Glomar Explorer: New Era in Deep-Sea Drilling?

An ambitious new plan for drilling into the ocean floor to depths never before attempted is being proposed by the U.S. deep-sea drilling community, but the proposal has already encountered some rough seas. The suggestion is to convert the ex-CIA submarine salvage ship *Glomar Explorer* into the world's most powerful drilling platform. An *Explorer* scientific drilling program would place particular emphasis on the ocean margins, where little drilling has been done because of the limitations of the current drilling ship, the *Glomar Challenger*.

The nearly half-billion-dollar price tag for the 9-year project is raising questions about its expected scientific return and the planning of major efforts in the geological and geophysical sciences. Congress has asked for a review within the National Science Foundation (NSF) of the funding procedures for all such large projects. The conversion of the *Explorer*, and possible alternatives, will now be the subject of an Executive Branch study. And a report released this week by a major study committee of the National Research Council (NRC) has given deep-sea drilling of the kind proposed for *Explorer* only a secondary priority.

Challenger has recovered cores from the ocean bottom at over 450 sites since 1968. The analysis of these cores has been of fundamental significance to the earth sciences, providing general verification of the theory of plate tectonics and establishing long-term climatic records for the earth, among other accomplishments. The proposal of the *Explorer* as a bigger and better successor to *Challenger* is contained in a report* by the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), the group currently providing advice for the operation of *Challenger*. The objective would be to drill deeper than ever before in places inaccessible to the more modestly equipped *Challenger*, especially on the ocean margin just beyond the continental shelf. Here, the *Explorer* could investigate the initial opening and the eventual destruction of ocean basins. Not incidentally, this is also an area where as yet undiscovered petroleum reserves may exist.

There is no doubt in anyone's mind that the *Explorer* would make a vastly more capable drilling ship than the *Challenger*. The *Explorer*'s size alone is impressive (Fig. 1). More important, it can lift 14 times more weight through its central flooded well than the *Challenger* can. Rather than attempt to lift sunken Soviet submarines, it would lower up to 3650 meters of double-walled pipe, called a riser, to the sea floor, which could then be penetrated by up to 7000 meters of drill pipe. This would allow a total drill pipe length of 10,650 meters. Such an arrangement would have several benefits. The circulation of drilling mud through the riser would allow more efficient drilling. The connection of the riser to a blowout preventer on the bottom would also permit deep drilling in areas such as the ocean margins where petroleum under pressure may be encountered. *Challenger* lacks these and other features of the proposed version of *Explorer* and can only deploy a total of 7600 meters of drill pipe. The capabilities of *Explorer* would also exceed those of any commercial drilling vessel, which are now limited to 1830 meters of riser.

The costs of such sophisticated deep-sea drilling would be almost triple those of the present one. The Deep Sea Drilling Project (DSDP) now costs about $20 million each year, one-third of which is provided by five participating foreign nations (West Germany, France, United Kingdom, Japan, and the U.S.S.R.). Once the $50-million conversion of *Explorer* is completed, annual costs would rise to more than $60 million (without provision for inflation) to operate the *Explorer* alone, survey possible drilling sites, and perform preliminary analyses of the recovered cores. This compares with the $92 million NSF provided in fiscal year 1978 for all the ocean sciences and the earth sciences combined. No foreign participants have made any promises of support for an *Explorer* program, although only informal discussions have been held so far. The clearest signal is from the United Kingdom, which has indicated a preference for awaiting commercial development of an equivalent ship.

The NRC report on research needs on the continental margins† also recommends spending $40 to $50 million a year over the next 10 years to study the boundaries between the continents and the ocean. But the NRC committee, made up largely of academic and industrial scientists who are not DSDP participants, has very different ideas about how to spend the money. It gives highest priority to a study of sediment dynamics and other programs to perform thorough geological and geophysical surveys, especially on domestic margins. These surveys would place considerable emphasis on the landward side of the boundary. The deep ocean drilling proposed by JOIDES and NSF would be, in the words of the report, "a fitting ultimate test of the concepts and models developed from geophysical and geological studies," but ". . . first the high-quality geophysical research, then drilling."

