Earth Sciences

Cold death questioned for early algae

During the last few centuries, the vast early portion of Earth's history has dwelled in relative scientific obscurity while geologists and paleontologists have trained their hammers on the more accessible rocks of the most recent ages. This early period, called Precambrian time, runs from the planet's birth around 4.6 billion years ago to 570 million years ago, which is about the time when animals with skeletons started to appear.

Despite its traditional obscurity, the ancient rocks of the Precambrian have started to yield secrets concerning this unsung portion of the geologic record. In the latest such news, two Australian paleontologists report the discovery of an incredibly rich collection of tiny algae fossils from the last part of the Precambrian.

In the Feb. 16 NATURE, Wen-Long Zang from the Australian National University and Malcolm R. Walter from the Bureau of Mineral Resources in Canberra, Australia, describe a large collection of microfossils found in 600- to 650-million-year-old rocks in central Australia's Pertatataka formation. Called acritarchs, these fossils are the spherical cysts, or cell walls, of tiny algae that lived at the time. In the Australian rocks, Zang and Walter have identified many new types of acritarchs that are both relatively large and complex in shape. With widths of 0.2 to 0.4 millimeter, these fossils bear ornaments like spikes and flanges that protrude from their spherical surface.

Andrew H. Knoll at Harvard University says the Pertatataka find is the richest of its kind, revealing that a diverse community of planktonic algae thrived at the time. The discovery will help scientists trace a wave of extinctions that killed off the large, lavishly shaped acritarchs near the end of the Precambrian. Some researchers have proposed that a series of ancient ice ages wiped out these forms of algae. However, the Pertatataka community shows that acritarchs survived the ice ages, and thus must have disappeared at a later time for different reasons.

How much heat in the Arctic?

Computer models predict that the expected greenhouse warming will heat Earth's polar regions far more than the midlatitudes or tropical areas, but scientists have relatively little information on the current climate of these frigid locales. To fill in some of the details about the Arctic, U.S. and foreign scientists are launching a series of airborne experiments in March and April that will probe the atmosphere and ice around the Fram Strait in the northern Greenland Sea.

Led by the National Oceanic and Atmospheric Administration (NOAA), this project includes three separate studies of the Arctic climate and meteorology, says Russell Schnell of NOAA's Cooperative Institute for Research in Environmental Sciences in Boulder, Colo. In one investigation, Schnell and his colleagues will measure the net amount of solar radiation the Arctic absorbs. They will also examine the climate effects of Arctic haze, the infamous pollution that travels to the most northern latitudes from Europe and the Soviet Union. Says Schnell, "The Arctic is as polluted in winter and early spring as any place you'll ever find in North America."

Another group will investigate how leads, or cracks in the Arctic ice pack, affect temperatures. Because ocean temperatures cannot fall far below 0°C and the winter Arctic air is often 30° to 40°C cooler, leads release a tremendous amount of heat into the atmosphere. Earlier studies have shown that heat from these open areas can rise for miles, going straight up into the stratosphere, Schnell says.

The third project will focus on intense storm systems, called polar lows, that rapidly develop in the Arctic. Looking like small hurricanes, these storms can spring up in half a day, and they kill many fishermen each year, says Schnell.

Space Sciences

Moonrock tells of little-known lunar layer

"It's wonderful," says Ursula B. Marvin, "that after all these years one can still find a completely new rock type on the moon." According to Marvin, a space scientist at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., the tiny fragment provides information about a little-sampled layer of the lunar crust.

Included among the samples brought back by the Apollo 15 astronauts in 1971, the unusual rock was pointed out to Marvin by Marilyn M. Lindstrom, who was working with the moonrocks at the NASA Johnson Space Center in Houston. Marvin describes the rare bit, only about 1.5 millimeters across, as "white glass with two bright red spinels in it." Spinel is a crystalline mineral that exists in various colors, and although researchers might have broken up a larger chunk for different kinds of tests, Marvin says Lindstrom called this one "too small to split but too beautiful to pass up."

What makes it significant is that it contains tiny grains of a magnesium-rich mineral called cordierite, together with an olivine mineral called forsterite. According to J. William Carey of Harvard University, the maximum pressure at which this combination could form is equal to that about 30 miles below the lunar surface, about 6 miles above the moon's crust-mantle boundary. A few Apollo moonrocks appear to have formed at greater depths, and some came from closer to the surface, but the Apollo 15 sample represents an intermediate level. The high magnesium content suggests it came from deeper than about 16 miles, Marvin says, while the cordierite means it was probably no more than 30 miles deep.

The researchers report in the Feb. 17 SCIENCE that the rarity of this combination, called a cordierite-spinel troctolite, among the Apollo moonrock samples suggests it probably formed far enough down that only a major cataclysm, such as a meteorite impact, could have exposed it to view. The astronauts collected their samples near the moon's huge Imbrium basin, and the researchers suggest the cordierite bit was "excavated" by the same impact that formed Imbrium.

Aluminum slurry as a shuttle-booster fuel

Once the solid propellant used in the shuttle's "strap-on" booster rockets has been ignited, it burns nonstop until gone. Liquid-propellant rockets are more complex, requiring pumps and other systems, but NASA has been studying their use for the shuttle boosters in part because they would allow the motors to be throttled down or even stopped and restarted if necessary. In addition, however, researchers are investigating a propellant that is not exactly liquid or solid.

Instead, it is a "slurry," such as mud, consisting of an insoluble solid in a liquid. Stephen R. Turns, at NASA's Center for Space Propulsion Engineering at Pennsylvania State University in University Park, is studying a combination of powdered aluminum in standard kerosene rocket fuel, or RP-1. "With other factors equal," he says, "the heavier the fuel per unit volume, the greater the payload capacity." Furthermore, he says, changing to slurries "would allow the shuttle's basic configuration to remain unchanged." He is now studying the numerous "microexplosions" that occur before the aluminum ignites, potentially shortening the slurry's burning time.

Delta 2 rocket's maiden launch

On Feb. 15, the first flight of a Delta 2 — one of several new rocket designs ordered by the Defense Department to free that agency from dependence on the space shuttle — successfully carried into orbit an upgraded version of the U.S. Air Force's Navstar navigation satellite. By 1992 the Navstar Global Positioning System is to consist of 21 satellites, providing accurate locations to air, sea and land forces 24 hours a day.