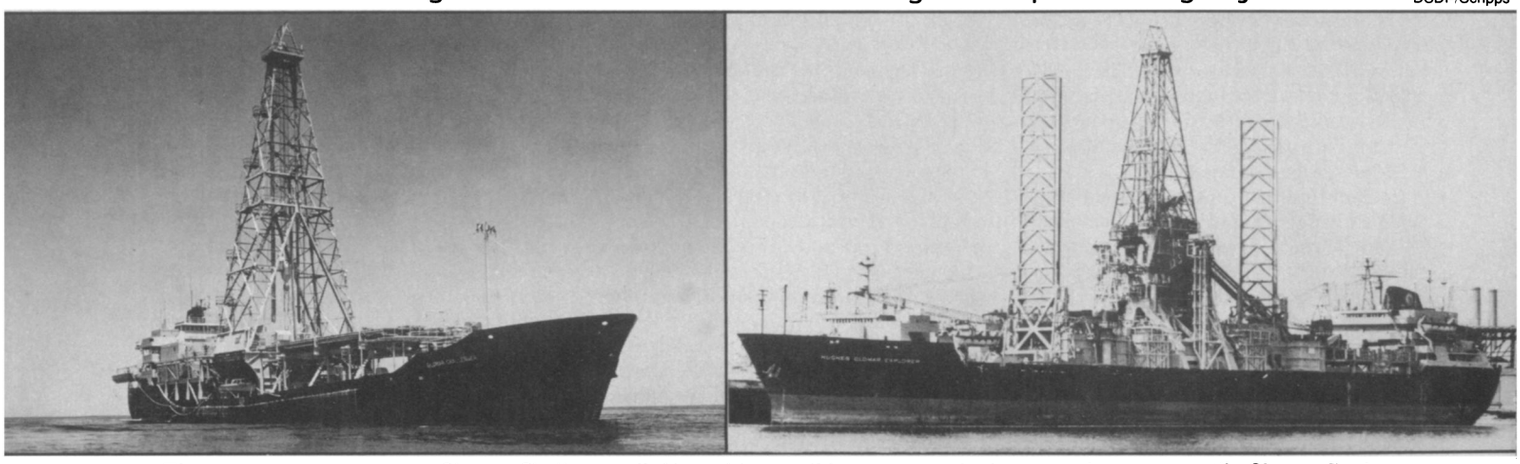
DSDP: 10 Years After

Science and government examine the choices facing the Deep Sea Drilling Project

DSDP/Scripps

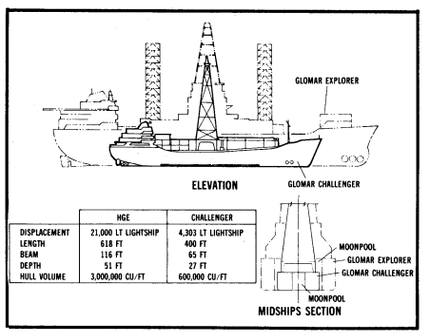


The ten-year DSDP *veteran,* Glomar Challenger *(left), and its possible successor, the larger and more versatile* Glomar Explorer.

BY SUSAN WEST

More than 100 years ago, the *HMS Challenger* set out from England on the most ambitious scientific project of the century — a study of the world's oceans. The results of four years of sampling, dredging, measuring and charting filled 50 volumes on currents, underwater topography, bottom sediments and the deep sea. Among other things, it discovered the jagged submarine ranges of the mid-Atlantic ridge, the birthplace of the Atlantic Ocean. *Challenger's* findings opened wide the doors of oceanography.

For the past ten years, the *Challenger*'s 20th century namesake has produced no less startling accomplishments. As of the 59th leg of the Deep Sea Drilling Project (it has just begun Leg 61) the *Glomar Challenger*'s drill had bitten into 686 holes at 451 sites, taking more than 170,000 feet of cores from the ocean's bottom. Nearly every leg has returned bearing treasure. Outstanding among its many accomplishments are the confirmation of sea floor spreading and plate tectonics and the discovery that the Mediterranean Sea and the Gulf of Mexico dried and then refilled, leaving hilly and hydrocarbon-enriched deposits of salt. Its contribution to marine geology is immeasurable: "... before the advent of the *Glomar Challenger,* the occupation of the marine geologist was very grim indeed," says William A. Nierenberg, director of Scripps Institution of Oceanography, in the January-February 1978 AMERICAN SCIENTIST. "The ocean — 5,000 feet thick — is an almost complete barrier between the geologist and his geology."



