earth sciences

From our reporter at the 24th International Geological Congress at Montreal

Formation of the Niger delta

The huge Niger delta, a 200-kilometer-wide feature that dominates the coast of Africa's Gulf of Guinea, was formed as direct result of continental drift. That conclusion, says R. A. Reyment of Uppsala University in Sweden, is the result of 20 years of study of West African and Brazilian geology. Reyment postulates that as Africa and South America drifted apart, waters of the growing Atlantic Ocean first crept into what is now Nigeria from the south. The continuing separation of the continents left a 200-kilometer gap in the African coast. In effect, South America took a triangular chunk out of Africa. This gap rapidly filled with sediments. The oldest sediments in the delta, which probably date the time of formation, are roughly 80 million years old.

A triangular region between Natal and Recife in Brazil, he reports, fits snugly into the gap in continental basement rocks underlying the present-day delta. Since the time when it was first formed by continental drifting, the delta has grown about 200 kilometers outward from the original coastline. He concludes that scientists making geographic reconstructions of predrift continents should take into account that this expansion of the African coastline is a relatively recent development.

Fossil changes: 'Normal evolution'

The boundaries between eras, periods and epochs on the geological time scale generally denote sudden and significant changes in the character of fossil remains. For example, the boundary between the Triassic and Jurassic periods of the Mesozoic era (about 180 million years ago) was supposedly marked by spontaneous appearance of new species. Researchers have sometimes come up with drastic explanations for these changes such as an increase in mutation rates due to cosmic rays.

A reassessment of the data by Jost Wiedmann of the University of Tübingen in the Federal Republic of Germany gives a clearer picture of evolution at the boundaries of the Mesozoic (225 million to 70 million years ago). He concludes that there were no worldwide extinctions of species or spontaneous appearances of new species at the boundaries. Instead, there was a continuous disappearance of "old" fauna, a continuous and gradual appearance of "new" fauna, and sudden diversification of species that had appeared previously. These changes can be explained by "normal" evolutionary processes, he says; worldwide ecology may simply have warranted greater diversity of species.

A former seamount in California

There are several places in California where rocks of different types meet and are deformed in a way suggesting that they may have been opposite sides of a subduction zone where one crustal plate sank below another. Usually the rocks are extremely jumbled and datable fossils are scarce, so it is hard to tell what happened when.

There is an area with abundant fossils and relatively simple structure, though, that can be interpreted as an east-dipping subduction zone where a plate to the west was sinking below one to the east. This area, says James D. Berkland of the University of California at Davis, is in northern California around Middle Mountain.

The youngest rocks are sedimentary and are about 70 million years old. They dip beneath older rocks and overlie a slab of lava 1,200 meters thick. Berkland proposes that the lavas are the remains of an undersea mountain formed about 140 million years ago on the Pacific floor. As the Pacific plate moved eastward and was consumed below the North American plate, the seamount became eroded, subsided below sea surface and was covered with sediment. Subduction apparently stopped as the mountain was jammed under the upper plate. The motion of the plates was consumed elsewhere and the subduction zone became frozen. Later uplift and erosion destroyed parts of the upper plate and exposed the buried seamount.

Elusive boundary of Caribbean plate

Between the two major crustal plates carrying North and South America is a small Caribbean plate. The Cayman Trench appears to be part of the northern boundary of this plate. The boundary of the plate at the western and eastern ends of the trench isn't clearly defined.

Stephen Kesler of the University of Toronto and David R. Forth of Louisiana State University noted that several faults in Guatemala seem to be extensions of the Cayman Trench. He wondered if there may be a fault zone cutting across the isthmus that could be part of the Caribbean plate boundary. Two of the faults have been recognized as far west as western Guatemala, and the western ends of both faults have been active in the last two million years.

The geologists conclude that the faults do seem to be the site of large-scale vertical adjustments between plates but horizontal movements on the faults aren't large enough to positively identify them as a major plate boundary. "Our final conclusion is that it isn't as simple as we might hope."

Structure of Tethys basins

A team of nine Soviet geologists from the Academy of Sciences and the Ministry of Geology of the U.S.S.R. have investigated the peculiarities of the crustal structure underlying certain inland seas and continental basins. The Mediterranean, Black and Caspian Seas and three sediment-filled basins, the Lombardian, Pannonian and North Caspian, occupy the basins once filled by the ancient Tethys Sea.

Geophysical studies show that the depressions form a single system and are similar in structure. For one, the earth's crust under the basins tends to be thinner than elsewhere. The granite layer thins toward the center of the basin and may disappear altogether. At the same time, the basalt layer of crust increases slightly in thickness. Seismic sounding shows that the thinning of the crust is accompanied by upward bulges of mantle. The depressed central parts of the basins are bounded by active faults.