Earth Sciences

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

Unearthing early El Niños

Scientists know that an El Niño upsets world weather patterns every seven years or so as the warm equatorial waters of the Pacific Ocean are directed toward the Americas. But they haven't been able to predict the exact timing or severity of El Niños with any great success, largely because detailed meteorologic records have been kept only for a few decades. So a number of scientists are turning to the *geologic* record for traces of El Niños that occurred in the more distant past.

One such study is being conducted at a site on the coast of northern Peru by Lisa E. Wells of Stanford University. Wells has examined the sheets of mud that were deposited by swollen rivers during the last El Niño, in 1982 and 1983; that El Niño and all others are thought to be the only causes of flooding along the normally arid Peruvian coast, she says. By noting the characteristics of these sheets, Wells learned to recognize the flood deposits left by major El Niños in the past. At one study site, she has identified at least 11 large events that occurred in the last 10,000 years.

"I think there are significant events on a 100-year interval that come through this site, but events that actually flood the entire floodplain occur roughly every 1,000 years," she says.

Wells notes that rivers to the north of her study site usually flood more often during El Niños. She thinks that a record of smaller, more frequent events may be preserved in these areas. Other researchers are searching for geologic traces of El Niños in Australia and the Galápagos. These types of studies, she says, may help scientists understand the conditions that foster El Niños and help address questions such as whether El Niños occurred during periods of glaciation.

Oil-attacking microbes make magnetite

Everyone knows what the globe looks like today. But over the earth's history, continents have moved all over, changing the face of the planet considerably. Paleomagnetists reconstruct maps of past continental configurations by observing how the orientations of magnetic fields in rocks differ from the earth's field today. The preserved fields, acquired by rocks as they formed, had been aligned with the earth's magnetic field before continental motions skewed them.

In the last few years, however, paleomagnetists have realized that the measured magnetic field of a rock is not necessarily the same field acquired by the rock when it formed. The addition of a secondary magnetic field to sedimentary layers long after those layers were deposited is more the rule than the exception for Paleozoic-aged rocks, dating from about 200 million to 600 million years ago, says Chad McCabe at Louisiana State University (LSU) in Baton Rouge. McCabe and others hope to understand what causes this secondary magnetization in order to make paleomagnetic reconstructions more accurate.

One possible cause of secondary magnetization is microbes. In work with LSU geochemist Roger Sassen, McCabe has discovered 1- to 150-micron-sized spheres of a magnetic mineral called magnetite at about six sites containing bitumen, a solid hydrocarbon that forms when microbes attack crude oil. Because the shape and texture of the spheres are often associated with biological processes, the researchers think that the magnetite formed as a by-product of biodegradation.

McCabe has found magnetite spheres in limestones too, but it's not clear that those spheres formed in the same way. Scientists have suggested that secondary magnetization in general is caused by chemical and thermal processes, but these have not been satisfactorily demonstrated.

The recent finds have implications for oil exploration as well as for paleomagnetism. According to McCabe, some petroleum geologists have suggested that oil reservoirs are associated with magnetic fields that are different from the expected field of the earth. "Our work could explain that phenomenon," says McCabe, since oil often seeps out of reservoirs and moves toward the surface, where microbes live. If McCabe and Sassen's interpretation of their findings is correct, then it suggests that looking for such magnetic anomalies might be a good way to prospect for oil. It would also give geologists a tool for studying the past migration paths of oil.

Modern examples of ancient life

At the Smithsonian Institution's National Museum of Natural History in Washington, D.C., there is a beautiful mural of the early earth (SN: 7/12/86, p.23). The painting shows calm waves lapping a beach dotted with stromatolites — columnar structures built layer by layer by microorganisms as they catch sediments with their sticky surfaces. This portrayal of the environment in which stromatolitic communities flourished billions of years ago is a classic one. It is based on one of the few known modern stromatolites, which reside in the relatively calm, highly saline waters of Shark Bay in Australia.

But according to Robert Dill, a geological consultant in San Diego, Eugene Shinn at the U.S. Geological Survey in Miami Beach and their co-workers, scientists should consider at least one other kind of modern environment as an analog for where ancient stromatolites lived. Dill's group recently discovered 2-meter-high stromatolites in channels between the Exuma Islands in the Bahamas. Unlike those at Shark Bay, these stromatolites are completely submerged and are subjected to very strong tidal currents of up to 3 knots. The currents are so powerful that they cause sand dunes to completely cover the stromatolites every two to three months. Dill thinks the high currents around the Exuma Islands, like the high salinity at Shark Bay, keep algae-eating creatures away from the stromatolites.

Because Shark Bay is an intertidal environment, with the stromatolites being washed by the tides, most scientists had assumed that ancient stromatolites were also intertidal, even though at many sites there is no geologic evidence for intertidal conditions in the fossil record, says Dill. The Exuma stromatolites "open up a completely new interpretation for the environments of ancient stromatolites," he says. Smaller stromatolites had been found before in the Bahamas, says Dill, but no one had recognized their significance. A paper describing the Exuma find appears in the Nov. 6 NATURE.

Trickle-down theory of sedimentology

A priceless geology talk was given at a session on geosciences education by Wilbert R. Danner at the University of British Columbia in Vancouver. Danner has applied the principles of sedimentology to money that he finds lying on the ground during his walks through campus. He has found that the rate at which coins are deposited on parking lots is greatest in the winter, when short days, snow or storms make it difficult to see coins or make it undesirable to retrieve them.

In contrast, a nearby nude beach receives its greatest deposits of coins during the summer, when people take off their clothes and carry them. Danner says there was a deficit in coin sedimentation during a bus strike last summer and when the bus company began to require paper currency or tickets.

He has also studied the deposition of cans and bottles — a different kind of sedimentation, more like that from the explosive eruptions of volcanoes, he says. All in all, he's netted (for a student fund) $653.72 from his studies of money as well as about $5,000 from his field collections of cans and bottles. This kind of research is especially lucrative for geology students, he says, "because they're always looking at the ground and not at the birds."