The Explorer *dwarfs the* Challenger.

The *Challenger* has punched substantial holes in that barrier, despite its birth in the dark shadow of the ill-fated Mohole project, to which it has superficial similarities. Mohole, so named because it planned to drill six kilometers to the Mohorovičić discontinuity, was conceived in the late 1950s. (The Mohorovičić discontinuity marks the point beneath the earth's crust where the velocity of seismic waves changes abruptly, and presumably separates the upper mantle from the earth's interior.) When its projected costs nearly tripled to about $125 million and a scandal developed around the engineering firm chosen for design and construction, Mohole was aborted by Congress in 1966.

In the meantime, a group of scientists had gathered who thought a less costly project to drill more and shallower holes would be more scientifically fruitful. In 1964, after several attempts, Lamont-Doherty Geophysical Observatory, the Rosenstiel Institute of Marine Sciences, Woods Hole Oceanographic Institute and Scripps coalesced into the Joint Oceanographic Institution for Deep Earth Sampling (JOIDES). As the advisory group to the project, JOIDES submitted a proposal for funding to the National Science Foundation, and in June 1966, Scripps received a $12.6 million contract for an 18-month program in the Atlantic and Pacific oceans. In August 1968, built and operated under subcontract to Global Marine Corp. of Los Angeles, the *Challenger* drilled its first hole in the Gulf of Mexico. Three extensions and nearly $150 million later, JOIDES has grown to include nine U.S. and five foreign laboratories. Since late 1975, in the International Phase of Ocean Drilling, the *Challenger* has provided raw material for researchers in the United States, the Soviet Union, West Germany, Japan, France and the United Kingdom, each of whom contribute about $1 million annually to the project.

The *Challenger's* contract runs out in October 1979. The NSF has proposed that it be extended to 1981 at a cost of $22 million a year. A decision on the extension will be reached this summer or fall.

But continued shallow drilling with the *Challenger* is reaching a point of diminishing returns. Like a child who has grown into all his clothes, the DSDP must be re-outfitted. In ten years' time, the DSDP and the *Challenger* were able to make broad, fundamental and rapid additions to the "grim occupation" of marine geology. Filling in the details requires more selective decisions. The need for careful planning is particularly acute as Congress tightens the purse strings on Big Science. But controversy about the payoffs from continued drilling threatens to end the DSDP altogether.

A 1977 JOIDES report, The Future of Scientific Ocean Drilling, recommends an intense ten-year program for some con-

tinued shallow drilling as well as increased deep drilling, concentrating on the continental margins. The program — priced at abut $700 million — calls for continued use of the *Challenger* until 1984 while a larger vessel, the salvage ship *Glomar Explorer,* is prepped to start deep drilling in 1981. An ad hoc advisory group to the NSF endorsed the JOIDES recommendations this spring, and the NSF plans to propose such a program for presidential initiative in the fall. But a report released last week from the Ocean Sciences Board of the National Research Council gave *Explorer*-type drilling second priority in the study of the continental margins. The report instead emphasized sediment dynamics studies and research based on geological and geophysical surveys — at 50 percent off the JOIDES price. The conflict may endanger the DSDP's life. When the two most visible scientific policy groups disagree, it tends to make decision-makers uncomfortable and, worse, stingy.

The JOIDES and NRC reports reflect the scientific squabble about the future goals of the DSDP. Each geologic discipline has its own ideas. Paleooceanographers and sedimentologists want more samples of the soft, flat planes of the ocean bottom; many want to reenter earlier holes of the DSDP. Mineralogists and "hard rock" geologists pull for more work on the rugged ridges and in the volcanic ocean crust. The demand for hydrocarbons backs researchers who push for exploration of the continental margins — a task beyond *Challenger*'s talent. Still other scientists, favoring prudence and fearing an expensive scientific boondoggle, call for a hiatus to evaluate the ten years of drilling.

In some minds, *Challenger* has not even finished its initial assignment. According to Wolfgang Berger of Scripps, the early years of the DSDP were controlled by geophysicists who wanted to confirm their remote sensing data and wasted by time spent on sea floor spreading at the expense of sedimentology. "Leg three showed that sea floor spreading held," the sedimentologist told SCIENCE NEWS at the recent Maurice Ewing Symposium (SN: 4/22/78, p. 268). "It could have stopped there. But sediments were subservient to tectonics until Leg 16."

