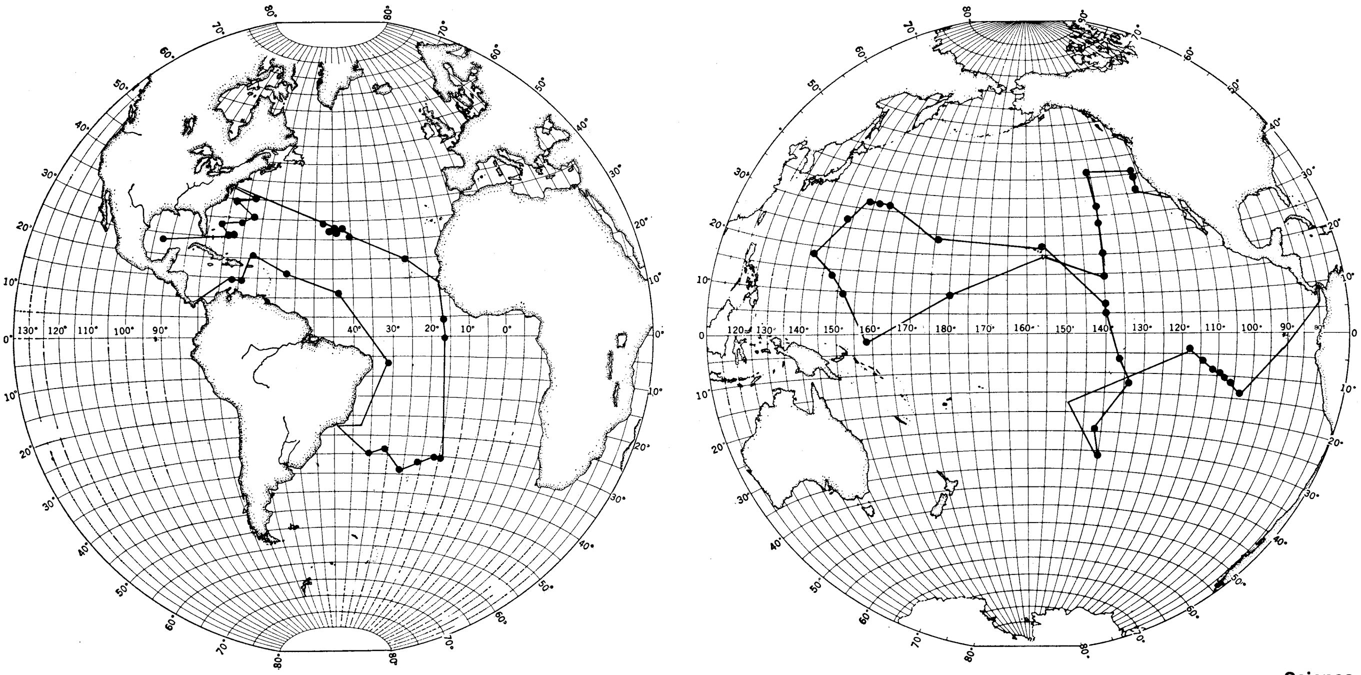


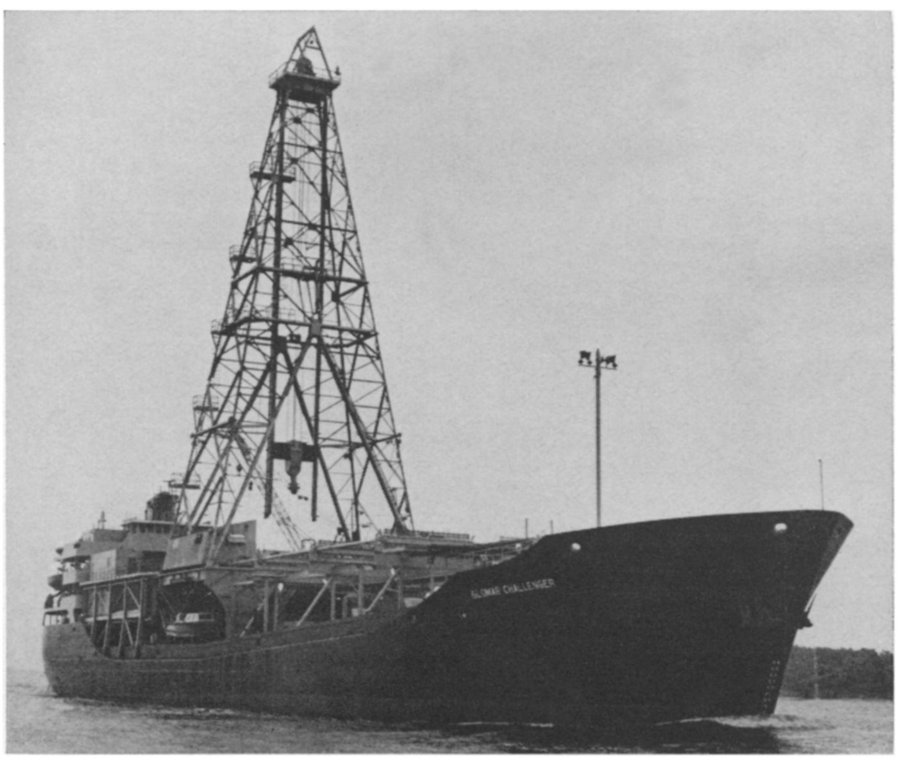
Science

The Challenger will drill its way across more than 40,000 miles, ending up only 1,000 miles from where it started.

Drilling under the sea

More than 60 deep holes in the ocean bottom will reveal the world of millions of years ago

by Jonathan Eberhart



Global Marine

The ship's 142-foot-high derrick can hold a drill string of 1,000,000 pounds.

The Mohole, a plan to drill deep into the Mohorovicic Discontinuity between earth's crust and mantle, was threatening to triple its cost and add four years to its timetable when Congress finally killed it in 1966.

Though the Mohole and its Congressional investigations are now only an unpleasant memory, the lure of the ocean bottom remains. Many of the secrets of the origin and development of earth's waters, land masses and even climate lie beneath the seas.

This month, a remarkable scientific expedition is embarking on an attempt to probe some of these mysteries. Covering some 40,000 miles of open water, the project will repeatedly crisscross the Atlantic and Pacific Oceans, at the same time ranging north and south over more than a fifth of the world's circumference. More than 60 holes will be drilled during the 18-month voyage, and although none of them will penetrate as far into the crust as would have the four-to-five-mile Mohole (the deepest will reach about 2,500 feet), some may originate in 20,000 feet of water, more than a mile deeper than the Mohole site.

There have been a good many ocean-bottom core-drilling projects before, but they were all located relatively near exposed land masses, and in comparatively shallow water.

Significant as the results of the expedition may be, the advances in deep-drilling technology needed just to make it possible may turn out to be at least as important.

Going straight down through 20,000 feet of water, says Dr. Tjeerd H. van Andel, science adviser to the new deep-drilling project, is like trying to drill a land hole the length of a football field with a piece of baling wire.

To keep the drill string from whipping around like a piece of fringe, and possibly pulling out of the hole or breaking, the ship carrying the drilling rig must be kept as directly over the hole as possible. The ship should not stray from its intended spot by more than about three percent of the depth of the water, Dr. van Andel says. Fortunately, he points out, this allows greater lattitude for deeper holes, which need it most. To provide this control a new system has been developed and incorporated into a 400-foot ship called the Glomar Challenger, which completed its sea trials only days before setting out on the drilling expedition.

At each drilling site, two sonar beacons will be lowered from the Challenger to the ocean floor, from where they will send signals to an array of detectors on the ship's bottom. A computer will automatically monitor the ship's position in relation to the beacons and control the engines keeping the vessel over the target.

