III. Scientific Merit of the Planned Program

A. Scientific Objectives and Priorities

The proposed ocean margin drilling (OMD) program is large and monolithic compared to most earth (oceans and solid earth) science programs run by the National Science Foundation (NSF). Even if the total annual expenditure is not so large compared with the aggregate of all other programs that could be labeled earth science, the others are divided in many packages and supported by individual constituencies. While oceanographers, geologists, geophysicists, and other earth scientists should agree that this program be assigned very high priority, no such consensus has apparently yet been achieved.

The present plans, developed March 3-6, 1980, are based on advice from expert representative groups of scientists and engineers. But questions have been raised relating to determining scientific objectives and to the **inevitable compromises** that result from trying to satisfy many interests within budget constraints.

Most scientists agree that the presently planned program is a good compromise given the constraints that appear to be governing. The constraints were developed by the program planners from the following assumptions:

- The Glomar Explorer is a valuable national asset and it should be a cost-effective platform for deep ocean drilling.

- The passive ocean margins should **receive** high priority for scientific investigation because they are a geological frontier **that might contain oil and gas resources.**

- **The petroleum industry and NSF will share in funding and program** planning.

The scientific experts planning the Explorer drilling **program were not** asked "what is the most important science we need to do in **the field of** geology and geophysics." Rather, it was "what is the most important science you can do with an Explorer-type vessel given the constraints that: a) most of the work is on passive margins; b) drilling is deeper than 6,000 feet water depth (but not much deeper in the early phases); and c) most of the margin drilling is on U.S. margins." These are different questions, and the implication that a new program had to be done according to these constraints was given to those who prepared the most recent scientific plans.

Many **believe that the recently developed plan contains many worthwhile scientific objectives -- the drilling plan and sites chosen encompass significant scientific investigations that are in keeping with past committees' recommendations. It is a first step towards defining of a complete program that was lacking in previous plans. However, some are concerned that the entire program is too diffuse and attempts to accomplish too many goals -- these scientists advocate a more narrowly concentrated effort.**

Many scientists agree that the present OMD program is probably the broadest scientific program that could be put together using the Glomar

63-314 0 - 80 - 2

Explorer in an industry-academic-government cooperative venture. However, many scientists believe that it may not be the best, the most appropriate, or the most important scientific program that could be proposed for exploring the oceans floor.

Whether scientific objectives can be achieved from the holes drilled and information collected will, in large part, depend on by the capabilities of the technology developed. Some deep holes may not be completed as planned because of the uncertainty associated with deep drilling in as yet unknown materials. Engineers have estimated a 50 percent probability of completing all the planned holes. As the technology is developed, better estimates of success probabilities for each hole can be made, but it is likely that some deep drilling goals will not be reached.

Also, many scientists see the present program as being too much at the instigation of NSF administrators rather than in response to the requests of the scientific community. They argue that it may result in good technology and give rise to good science, but it does not result in a good or cost-effective scientific program.

However, other scientists argue that, in general, the present plan is worthy of complete support. They state that the scientific objectives are of high priority and that if the petroleum industry provides 50 percent of the funds, the program will be a bargain for science. Some claim that even allowing for the predicted chances of technological failure, each hole or site will offer partial answers to many of the questions asked. They also note that much of the success of past deep-sea drilling has been from unanticipated results.

Because **scientists disagree on the program's goals and scope, it appears important that the peer review process for the scientific program should be more explicitly defined in the future. Since the holes, sites, and** objectives are likely to change as the technology and plans are developed, additional review is necessary to assure broad support and proper attention to high-priority scientific problems.

Since neither a document nor a process for scientific peer review of the program is yet available, OTA identified through its panel some of the more important and specific criticisms of the scientific plan. These fall into three categories:

- Although many good scientific questions are posed, the resources to attack them appear to be spread so thin that important breakthroughs are unlikely to occur. The plan represents a compromise and the product of a large workshop attended by a group of respected scientists.

- The requirement that drilling occur only in water deeper than 2000 meters may rule out relatively simple approaches to important scientific questions and may stifle research in areas of the sea floor having an economically realistic resource potential. Neither the existence of nor the reason for this minimum depth has been made clear. However, OTA has found that the limitation was proposed by the industry participants. This depth limitation is considered by some to be a barrier to developing an effective research strategy.

- To some, the present program gives too little support to academic geophysics and submarine geology. This shortcoming particularly disturbs academic scientists who believe that submarine geology and geophysics led the way to the present revolution in earth sciences. They point out that the academic research fleet is in a crisis state because of budget cuts and the soaring fuel prices, and important new research enterprises in oceanography, including the upgrading of multi-channel seismic programs, hydraulic piston coring, and acoustic tomography lack adequate support.

There is wide agreement, even among those who support the present program, that more emphasis on geophysical surveys is needed. While funds are reserved for "other science," the plan for a science program is lacking. A JOI committee is now planning a geophysics program that includes provisions for scientists to compete for specific projects.

