Testimony of
Dr. Margaret Leinen
Assistant Director
Directorate for Geosciences
National Science Foundation

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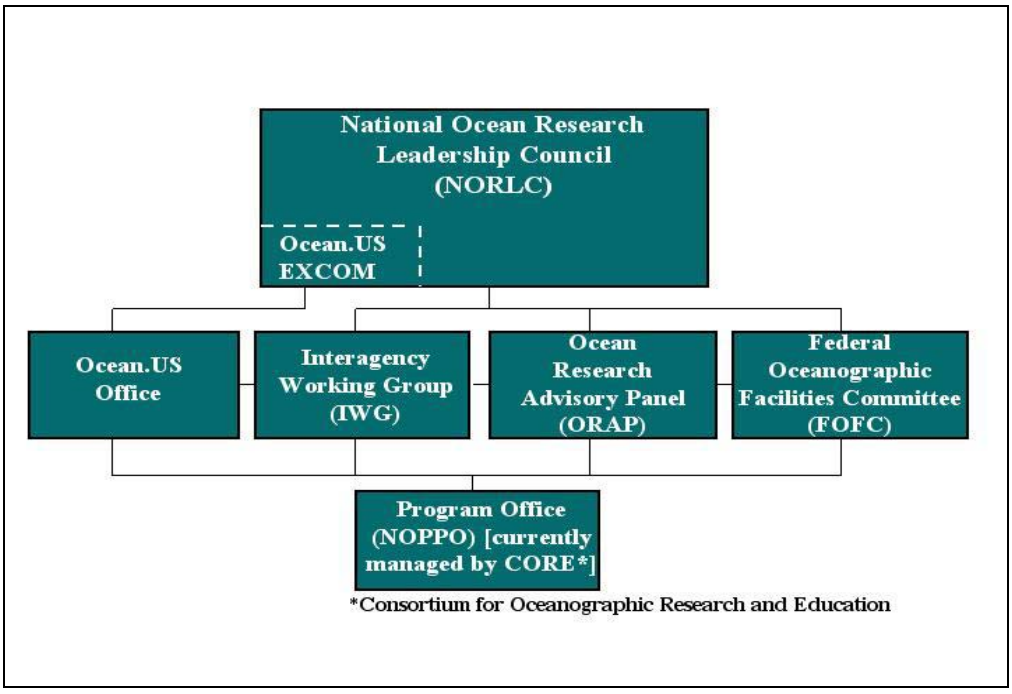
Thank you for asking me to testify today on oceanographic facilities – the means for accessing our oceans to support ocean research and applications. This Commission has heard other testimony about "what" knowledge we seek from our oceans and "why" – from understanding the nature of climate change, to exploring gas hydrates, from the link between the oceans and human health, to anoxia and harmful algal blooms, from the promise of microorganisms in biotechnology, to environmental and human influences on fish populations. What I am here to discuss today is "how" we obtain the knowledge we seek. Ships, submersibles, autonomous underwater vehicles (AUVs), remotely operated vehicles (ROVs), drilling capabilities, airplanes and satellites, as well as other technologies, together enable us to access the ocean from the surface to deep in the seafloor.

At the National Science Foundation (NSF), we have clear interests in enhancing facilities for the purpose of performing basic ocean science research. We are by no means alone. Other federal agencies including Navy, the National Oceanic and Atmospheric Administration (NOAA) and Coast Guard also have interests in such facilities and the programs to support them to meet research and operational needs.

I presently serve as Chair of the Federal Oceanographic Facilities Committee (FOFC) of the National Oceanographic Partnership Program (NOPP). NOPP, established in 1997, is acollaboration of fourteen Federal agencies to provide leadership and coordination of national oceanographic research and education programs. The policy-making body of NOPP is the National Ocean Research Leadership Council (NORLC), comprising the heads of federal departments and agencies with ocean-related interests. The Chair is currently NSF Director Rita Colwell. The NORLC created FOFC in 2000 to advise NORLC on policies, procedures, and plans relating to oceanographic facility use, upgrades, and investments.

