Earth Sciences

Stefi Weisburd reports from San Antonio, Tex., at the meeting of the Geological Society of America

The banded iron formation mystery

Banded iron formations may be the most beautiful, economically important and enigmatic rocks ever created on this planet. They are made up of alternating layers of iron ore and silica; some layers only a fraction of a millimeter across extend uninterrupted for kilometers. The worldwide heyday of banded iron formations was about 2 billion years ago. After that, their numbers fell dramatically.

The number of hypotheses on the origin of these formations has grown over the decades, but scientists have yet to settle on any one. In most of the theories, the oceans were saturated with vast amounts of dissolved iron. Periodically, perhaps because of seasonal "blooming" of oxygen-producing organisms or the upwellings of the iron-rich water, the iron was oxidized and precipitated out in layers.

Now Robert M. Garrels at the University of South Florida in St. Petersburg has added a new wrinkle to the proposals. The marine ideas, he says, can't explain why the iron layers don't contain calcium carbonates, an important component of today's oceans. So he proposes that the formations were made when freshwater streams brought the iron into bays after the rains. The thin layers could have formed when the waters evaporated each dry season, he says.

Rigel L. Lustwerk at Pennsylvania State University in University Park has another idea. She notes that as best as scientists can tell, the major episodes of iron deposition coincided with glaciation. In addition, recent studies suggest that the oceans were much warmer at that time than they are now. Lustwerk suggests that the iron formations were deposited when iron- and silica-rich warm ocean waters flowed toward the glaciated polar regions. The suddenly cooled waters could no longer hold the minerals, so they were precipitated out. The alternating layers formed, she proposes, because the two minerals have different settling rates.

Iridium spike not a comet strike?

When researchers discovered a high iridium level in sediments that had been deposited during the Cretaceous-Tertiary (K/T) mass extinctions, it stood out like a sore thumb. Iridium is rare on the earth's surface, and since it's found in greater concentrations on comets or asteroids, some scientists proposed that an impact of an extraterrestrial body caused the iridium spike, as well as the extinctions. And so began a fervent debate over what killed the dinosaurs and other life 65 million years ago (SN: 2/1/86, p.75).

Recently, however, scientists at Exxon Production Research Co. in Houston concluded that the K/T iridium spikes may have nothing to do with the extinctions. Art Donovan and his coworkers have studied what they say is one of the most complete K/T sections known. They have found *three* iridium spikes created in a time span of about 1 million years at a site in the Clayton formation in central Alabama. Most significantly, each of these spikes corresponds to a period when sedimentation rates were very low.

"So the concentrations of iridium at the boundary," says Donovan, "may be controlled by depositional patterns," and not the result of a comet hitting the earth at that time. Most K/T sections are very condensed, he adds, because the sea level rose at the end of the Cretaceous period, making sedimentation rates fall.

"Impacts could still have been a source for the iridium in general," as could volcanic eruptions, says Donovan, but the concentrated *spikes* of iridium seem to be due to changes in sedimentation rates. What scientists need to do now, he suggests, is look carefully at the layers desposited during other times of low sedimentation to determine the frequency of high levels of iridium and other elements.

Space Sciences

Museum-piece satellite goes into space

A former exhibit from the Smithsonian Institution's National Air and Space Museum in Washington, D.C., is now in orbit around the earth. Originally designed as a navigation satellite in the U.S. Navy's Transit series, it was given to the Smithsonian in 1976 instead of being launched, and spent the next eight years on display in the museum's Gallery of Satellites. Now it is in space at last, but with a new mission, new equipment and a name name: Polar BEAR.

Refitted to monitor auroras, magnetic-field changes and other ionospheric effects due to disturbances such as solar flares, Polar BEAR (Polar Beacon Experiment and Auroral Research) was launched Nov. 13 for the Air Force Space Division and the Defense Nuclear Agency. It was initially built for the Navy by the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Md., but was donated to the museum when the design turned out to be so reliable that other satellites in the series were deemed unlikely to need replacement as often as had been anticipated.

It was called back into service in 1984, when Polar BEAR engineers at APL found that Air Force and Navy satellites would no longer be available for modification, as they had in the past. The idea of making such an unusual request of the Smithsonian occurred to Polar BEAR program manager David Grant at APL, and when the lab offered to trade a similar satellite of an even earlier design, the museum was more than happy to cooperate.

In adapting their windfall for its new role, the engineers kept the device's overall structure or "bus," its solar panels and various electronics packages. Everything was in "extraordinarily good condition," says Grant, and even after extensive mechanical modification and the addition of about 40 more electronics boxes, the use of the craft trimmed more than $2 million from Polar BEAR's projected $12.5 million cost.

Circling the earth in the ionosphere, following a nearly pole-crossing orbit 602 statute miles above the surface, Polar BEAR carries three experiments, whose data will be used to help improve communications over the polar regions. All three had been turned on by Nov. 19, and were undergoing checkout.

One is a scanning device that can produce images of the aurora by both ultraviolet emissions (day or night) and visible light. It is the successor of a similar instrument that was launched in 1983 aboard a Defense Nuclear Agency satellite called HILAT, said to have been the first ever to observe the aurora in full daylight. Though HILAT is still at work, its auroral sensor stopped functioning after only 18 days on the job, but not before elating researchers with the quality of its images (SN: 9/24/83, p. 196).

The Polar BEAR auroral sensor may also shed some light on a controversial hypothesis by the University of Iowa's Louis Frank that "dark spots" in another satellite's ultraviolet (1,304-angstrom) images of the atmosphere may represent water vapor from vast numbers of otherwise undetected comets (SN: 3/29/86, p. 199). One other satellite — Sweden's Viking, launched Feb. 22 — made 1,304-angstrom images through late June with no such dark spots immediately apparent, though Viking researchers note that additional processing will be necessary to confirm the observations.

Another of Polar BEAR's sensors, meanwhile, is a magnetometer to follow changes in earth's magnetic field over the poles. Besides relating to the shifting aurora as well as other terrestrial responses to varying solar conditions, the device helps determine Polar BEAR's orientation in space. The third experiment, called Beacon, sends signals to the ground at various frequencies as a measure of electron-caused scintillations in the ionosphere, which can affect satellite communications. Beacon, which will also sample the electron spectrum over the poles, handles Polar BEAR's data transmissions.