For the program to succeed, the most advanced state-of-the-art geophysical surveying methods and experiments will be needed. If the drilling program is delayed because of reduced funding in the next fiscal year, geophysical research could continue as was proposed in 1979 by the National Academy of Sciences. The NAS report -- "Continental Margins Geological and Geophysical Research Needs and Problems" (known as the "Bally" report) -- recommended that academic institutions should have at least one modern, thoroughly-equipped, state-of-the-art geophysical surveying vessel, as well as the supplementary equipment aboard existing oceanographic ships for conducting multi-ship surveys.

Between now and when the Explorer is ready to begin drilling, the selection of sites and holes should not be frozen. The Houston document presents a drilling plan based on present knowledge. Additional surveying, both as part of and outside this program, will change ideas, concepts, precise drilling sites, and even general drilling regions. Just as the International Phase of Ocean Drilling (IPOD) program remained flexible and evolved with time, so should the OMD program.

B. Discussion of Science Objectives

Some scientists are concerned about past and possible future compromises. The program plan from the recent Houston meeting on ocean margin drilling is a considered compromise. While a major truncation of the recommendations from the 1977 Woods llole conference on the Future of Scientific Ocean Drilling (FUSOD), it takes into account costs, engineering and technology, and the details of associated scientific investigations to a much greater degree. The four areas of investigation -- passive margins, active margins , ocean crust, and paleoenvironment -- raise fundamental scientific questions that drilling could address. As a compromise, the plan provides for a few holes to be drilled in each area type. While the probability of achieving all objectives in each hole is no better than even, that of accomplishing some of the objectives is considerably higher. While, in general, the importance of the scientific results will depend on how deep the holes are drilled, the probability of producing significant results are quite high.

The conclusion that significant scientific results will be achieved depends on several assumptions. These **are:**

- That the schedule will be slowed down in view of budget considerations.

- That the regional geophysical and geological studies necessary to define a problem area, as well as more detailed site investigations needed to pinpoint specific targets for drilling will also have been completed. This is not guaranteed, but if the funding is available, the lead time before drilling is such that they could be done.

- That technological cost overruns, if they occur will not be made up by taking funds away from the scientific investigations.

- That the program is greeted with enthusiasm by the ocean scientists, especially younger ones who will be working with the data.

- That the primary objective of drilling is to gain scientific knowledge rather than to assess commercial resources.

- That the program will not be possible without government-industry-academia cooperation. Given the actions that have taken place to date, this is not an unreasonable assumption. Accepting these three constituencies, the program needs to respond within its budget to their needs.

It would be fair to conclude that the four problem areas -- active margins, passive margins, ocean crust, and paleoenvironment -- have the highest scientific priority in marine geology and geophysics. However,

"there are other significant problems, particularly processes in ocean rifts and the nature of very deep continental margins. To sample these regions would require even more advanced technology than that proposed for the OMD program.

Some more specific concerns about the program include:

- **The total budget of about $692 million includes $43 million for scientific activities on board the drilling vessel and $118 million for scientific support and site surveys. The $43 million obviously has to be tied closely to drilling operations, but the $118 million does not. The latter sum could be used to meet technological cost overruns. Most scientists OTA contacted believe that a system is needed to make sure that science funds are not diverted.**

- Acceptance of the program poses some risks for oceanographic institutions and individual scientists. Many now receive annual support from the petroleum industry. Because of their participation in this program, industry might transfer funds from direct support of oceanographic institutions or individuals to indirect support through the NSF program. The oceanographic institutions may receive ocean margin drilling funds at some cost to their other programs.

- **USGS is enthusiastic about the program, but is not providing financial support. USGS is charged with learning about the nation's geology and making resource assessments. It also owns**

much of the existing marine geophysical data. It is not clear why USGS is not funding the program.

- The Department of Energy (DOE) is not yet participating financially in the program. Given its responsibilities for energy resources, DOE should be interested in information relevant to industry. The problem may be accentuated by industry apprehensions about the government getting into the oil and gas business.

- One might question the scheduling of the OMD program and what it would be if the Glomar Explorer were not now government owned and idle. No one is apparently against drilling in the four areas selected, but there are major questions of when to drill and what ought to be done first. Considerable lead time is involved in preparing the Glomar Explorer. Even if all of the geophysical and site survey information were available, drilling would not begin for some years. On the other hand, given the present state of geophysical knowledge, a stretching of the schedule for a few years in times of tight budgets may be acceptable.

- Some also argue that NSF should not be too deeply involved in a major marine engineering development program. The goal of this program would be a riser and well control system capable of operating in very deep water. Despite extensive industrial experience with ocean drilling, nothing like this has been attempted before. All of the engineering studies anticipate difficulties that are severe but not insurmountable.

Such an engineering program represents a far greater technological leap than anything accomplished in the Glomar Challenger program, and the type of engineering problems involved in mounting an all-weather, open-ocean operation are very different from NSF's experience with large scientific technology projects on land. The risks to NSF -- and to the scientific community at large -- are substantial. Some view this as a major shortcoming of the program. There is also the view, however, that a major technological push is good for future scientific advancements despite the risks.