The engine system is also unique to the Challenger. Four tunnels—two forward and two aft—pass through the hull and contain propellers that can provide thrust to rotate the ship so that it is always headed into the wind and current. The vessel's regular main engines are then operated by the computer to counteract drift.

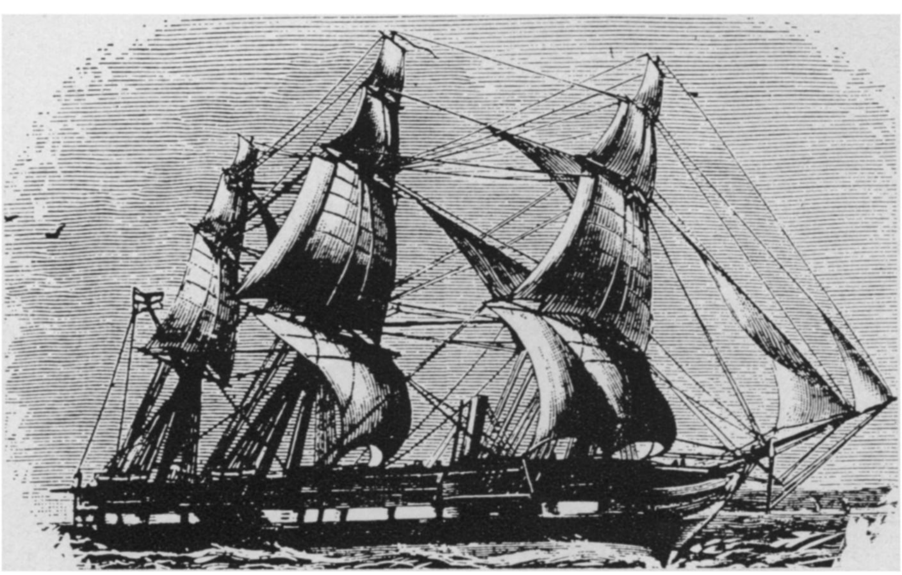
But maintaining the ship's position is not enough to satisfy the scientists' need for precision. Movement of the drill string by deep currents could cause the bottom end to move up and down in its hole, which in turn could mislead researchers as to the depth at which a given core sample originated. This is particularly important since a yard of bottom sediment can represent a million years of history.

To minimize this effect, massive drill collars will be placed around the bit assembly in the hole to help keep the drill from rising. In addition, sliding splines or half-shafts will be included in the drill string to permit some slack to be used in sideways swaying while still transmitting the rotation to the bit.

Sediments perhaps as old as 200 million years will be taken from a wide variety of sites, beginning in the Gulf of Mexico near Orange, Tex., home of the Livingston Shipbuilding Co., which built the Challenger to the design of Global Marine, Inc.

Among the first targets will be some dome-like structures, located by sonar beneath the sediment on the Gulf floor. Reports that the domes might contain a vast oil field are laughed off by Joseph Sides, chief scientist for the project at the sponsoring National Science Foundation, who says that finding oil there is "about as likely as finding the ocean floor made of green cheese."

Nevertheless, the domes are interesting. Geologically, they look like salt domes, according to Sides, but salt rarely accumulates at the ocean bottom. This may mean that they were formed by some presently unknown mechanism, he says, or possibly that the Gulf floor was once level with the rest of the continent.



The Challenger's British namesake began modern oceanography in 1872.

From the Gulf of Mexico, the Challenger will zigzag up the east coast to New York, drilling about seven holes in the continental shelf. One thing that may be learned, says Sides, is whether North America was thrust up gradually from the crust of the planet, or was born rapidly enough to crack it free.