National Ocean Partnership Program Organizational Chart



The Academic Fleet

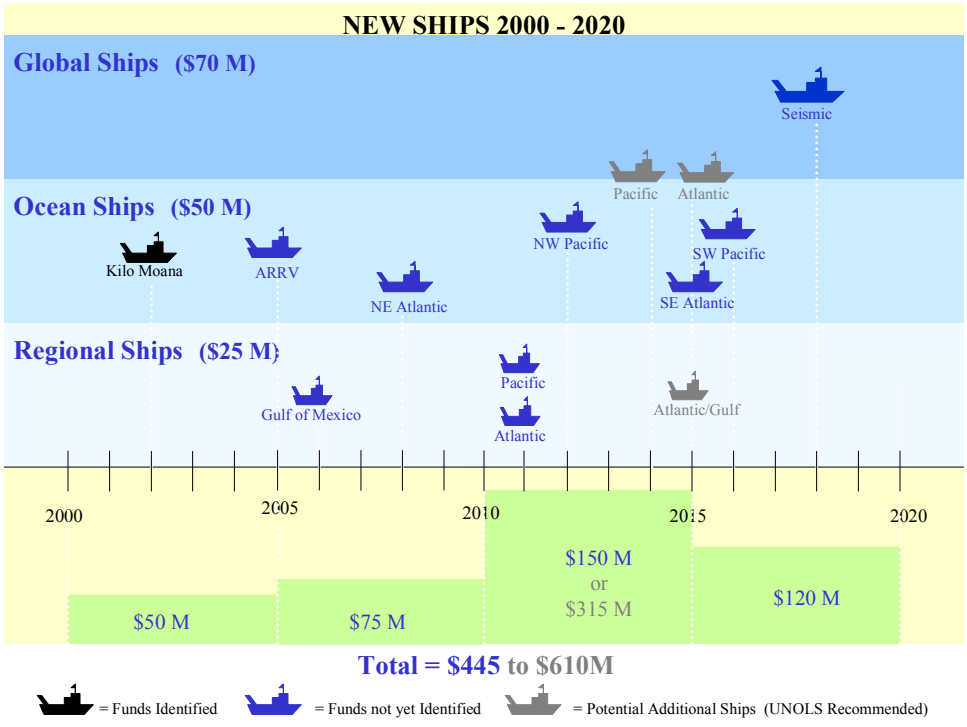
The first area that commanded FOFC attention in its first two years of existence was the future of the academic research fleet. Well-equipped and capable research vessels are a key requirement for the national effort to observe and study the oceans.

NSF previously provided the Commission with copies of FOFC's December 2001 report, "Charting the Future of the National Academic Research Fleet: A Long Range Plan for Renewal" commonly referred to as the "Fleet Plan." The Fleet Plan was written by an Interagency Working Group consisting of representatives of NSF, the Office of Naval Research (ONR), the Oceanographer of the Navy's Office, and the National Oceanic and Atmospheric Administration (NOAA), with input from the UNOLS Council, UNOLS Fleet Improvement Committee, UNOLS Office, the oceanographic scientific community, NOPP Ocean Research Advisory Panel and the FOFC member agencies. The report defines a federal interagency renewal strategy for the national academic research fleet. With many of the existing 28 research vessels approaching the end of their design lifetimes, the Plan calls for at least ten new ships (up to 13 if optimistic budget scenarios

permit new scientific thrusts to go forward) to maintain capacity and reinvigorate the fleet over the next two decades.

Four basic vessel classes are identified: Global, Ocean, Regional and Local. The "Ocean" Class vessels are a new class defined by the report that will replace the aging "Intermediate" Class ships in the existing fleet. While all four classes remain vital to the fleet, only those vessels 40 meters (130 feet) or greater were discussed in detail in the report, as these vessels have been typically Federally-owned and built (or acquired). Traditionally, vessels in the fleet that are less than 40 meters in length have been built with private or state funding, not with federal funding.

Of the ten new ships proposed (see graphic below), one will be Global Class, six Ocean class, and three Regional Class. Based on this 20-year renewal plan, fleet capacity will be maintained at current use levels while capability of the fleet will be increased. Historical trends of stable to slightly increased federal funding for academic oceanographic research and modest fleet overcapacity were issues considered in developing the plan. The geographical distribution of the vessels in the plan is consistent with the anticipated future demand for federally-funded academic research.



The Plan identifies the need to develop science mission requirements (SMRs) for the new vessels and a portfolio of concept designs based on these requirements in order to build and maintain a modern fleet. In addition to frequent technology upgrades to maintain state-of-the-art science capabilities on board the vessels, new technologies such as fuel cells and corrosive-resistant paint coatings, will be explored and potentially incorporated into vessel designs. To ensure that the Plan remains current, the content will be reviewed and updated at least every five years by the FOFC.

FOFC has now moved into the implementation phase of this planning effort, which will again require extensive interagency cooperation. Agencies have indicated that they will participate with the community in a process to match science requirements with ship design, including engaging in scalability studies. We are pleased that Navy has expressed interest in taking the lead on vessel construction, particularly the ocean class vessels. They bring valuable experience and expertise to bear on implementing the FOFC Plan, and their leadership is most welcome.