The report contends that its extensive program would lay the necessary foundation for any future expensive drilling program. Drilling by an *Explorer*-type ship should be given a second priority at this time, the report says, because the ideas for a drilling program are not very specific yet, and the broader aspects of margin studies should logically be emphasized at this stage. It also notes that many drilling objectives could be reached with current commercial drilling technology. "To sum up," it says, "we believe that it is far preferable that the basic science be healthy and adequately funded before more expensive drilling is planned."

One reason often mentioned by NSF officials for not putting off *Explorer* drilling is that scientific drilling beyond the Atlantic continental shelf would give a much better idea of whether there are significant amounts of oil in deep waters. Robert Mattick, O. W. Girard, P. A. Scholle, and John Grow, all of the U.S. Geological Survey, recently concluded that the continental slope off the U.S. East Coast has a potential for petroleum accumulation. The slope is the relatively steep edge of the continental shelf. The possibility exists, they say, that zones of organic matter called black shale, which were discovered by *Challenger* in the central Atlantic, may extend under the thicker sediments of the slope. There, they could have been heated sufficiently to produce oil. These investigators have identified some likely rock structures, beneath the slope, which could trap the oil if it were generated.

Most experts agree that oil possibly exists beneath the slope, but many are not very optimistic about it. Wallace Dow of Getty Oil thinks that the odds are unfavorable for major slope reservoirs, principally because the Atlantic slope has not received the large amounts of

*JOIDES, *The Future of Scientific Ocean Drilling* (University of Washington, Seattle, 1977).

†Ocean Sciences Board of the National Research Council, *Continental Margins—Geological and Geophysical Research Needs and Problems* (National Academy of Sciences, Washington, D.C., in press).

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sediment necessary to bury the organic source rocks. Keith Kvenvolden of the U.S. Geological Survey at Menlo Park points out that, according to the analyses of the DSDP black shale, the most likely product would appear to be natural gas rather than oil. Gas recovery from deep water would be much less economical than recovery of oil.

Even exploration geologists who are guardedly optimistic about the prospects of oil caution that *Explorer* would not be able to evaluate the actual potential for oil beyond the shelf. A single ship conducting scientific deep ocean drilling would complete perhaps only two to four holes per year. The sites of these holes would be selected to answer scientific questions, not specifically to find oil. Under these circumstances, according to Casper Arbenz of Shell Oil Company, the *Explorer* could not be expected to evaluate the potential yield of the slope, although it could help improve the usefulness of other data. Albert Bally of Shell, who is chairman of the NRC study committee, calls such an effort "a drop in the bucket" compared to the data needed. As an example of the effort that might be required, Bally cites the continued exploratory drilling in the Atlantic off Canada even after more than 100 wells have been drilled.

Petroleum resource evaluation is one of several "political" excuses that some scientists in and out of DSDP fear may be used to justify an ambitious drilling program rather than reliance on rational evaluation of scientific return for the dollars invested. Unlike the early *Challenger* program, the scientific return from *Explorer* drilling would not answer such fundamental questions as whether the earth's surface is composed of rigid plates that move. Rather, it would add the next level of detail, such as exactly what happens as two plates move apart to begin the opening of a new ocean basin. Tjeerd van Andel of Stanford University believes that, at this time, such details are not worth an investment of the magnitude suggested, especially without some sort of priority assessment that includes a larger segment of the scientific community.

Likewise, some researchers within DSDP, in particular paleooceanographers, see the *Explorer* as much more ship than their objectives require. Paleooceanographers, who are interested in the microfossils of sediments, stand to gain only marginally from the greater capabilities of *Explorer*. Its greater stability as a drilling platform and its possible reinforcement for operation in the icy South Atlantic would allow recovery of sediment cores from Antarctic Ocean