The second leg of the trip will cross the Atlantic to Dakar, Senegal. Most of the second-leg drilling will be concentrated in the mid-Atlantic ridge, in an effort to add more evidence to the theory of continental drift. The idea is that heat flow in earth's mantle is forcing new material up at the ridge site, causing the ocean to spread out from it in both directions, possibly as much as two inches a year. If the theory holds, sediments at a given depth should be older, the farther they are from the ridge, since they have had longer to be pushed away. Samples collected from around the ridge by dredging indicate this to be the case (SN: 4/27, p. 404).

Next, the Challenger will head south, checking for spreading in the South Atlantic, and after touching at Rio de Janeiro, will move up to the central ridge and then to the Antilles.

Island chains, such as the Antilles, are "one of the most uniformly shaped features on the crust of the earth," Sides says, and as such have been of interest to scientists for years. They may also be related to other phenomena such as earthquake zones (SN: 3/30, p. 301), according to geologist George Rouse, formerly of the Colorado School of Mines and now a consulting engineer.

From the Antilles the expedition will move through the Panama Canal to begin five Pacific legs of the trip. Each leg in each ocean should last about two months, with a week for refitting at each stop. The schedule has deliberately been left flexible so that the legs may be followed in a different order.

From Panama, the ship will first cross the East Pacific Rise, again looking for spreading, then touch at Papeete on Tahiti and head for Honolulu. On the way north, samples will be taken from a series of fracture zones that run for hundreds of miles, crossing the Pacific in an east-west direction. There are from six to eight major zones, and samples taken across each zone may reveal how far or how rapidly they have slipped.

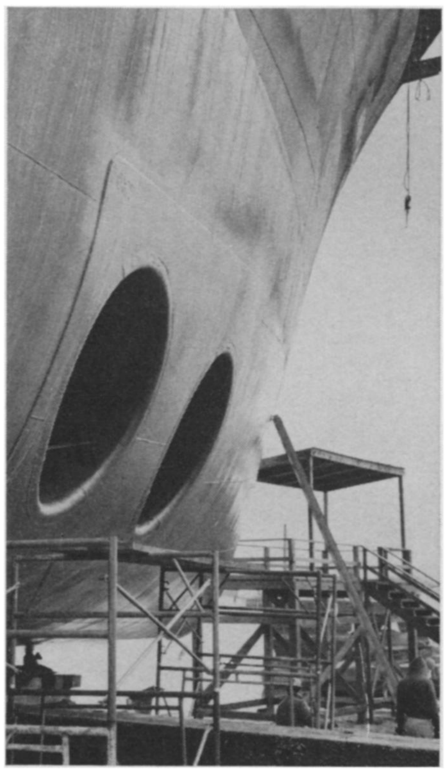
Then the course runs westward and down to Guam, stopping about 1,000 miles southeast of Japan to look at what may be the oldest sediments in the world's oceans; from there the Challenger heads down and back up to Honolulu, taking samples on the way

. . . deep drilling

from the tops of several seamounts and underwater mesas (guyots) reaching up from the ocean floor.

The homeward leg will run northward again, crossing the east-west fracture zones, while scientists compare the fractures with existing maps of variations in earth's magnetic field. From there it will be California and home.

The project's vessel was named for an earlier Challenger, a British research ship whose epic journey almost a century ago has been described as "the great breakthrough in the development of oceanography as a science." In its three-and-a-half-year voyage, the first Challenger crossed the Atlantic and Pacific, netted marine animals, took soundings, mapped currents, sampled the bottom and became the first steamship in history to cross the Antarctic Circle.



Global Marine

Tunnel-thrusters loom wide in the bow.

The results of the first Challenger's trip were so massive and so thoroughly studied that it took the British Government 16 years (1880-1895) to publish them—in 50 thick, quarto volumes. These covered subjects ranging from the behavior of currents to the anatomy of the creatures of the abyss, and from soundings to the classification of organic oozes.

"The new Challenger," says Dr. Melvin Peterson, chief project scientist from the Scripps Institution of Oceanography, "is, in our day, an equally important step."