Earth Science

Magnetic reversals: Effects on life...

The timing of six previously unreported magnetic reversals in the earth's past has led their discoverers to add further speculation to possible links between reversals and major changes in life on earth.

The two scientists, C. E. Helsley and M. B. Steiner of the University of Texas, identified three reversed and three normal polarity zones in rocks of the Moenkopi Formation in western Colorado. This brings to ten the number of such zones in the formation. The rocks are from the lower Triassic, the earliest part of the Mesozoic era of geologic time that began about 225 million years ago.

They note that these short polarity zones follow a long constant period of polarity that coincided with the end of the Paleozoic era. Similarly, the Mesozoic era ended 65 million years ago with a long constant period of polarity and was immediately followed by a period of frequent magnetic reversals.

"It is tempting to speculate that major geologic eras, defined on the basis of major changes in the fossil record, may end with a very low frequency of reversals and begin with a high reversal frequency," they say in the March GEOLOGICAL SOCIETY OF AMERICA BULLETIN. "The major changes in life forms that take place at these times may be the result of evolutionary adaptation during the long period of constant polarity in which the magnetic field is used in the regulation of some necessary or vital function. Such organisms would be at a severe disadvantage when a period of frequent reversals once again began; for at each reversal, the intensity of the field has been observed to decrease to a low or near zero value."

...measuring their intensities

Much less is known about changes in the intensity of the earth's magnetic field in the remote past than about changes in its direction (reversals). A Japanese scientist, Masaru Kono, who conducted his research while on a fellowship at the University of Colorado, has now helped correct that situation. From studies of 28 samples of lava, he has found that the intensity of the geomagnetic field 65 million years ago was about the same as it is now. In the transition periods between normal and reversed polarity, the intensity weakens to about one-third the usual value.

Together with earlier results, his findings suggest that except for the transition periods, the intensity of the earth's magnetic field has remained nearly uniform for the last 70 million years, regardless of polarity. Kono reports his findings in the March 10 JOURNAL OF GEOPHYSICAL RESEARCH.

The migrating Outer Banks

An ancient river channel and a deposit of peat have been discovered on the sea bottom off North Carolina, lending support to the view that the Outer Banks are migrating toward the mainland. Both the peat and the river channel—features common to estuaries—were discovered on the sea bottom under a sandy trough 12 miles south of Ocracoke Island, N.C., during studies by Duke University's research vessel Eastward.

According to University of Delaware geologist Robert Sheridan, the organic matter and channel are evidence that an estuarine environment similar to that of Pamlico Sound behind part of the present Outer Banks once extended much farther seaward. The ancient estuary, he says, could have survived only with the protection of the barrier islands.

Environment

Merger of waste problems

Coal-based electricity and oil extracted from tar sands are two important fuel alternatives to petroleum, but both generate serious waste disposal problems. When tar sands are treated with large quantities of hot water and steam, oil is released, as well as sand tailings, a watery sludge that is extremely difficult to discard. For instance, in Alberta Canada (where one of the largest tar sand deposits is found), tailings are stored in a large pond and contained by dikes that reach 300 feet in height. And similarly, fly ash, the waste product of burning the oil for electrical power, is collected by precipitators before it enters the stacks. A billion-watt power plant will produce about 907,200 kilograms of fly ash a day.

N. N. Bakhshi of the University of Saskatchewan in Saakatoon, Canada, presented a proposal at the annual meeting of the American Chemical Society in Los Angeles that could solve the disposal problem. He suggests combining the two by-products to produce water and an easily disposable filter cake. The filter cakes could be stacked in the areas from which the tar sands were taken, and the water could be reused in the oil recovery, a process which has large water requirements.

Nowhere to run

The presence of high ozone concentrations in nonurban air was detected by Lyman A. Ripperton and co-workers of the Research Triangle Institute, N.C., after taking over 7,000 ozone measurements in West Virginia, Maryland, Pennsylvania and Ohio. They discovered that one-fourth of all measurements exceeded the National Ambient Air Quality Standard for photochemicals. The research team believes that long-range transport of ozone from smog centers is partly responsible for the presence of the ozone, but that chemical reactions, taking place in the lower atmosphere as the ozone drifts from urban to nonurban areas, produces additional ozone while decreasing nitric oxide concentrations. Once a low nitric oxide condition is reached, the ozone tends to persist or maintain itself.

Leaky cell membranes

Plants exposed to high concentrations of air pollution oxidants, such as ozone, develop "leaky" cell membranes that can lead to the death of the cell and ultimately to the death of the plant, reported biologist Irvin P. Ting of the University of California in Riverside. In his experiments, Ting exposed plants to oxidant levels that are commonly experienced in the Los Angeles Basin (0.1 to 0.4 parts per million) and found that both water and nutrients leaked from the cells.

"Our research results are important because they increase our knowledge on the nature of air pollution effects on living things," said Ting at the ACS. "Our information can be used for the intelligent selection of agricultural crops and ornamental plants to be grown in polluted environments. Also, our information contributes to the establishment of air quality standards. But most important, our research established sound principles on which decisions about air pollution control can be established."

Future research will center around the nature and mechanisms by which the cells repair themselves and prevent the nutrient and water from leaking, as well as investigating why some plants are more highly resistant to oxidants than others.