

New Evidence of sea-floor spreading in the South Atlantic found on Deep Sea Drilling Project

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Woods Hole, Mass. - February 14 - Two scientists of the Woods Hole Oceanographic Institution today revealed new evidence of sea-floor spreading in the South Atlantic. Their findings suggest that the continents of Africa and South America were joined approximately 150 million years ago.

The sea-floor spreading measures about one inch per year for the last 70 million years, and appears symmetrical about the axis of the Mid-Atlantic Ridge which bisects the ocean floor between Africa and South America. The mechanism causing the sea-floor spreading is not yet known.

These are the tentative conclusions of the Co-Chief Scientists of Leg III of the Deep Sea Drilling Project, Drs. Arthur E. Maxwell and Richard P. Von Herzen.

Maxwell is Associate Director of the Woods Hole Oceanographic Institution, and Von Herzen is an Associate Scientist. They were members of a 15-man team of scientists and technicians aboard the drilling ship Glomar Challenger from Dakar to Rio de Janeiro from December 1, 1968, to January 24, 1969.

Scientific teams of the Deep Sea Drilling Project are carrying out drilling operations and preliminary core descriptions following plans laid out by the committees formed under the Joint Oceanographic Institutions for Deep Earth Sampling.

Speaking during a press conference held Friday at the Woods Hole laboratory, Maxwell and Von Herzen said that ten holes had been drilled during the cruise. More than 90 per cent of the attempted corings resulted in recovered cores.

"This is a highly successful rate, even on land, let alone at sea, where the conditions are much more difficult," Dr. Maxwell said.

The drilling took place on the flanks of the Mid-Atlantic Ridge where the structure and movement of the earth's crust was studied, and where sedimentation revealed the age of the ocean floor at varying distances.

The ages of the sediments, and their respective distances from the Mid-Atlantic Ridge, indicate that two points at equal distances on each side of the Ridge axis at 30 degrees south latitude have been spreading apart at the rate of two inches per year for the past 70 million years.

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Attached is a preliminary statement on the scientific findings of the Third Leg of the Deep Sea Drilling Project extending from Dakar, Africa, to Rio de Janeiro.

This statement was prepared by Dr. Arthur E. Maxwell, Associate Director of the Woods Hole Oceanographic Institution, and by Dr. Richard P. Von Herzen, Associate Scientist of the Institution. Dr. Maxwell and Dr. Von Herzen were co-chief scientists on the Third Leg.

An official report on Third Leg scientific findings by the entire staff of scientists aboard the drilling ship, Glomar Challenger, will follow at a later date.

Dr. Maxwell and Dr. Von Herzen are attending this press conference and will answer any questions pertaining to the attached statement.

The Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), a group that drew up the scientific program for the DSDP, includes the Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; Lamont-Doherty Geological Observatory of Columbia University; the Institute for Marine Sciences of the University of Miami; and Scripps Institution of Oceanography, University of California at San Diego. The University of Washington is now a member of JOIDES.

The Scripps Institution of Oceanography of the University of California at San Diego is prime contractor for the Deep Sea Drilling Project which is a part of the National Science Foundation's National Ocean Sediment Program. Scripps holds a \$12.6 million contract with NSF to conduct the 18-month deep ocean coring expedition.

Drs. Maurice Ewing and J. L. Worzel were co-chief scientists on Leg I (from Orange, Texas, to New York) and Drs. M.N. A. Peterson and N. T. Edgar of Scripps Institution of Oceanography were co-chief scientists for Leg II (from New York to Dakar).

In addition to Maxwell and Von Herzen, the following scientists participated in the Third Leg: Dr. Kenneth J. Hsu, Swiss Federal Institute of Technology; Dr. James Andrews, University of Hawaii; Dr. Tsunemasa Saito, Lamont-Doherty Geological Observatory, Columbia University; Dr. Dean Milow, Scripps Institution of Oceanography, University of California at San Diego; Mr. Stephen Percival, Princeton University; and Mr. Robert E. Boyce, Scripps Institution of Oceanography, University of California at San Diego.

The Woods Hole geophysicists directed the scientific program aboard Global Marine, Inc.'s, drilling ship, Glomar Challenger, as the vessel conducted ocean floor coring operations across the southern portion of the Atlantic Ocean to Rio.

Dr. William A. Nierenberg, Director of Scripps, is Principal Investigator for DSDP. Other key officials are Mr. Kenneth E. Brunot, Project Manager, Dr. Darrell L. Sims, Project Engineer; Dr. M.N.A. Peterson, Chief Scientist of the project; Dr. Elizabeth L. Gealy, Executive Staff Geologist, Mr. W.R.

Riedel, Curator; Mr. Dan R. Bullard, Jr., and Mr. James T. Dean, Jr., Cruise Operation Managers; Mr. W.R. Jack, Contract and Planning Administrator, and Mr. Thomas B. Hurtt, Business Manager.

Dr. Richard P. Von Herzen Dr. Arthur E. Maxwell

The South Atlantic cruise of the Third Leg of the Deep Sea Drilling Project took place between December 1, 1968, and January 24, 1969. Ten holes, carefully selected in advance for their strategic and representative positions, were drilled in the deep sea floor and corings were taken. (See Figure 1) The first site on this Leg, number 13 in the series of holes drilled, was located on the Sierra Leone rise. The last two sites during the cruise were located on the Rio Grande rise. The remainder, and majority of the drilling sites, were over the principal and most interesting topographic feature of the Atlantic Ocean basin--the Mid-Atlantic Ridge.

