by operating at an unnaturally alkaline pH.

Though raising blood to this pH poses a challenge for implanted systems, Arnold says "it's definitely doable" and something her team is actively pursuing. Wilson suggests, for example, that a semipermeable membrane could keep the blood molecules that neutralize acid away from the glucose being sampled.

Arnold anticipates that products based on the new technology may reach the market "within a couple of years." —*J. Raloff*