earth sciences

PALEOMAGNETISM

Seamounts and a decoupled Pacific plate

Since 1967 Scripps Institution of Oceanography scientists have conducted paleomagnetic surveys on 49 seamounts in the Pacific Ocean.

Their new work, in combination with all previous paleomagnetic data from the Pacific basin, confirms earlier results indicating a 2,000-mile northward movement of the northeastern Pacific in the last 65 million years.

Their study also provides strong evidence that the northeastern Pacific and the South Pacific were decoupled sometime during that period; the Pacific floor seems not to have remained rigid the whole time.

It appears likely, say Drs. Jean Francheteau, J. G. Sclater and M. L. Richards of Scripps and C. G. A. Harrison of the University of Miami in the April 10 JOURNAL OF GEOPHYSICAL RESEARCH, that the present Pacific plate is a composite of at least three distinct former plates. Volcanic nonseismic ridges in the Pacific may be the fossil boundaries where the three coalesced into a single plate.

SEISMOLOGY

Thickness of the lithosphere

In the hypotheses of sea-floor spreading and plate tectonics, the lithosphere is composed of the earth's crust and a portion of the upper mantle. The two layers together act, in effect, as a single, rigid horizontal plate.

Estimates of the lithosphere's thickness, an important point in discussing the mechanism of plate tectonics, have varied considerably. Drs. Hiroo Kanamori and Frank Press of the Massachusetts Institute of Technology report in the April 25 NATURE their use of new and highly precise seismic velocity data to test models of the thickness.

All successful models showed a large decrease in the velocity of shear waves at a depth of 70 kilometers. Numerical experiments confirmed the fact.

From these results they conclude that the lithosphere is about 70 kilometers thick.

GEOCHEMISTRY

Ocean as source of CO

Earlier this year U.S. Naval Research Laboratory scientists announced evidence that the ocean may be a source of the carbon monoxide in the atmosphere (SN: 1/24, p. 96). This was a considerable surprise, because previous theory indicated that the oceans might be a sink for removal of the gas from the atmosphere.

Independent evidence supporting the NRL finding is reported by two scientists from the Max Planck Institute for Chemistry in Germany, W. Seiler and C. Junge, in the April 20 JOURNAL OF GEOPHYSICAL RESEARCH.

From measurements taken during an oceanographic expedition in the North Atlantic in 1969 they determined that the amount of carbon monoxide dissolved in the seawater was 10 to 40 times higher than the equilibrium value for the air concentrations. "These high amounts of dissolved CO," they conclude, "can be explained only by a continuing production of CO in seawater that acts as a huge source of CO in the atmosphere."

The gas probably is produced by bacterial decomposition of organic material such as plankton.

The problem of where the atmosphere's excess CO goes can be explained in part, they say, by oxidation of the gas in the stratosphere.

GEOPHYSICS

Tectonics of East Africa

Modern theories and oceanographic methods have become so effective that the evolution and movements of the ocean floor are now much better studied and understood than similar processes on land.

This has made it possible to construct an outline of the movements involved in the formation of the East African Rift Valley (SN: 1/10, p. 39) from the history of the surrounding ocean basins. The results of such a reconstruction, reported by Drs. D. P. McKenzie and D. Davies of the University of Cambridge and Peter Molnar of the Lamont-Doherty Geological Observatory in the April 18 NATURE, are in general agreement with studies of the Rift Valley itself.

They studied the motions of three plates of lithosphere that meet at the south end of the Red Sea: the Arabian, Nubian and Somalian plates. The relative motion along the Rift Valley, they showed, can be explained by the opening of the Red Sea and the Gulf of Aden.

The study, they say, shows that the concepts of plate tectonics can be useful where plates are separating at millimeters a year and the total relative motion has been only 30 to 300 kilometers—rates at least an order of magnitude smaller than those of most major plate boundaries in ocean regions.

GEOPHYSICS

Alternative to bumps on the core

There has been much recent interest in the finding of a strong correlation between the earth's gravity and geomagnetic fields. Since geomagnetic variations can be attributed to features of the earth's outer core, some geophysicists have suggested that the correlations between the two fields are evidence of undulations or bumps on the surface of the core (SN: 2/28, p. 225).

Two scientists from the University of Hawaii's Institute of Geophysics, Drs. Mohammad Asadullah Khan and George P. Woollard, have taken a look at the evidence and decided it should be interpreted another way.

They propose that the correlation is due not to distortions on the core-mantle boundary but merely to horizontal variations in temperature in the earth's upper mantle. They have shown that electrical conductivity increases sharply in the hotter areas of the upper mantle. Magnetic fields associated with stronger electrical currents in these areas tend to oppose or attenuate the propogation of the magnetic field from the core.

The net effect, they say in the April 25 NATURE, is that gravity lows over the hotter upper mantle match geomagnetic lows, and gravity highs over the colder mantle match geomagnetic highs.