We had two primary objectives on Leg III. The first was to investigate the tectonic development of the Mid-Atlantic Ridge-- structure and movement of the crust in that area--and secondly to investigate the history of sedimentation in the South Atlantic. In the South Atlantic there is a relatively uniform pattern of magnetic anomalies which seem to indicate a spreading of the sea floor in the South Atlantic over the last 150 million years or so. That is, the continents of South America and Africa have been supposed to have been one geographic unit at that time in the past. And since that time (by a mechanism as yet not known), the two land masses are thought to have separated, leaving the South Atlantic Ocean to fill the space between them. The information which we are collecting from the Ridge and the basin is expected to contribute toward a verification of this postulation.

Results

In such an expedition, success can be measured in part by the technological achievement. By this measurement, the Third Leg cruise was highly successful, with a 92 per cent retrieval of coring. Out of 2,741 feet of attempted corings, 2,536 feet of core were recovered. The real scientific accomplishment will, of course, be more apparent in the coming months as the new data are analyzed for their full meaning. In addition to the softer sediments retrieved in the corings, some extremely valuable samples of basalt rock were recovered from most of the sites.

A. The Mid-Atlantic Ridge.

The sites across the Mid-Atlantic Ridge were planned as a profile at about 30° south latitude. Distances from the Ridge axis range from 250 to 1,300 kilometers (150 to 800 miles). Drilling at each site was deep enough to penetrate the sedimentary column and reach basalt basement. Water depth at the sites ranged from 11,000 to 15,000 feet. Studies of the cores brought aboard and analyzed in the ship's laboratories revealed that the ages of the oldest sediments immediately above the basalt basement at each site ranged from 11 to 67 million years. (Table I) A plot of the age of the sediments versus the distances from the Ridge axis indicates a relatively constant rate of sea floor spreading of about 2 centimeters per year (slightly less than 1 inch per year) over the past 70 million years.

That is, two points at equal distances on each side of the Mid-Atlantic Ridge axis at this latitude have been spreading apart at the rate of 4 centimeters per year (2 inches per year)

Although a small scatter of the data may allow for some variation in spreading rates, the overall pattern seems remarkably uniform. Furthermore, the fact that sites number 17 and 18 are located on the east side of the Ridge axis, whereas all the other Ridge sites are on the west flank, gives us reason to believe that the spreading in both directions from the Ridge axis is symmetrical.

The drilling sites were selected on the basis of correlation with the magnetic anomaly patterns which had been previously deduced. The magnetic patterns are believed to indicate a history of magnetic variations of the earth which have been retained in the rocks beneath the sea floor. As noted in Table I, there is some discrepancy of the sediment ages with the magnetic anomaly pattern ages. This will most likely be resolved with some minor adjustments of the hypothesized geomagnetic time scale or possibly some adjustments of the paleontological ages when the cores have been examined in more detail. Before the sites were drilled, the relatively constant thickness of sediments across this part of the Mid-Atlantic Ridge, as deduced from seismic measurements, was used by some to argue against the sea floor spreading hypothesis. The sites with the oldest sediments might be expected to have the greatest sediment accumulation if the sea floor were indeed spreading. The geological ages of the sediments across the Ridge holes ranged from Recent to Upper Cretaceous. In spite of the wide variation in age, Table I shows that the total sediment thickness across the Ridge was relatively constant (in accord with the seismic evidence), ranging from 70 to 175 meters (230 to 575 feet) in thickness.

However, it appears that the period of most rapid sedimentation over any part of the Ridge occurred soon after creation of new sea floor near the Ridge axis. Sedimentation rates ranged up to 2 centimeters per thousand years. As the newly created sea floor spread away from the axis, the rates of sedimentation apparently decreased

markedly. Therefore, the sediments at the various sites across the Ridge have a much different age distribution whereas the total thickness is more uniform.

The majority of the sediments consist of fossilized skeletons of marine organisms, predominately. nannoplankton chalk oozes and some Foraminiferal ooze sediments, although some unfossiliferous clays were also identified. These different types of sediments have been classified as formations and most all of them are traceable between different sites across the Ridge, The type of sediments has changed with geologic time, and a given formation is sometimes of slightly different age at different sites. This may result from conditions at the Ridge axis being favorable to the accumulation and preservation of sediments.

Samples of basalt were obtained at the bottom of the holes at all Ridge sites. The difficulty of coring basalt prevented penetrations greater than a few feet into this material but it is not believed that significant thicknesses of additional sediments exist below this basalt. This conclusion appears to receive its strongest support from the rather uniform sequence of sediment ages found away from the Ridge. However, the texture of this basalt at some sites indicates that it was extruded at the sea floor, while at others it was intruded into the sediments as a sill. In the latter case, it does not seem likely that any great thickness of sediments were covered over by the basalt emplacement.

B. Sierra Leone Rise.

At site 13 on the Sierra Leone Rise, a wide variety of sediment types was encountered. These include nannoplankton chalk oozes, sometimes containing Foraminifera, zeolite clays, radiolarian oozes and radiolarian cherts, red shales, and dolomites. These sequences are similar to that found in other holes in the western part of the North Atlantic. They may indicate a wide variety of conditions in climate or oceanic circulation, perhaps taking place on an ocean-wide basis.

C. Rio Grande Rise.

The two sites on the Rio Grande Rise were located in relatively shallow water depths of about 7000 feet. The sediments there consist mainly of nannoplankton-Foraminifera era chalk oozes. The much greater percentage of Foraminifera here than on the Mid-Atlantic Ridge sites probably indicates that this region has remained an elevated rise since Cretaceous time. A lithified coquina (limestone) found at the bottom of site 21 may indicate that the rise was even shallower in the past, since this could be a beach deposit.