earth sciences

Gathered at the Geological Society of America annual meeting last week in Milwaukee

PALEONTOLOGY

Biological effects of earth's magnetic field

In the course of geological history, the earth's magnetic field has frequently reversed at intervals of 1 million to 100 million years. A few scientists now suspect that these reversals may have had drastic effects on terrestrial life.

Dr. James D. Hays of Columbia University's Lamont-Doherty Geological Observatory has studied 28 deep-sea cores from locations throughout the world.

He found that during the past 2.5 million years eight species of one-cell marine animals called Radiolaria became extinct. Six of these extinctions occurred simultaneously throughout their geographic range immediately following magnetic reversals. The chance that this correlation occurred by chance, Dr. Hays estimates, is one in 10,000.

There are several possible explanations. The most likely, Dr. Hays believes, is that the earth's magnetic field has a direct effect on animal life. Recent biological studies, he notes, show that certain animals such as snails and bees are sensitive to magnetic fields of the same strength as the earth's.

TECTONICS

Patterns of breakup and assembly

One of the corollaries of plate tectonics is that some deformed belts of the crust represent the suturing of continents formerly separated by an ocean basin. The Himalaya Mountains are an example.

Dr. Eldridge M. Moores of the University of California at Davis has reconstructed a history of fragmentation and assembly of the continents beginning with the formation of a supercontinent he calls Pangaea I by suturing of the Trans-African Balkalian system. Pangaea I fragmented into four continents by the time of the Upper Cambrian, some 500 million years ago, only to be resutured along the Caledonian, Appalachian and Ural Mountains to form Pangaea II. The second Pangaea eventually broke up to form the continents that exist today.

This model, Dr. Moores says, partially explains worldwide sea level fluctuations and proves that the "old cliche of geology books that the seas came in and the seas came out is probably true."

GLACIOLOGY

Antarctic ice surges

In 1966 Dr. A. T. Wilson of New Zealand proposed that the Quaternary ice ages may have been triggered by surges in the Antarctic ice sheet that created an ice shelf covering the southern ocean. This would increase the planetary albedo (reflectivity) by about 4 percent and cause a global decrease in temperature. These surges, says Dr. George H. Denton of the University of Maine, would be accompanied by rapid increases in sea level, northward dislocation of the Antarctic convergence, northward movement of the glacial marine sediments of the ocean floor surrounding Antarctica and substantial changes in the Antarctic ice level. All these events, he notes, would leave their mark on the geological record.

But so far there is firm evidence only for the predicted changes in the level of Antarctic ice sheets, he says. Geological studies along the Transantarctic Mountains show that the Antarctic ice sheet did reach a low level in the late Wisconsin stage of the glacial advance in North America.

Though present data do not actually support the existence of major ice surges. Dr. Denton concludes, they are consistent with it, and the Wilson theory should not be discarded without further study. But Dr. Denton thinks that minor surges of individual Antarctic ice sheets may have occurred.

SEA-FLOOR SPREADING

Pre-Mesozoic ocean crust

The rate of sea-floor spreading inferred from magnetic anomaly patterns in ocean sediments means that almost all of the present ocean floor postdates the Mesozoic breakup of Pangaea II 200 million years ago.

But Drs. Robert S. Dietz of the Environmental Science Services Administration Atlantic Oceanographic and Meteorological Laboratory and John C. Holden of the University of California at Berkeley believe they have found a place where ocean crust of Pre-Mesozoic age underlies the East Indian Ocean basin.

They hypothesize that the Ninety East Fracture Zone adjoining the basin is a trench boundary of the Australian plate created when India began to drift away to the north after the breakup of Gondwanaland. As Australia moved north and impinged against Asia, the East Indian basin crust remained unconsumed by the Java trench.

This old ocean floor, researchers conclude, will probably be with us for another 50 million years before it disappears in the Java trench.

TECTONICS

Rise overridden

The East Pacific rise, which seems to end at North America in California, may well have been overridden by the continent. The effects of such a situation, according to Dr. J. Tuzo Wilson of the University of Toronto, could explain many geological features of the western United States, such as the late Tertiary uplift of the Cascade Mountains and the San Andreas Fault.

By extrapolating from magnetic anomaly patterns, Dr. Wilson estimated where the hidden rise ought to lie. The ridge crest between two fracture zones west of California is offset to the east, he says, so that part would have run up against the continent before the rest, closing the trench and causing faulting on the adjacent land. In such a case, though, the material welling from the rise would be forced to flow away from the continent so the trench would not be needed to absorb the spreading sea floor.