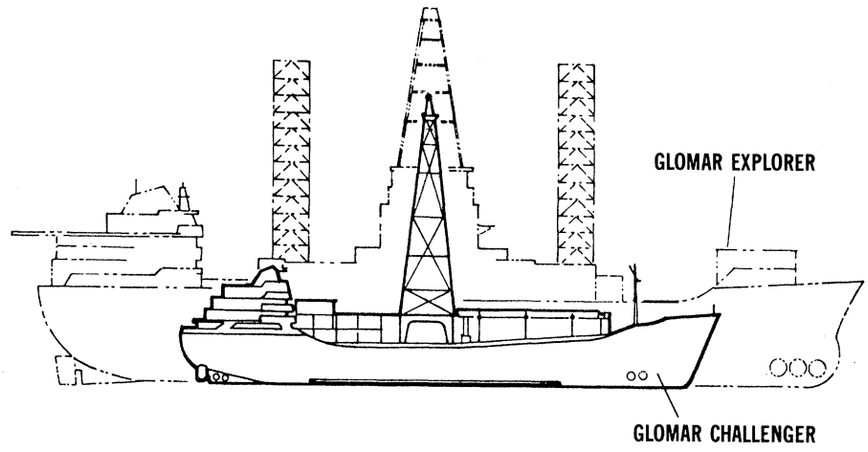

Fig. 1. Size comparison of *Glomar Explorer* and *Glomar Challenger*. The total hull volume of *Explorer* is five times that of *Challenger*. Each has a central flooded well through which a drill pipe can be lowered.

areas important to unraveling changes in general ocean circulation. But the *Explorer*'s tremendous lifting capacity, riser, and blowout preventer are not mandatory for most objectives in paleooceanography. William Ryan of Lamont-Doherty Geological Observatory thinks that few DSDP researchers have given much thought to the cost of drilling such "simple holes with an expensive ship."

Those scientists interested in the nature of the rocks of the ocean crust, which are usually covered by overlying sediments, would benefit somewhat more from the conversion of *Explorer*, but they still have relatively modest needs. Crustal drilling has been hampered by the technical difficulties of penetrating into and recovering cores from the hard but often crumbly ocean crust. Riser drilling would probably improve penetration and core recoveries, but the Ocean Crust Panel's paper in the JOIDES report emphasizes that the *Explorer* is more ship than they expect to need. "The projects we proposed above," the report says, "do not demand a ship much more powerful or a drill string much longer than on *Glomar Challenger* at the present day. This is principally because we do not believe the potential results of very deep drilling can justify the relative costs in time and money of the deep holes involved." They would like to see more money put toward "the development of new techniques, instruments, and experiments to transform the scientific returns from holes of much the same depth as we are now drilling."

The remaining two of the four areas of research targeted by the JOIDES report would require a drilling ship similar to *Explorer*. One area is drilling on passive ocean margins such as the U.S. Atlantic Coast, where the water is deep and the sediments very thick. The other area is investigating active margins where deep ocean trenches mark the descent of ocean crust into the earth's mantle. In fact, some questions posed for these areas in the JOIDES report could still not be attacked, even with the technical capability of the *Explorer*.

Details of the proposal have yet to receive much attention outside of the deep-sea drilling community and NSF. Congress slashed a $4.2-million request for *Explorer* feasibility studies and preliminary planning to $1 million, primarily because consideration must first be given to the role of such new "Big Science" projects in the NSF budget. The details of the scientific and technological rationale may be more thoroughly scrutinized by a study group being gathered from interested agencies by the President's Office of Science and Technology Policy (OSTP). Phillip Smith of the OSTP says that their study of the future of deep-sea drilling will include the possibility of continued *Challenger* drilling without the *Explorer*, as well as a complete drilling hiatus. *Challenger* is committed to DSDP drilling until October 1979, with a proposed extension to 1981. JOIDES has argued against a hiatus as an undesirable disruption of a smoothly operating national and international program. It is also being argued by NSF officials that any delay in converting *Explorer* would entail significant additional costs. Smith does not expect that these arguments will carry much weight with OSTP or the Office of Management and Budget in light of the substantial amount of money involved.

Explorer drilling, exciting as its potential is to some parts of the scientific community, will not become a reality quietly, if it does at all. Hard questions remain about whether the scientific results of the project justify its cost.

—RICHARD A. KERR