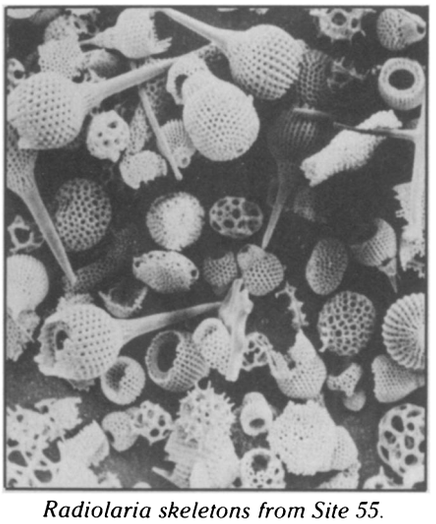
Berger and others favor a hiatus to analyze the backlogged cores and redrilling at earlier sites to achieve some of the original objectives not yet met — such as finding the origin of the magnetic anomalies, obtaining a continuous paleontologic record and discovering what fracture zones represent. After an "inventory" and reassessment, he says, the direction of the DSDP will be clearer.

A hiatus is politically impractical because of the problems of stopping and restarting such a large project, maintains William Benson, director of earth sciences at NSF. And scientifically, it isn't necessary. He points out that the project planners knew the *Challenger* could gather samples faster than researchers could analyze them in detail. "It's not so much that there are cores that need analysis, but does future drilling depend on the analysis? So far, no," he said at the symposium. "There are enough high science priorities and independent sites [that don't depend on analyzing the cores]."

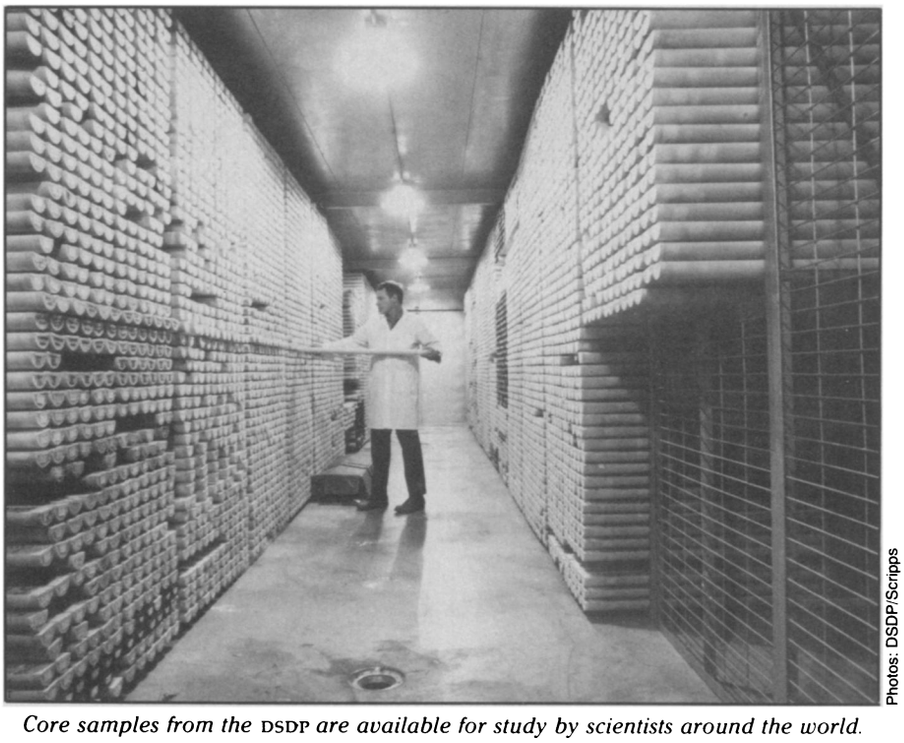
One such priority, which is included in the JOIDES report, is increased concentration on the continental margins, where oil and gas reserves may lie. Though JOIDES also proposes more paleoenvironmental work, they see margin drilling as the next logical step for the DSDP. Margin drilling is not aimed at striking oil and gas, but at learning the processes that lead to the development of these and other natural resources and at testing theories such as the plate tectonics model. Even so, the U.S. Geological Survey and the Department of Energy are pushing for the JOIDES program of intense margin drilling. Some researchers fear that the scientific goals of the DSDP may be twisted by such political overtones — Berger calls it "bandwagon science" because of its obvious political appeal.

But the *Challenger* has problems drilling in the margins and in other important areas, such as the deep ocean crust. Deep crustal drilling is the third major drilling goal outlined by the JOIDES report. Crustal drilling on the ridges has produced valuable findings about the age, formation and movement of the crust. But the *Challenger*'s drill string — a maximum of 24,000 feet — is not adequate to reach the critical layer of volcanics or to drill in the deep trenches. Thus, many answers about heat flow, seismic activity and the birth and

Challenger's *crew drops her drill string.*



Radiolaria skeletons from Site 55.



Core samples from the DSDP *are available for study by scientists around the world.*

Photos: DSDP/Scripps

destruction of the ocean crust elude the *Challenger*'s drill.

Most margin drilling is also beyond the *Challenger*'s reach, and the ship lacks other capabilities needed for such exploration. Its hull is not thick enough and its platform not stable enough to venture into icy, heaving Antarctic seas in search of off-shore resources. The worst problem of margin drilling is the risk of hitting oil and gas. To prevent disasters and control "gushers," should one occur, a ship must have a riser and blowout preventers, which the *Challenger* lacks. A riser is a casing like that used in land drilling. It circulates drilling muds and equalizes the pressure in case of striking a gas chamber. A blowout preventer seals a hole if a gusher occurs.

Though the *Challenger* could be upgraded, the ship lacks the necessary lifting capacity for a longer drill string and riser system. So, changing priorities make the *Challenger* obsolete. As her successor, JOIDES recommends the government-owned *Glomar Explorer*.

The *Explorer*, a salvage ship so big that the *Challenger* could fit in her well, is best known for a 1975 escapade involving a Russian submarine (SN: 3/29/75, p. 204). The CIA used the *Explorer* under guise of a research vessel to try and raise a 17-year-old sub. The resulting flap and some media confusion of the ship with the *Challenger* caused a push for more restrictions on international oceanographic research. If its skills can be put to better use in the DSDP, though, the *Explorer* may make amends.

Frank C. MacTernan, deputy project manager of the DSDP at Scripps, said alternative ships have been studied but none has the capabilities of the *Explorer* — in particular, a lifting capacity sufficient for a 12,000-foot riser system plus 30,000 feet of drill string. The best riser systems on oil company drilling ships measure about 6,000 feet, MacTernan said. The 618-foot, 25,000 horsepower *Explorer* has more than ten times the lifting capability of the 400-foot, 10,000 horsepower *Challenger*. The *Explorer* has power, a more stable platform and a thicker hull than the *Challenger* — everything needed to carry out JOIDES's program of increased margin and crustal drilling.

There is another important advantage — the ship is already built. Although conversion will cost — NSF is asking $4.2 million — the price tag on a new ship would be much higher. In addition, the ship is now out of mothballs and being refitted for ocean mining tests by subsidiaries of Standard Oil Co. and Lockheed Corp. Because it costs several million each time a ship is put in and taken out of mothballs, NSF hopes to score more savings by coordinating conversion studies with the mining activities and keeping the ship operational until 1981, when JOIDES recommends adding it to the DSDP.

But some scientists feel the *Explorer* is too much ship. Paleooceanographers, for example, are afraid of not getting their share — *Explorer*'s talents would be wasted on the shallow drilling they require. More time and money will be needed for site survey. Deeper drilling means more time will be spent at each site and fewer objectives met on each leg.

The NRC committee is also wary of *Explorer*-type drilling, shown by its second priority ranking in the committee's report on research needs on the continental margins. Rather than intense drilling, the committee proposes a program based on sediment dynamics studies and geological and geophysical surveys of domestic margins, both landward and seaward. *Explorer*-type drilling is so expensive, it should follow only after "exhaustive detailed study," the report contends — "first high-quality geophysical research, then the drilling." The surveys alone are valuable research, it stresses, and should not be abused as tools for selecting drilling sites. In addition, the committee believes many drilling objectives could be met with commercial drilling ships.

According to Benson, the committee "has confused two very important words — priority and sequence." JOIDES also stresses that drilling must be preceded by extensive surveys, he says, but that doesn't make drilling a second priority.

The NRC conclusions will be considered in the NSF's final proposal, as well as in an options paper to be prepared by the Office of Science and Technology Policy. The OSTP recommendations may not jibe with NSF goals, said Peter Wilkniss, director of the deep coring program for NSF, but he is optimistic about getting funding for *Explorer*-type drilling. Compared with other Big Science programs such as Skylab, the DSDP provides so much for so little, he said, and the availability of the *Explorer* is a favorable factor.

Still, labels such as second priority could be the death of the DSDP and the *Explorer*. "In these days of Proposition 13," Benson said, "anything labeled second priority won't get funded." □