Within the category of ocean-class vessels, NSF has a particular interest in the Alaska Region Research Vessel (ARRV) because of our significant investment in planning and design. The ARRV will replace and upgrade scientific and operational capabilities of the NSF-owned R/V Alpha Helix. We funded the Concept Design for this vessel in FY 2000 and, with $1M appropriated by Congress in FY 2001, support engineering and tank testing. Tank testing will be completed this June with the final design to be completed by January 2003. All NSF major facility construction projects are presently funded through the NSF MREFC account. We have an established process for review of projects proposed under this account, including approval by the National Science Board, prior to consideration by OMB and Congress. GEO has indicated to the MREFC Panel its intention of proposing the ARRV as a construction project beyond FY 2004.

Both Navy and NSF are exploring opportunities for providing funding for construction of the Regional Vessels.

Ocean Observing System and NSF's Ocean Observatories Initiative

NOPP has emphasized the need for a sustained and integrated ocean observing system, and the NORLC established the OCEAN.US office to assist in the planning and implementation of such a system. In close cooperation with Ocean.US planning efforts for an ocean observing system, NSF is working with the academic community and other Federal agencies to provide a new infrastructure for gaining access to the oceans – both along the coast and in the open sea. This infrastructure, an integrated network of ocean observatories, complements other efforts that focus on satellite, mooring and float technologies. Furthermore, it allows us to acquire long-term time-series and data on the ocean interior and the seafloor. NSF's Ocean Observatories Initiative has three elements:

- a lithospheric plate-scale observatory consisting of interconnected sites on the seafloor that span several geological and oceanographic features and processes,
- several relocatable deep-sea observatories based around a system of buoys, and
- an expanded network of coastal observatories.

Just as NSF supports the academic research vessel fleet for the "spatial" exploration of our oceans, the system of observatories provided for by the Ocean Observatories Initiative will facilitate the "temporal" exploration of our oceans. The products of this research, and the new tools to come, will eventually be incorporated into the operational observing systems. In turn, operational systems will feed back information that stimulates new research.

It is important for the Commissioners to understand that ocean observatories and the ocean observation system will complement, not replace, research vessels. Ships outfitted with state-of-the-art technology provide, and will continue to provide, unique access to the ocean. The academic fleet will play a key and long-term role in deploying and servicing sensor packages, mobile floats and gliders associated with an ocean observing system. Renewal of our academic fleet is required for the oceanographic community to take full advantage of our investment in the ocean observing system.

Other FOFC Coordination Activities.

A recent UNOLS report entitled "Discovering the Oceans" concludes that dramatic advances in submergence vehicle technologies and instruments, including autonomous underwater vehicles

(AUVs), occupied submersibles, remotely operated vehicles (ROVs), specialized sensors, and in situ samplers, now provide the potential for unprecedented access to the oceans and seafloor. These new technologies and vehicles will help foster a revolution in our ability to synoptically measure the chemical, biological and physical processes that occur in the oceans. Making effective use of these new technologies and platforms requires new mechanisms of coordination to ensure and improve access to them, and FOFC will be involved.

Multiple agencies are already engaged in considering the future of human-occupied submersibles. With the Navy-owned Alvin, built in 1964, reaching the end of its useful life, NSF, ONR and NOAA sponsored an engineering study, completed in 2000, to review the options for the future of deep submersible science. It concluded that the most cost-effective and scientifically efficient solution for the long-term would be the design and construction of a completely new submersible. In 2001, NSF provided funds to begin a concept design for this new submersible, which has been supplemented by NOAA in 2002. The new design would improve science capabilities and increase operating depth capability from 4500 to 6500 meters, enabling U.S. scientists to reach an additional 35% of the seafloor (i.e., over 98% coverage).

FOFC will also soon start a review of the aircraft used for marine research and observations, and the possibility of a similar review of ocean remote sensing satellites is under discussion by the Committee.

Scientific Ocean Drilling

In my capacity as Assistant Director of Geosciences at NSF, I also want to briefly describe another important program and new facility for ocean sciences – the Integrated Ocean Drilling Program. NSF has been the international leader in managing and supporting scientific ocean drilling since the Deep Sea Drilling Project (1968-83). Drilling is the only tool for sampling sediments, crustal rock and the deep biosphere from the 70 percent of the Earth's surface covered by oceans. Ocean drilling provides a fundamental capability for developing new ideas and understanding of the Earth and its environment, including:

- the changes in ocean and atmospheric circulation and chemistry over the last 200 million years, particularly those that lead to the initiation and timing of continental glaciations;

- the processes continuously creating and altering new ocean crust produced at midocean ridges, as well as those that accompany the recycling of sediment and crust into the mantle at trenches and island arcs;
- the mechanisms responsible for continental rifting and the subsequent mantle processes which drive plate tectonic motion; and
- the scale of fluid circulation in ocean sediments and crustal rock and its role in the thermal and geochemical balance of the planet, and in controlling the timing and location of earthquakes along trenches and island arcs.

Additionally, an emerging research thrust is the use of boreholes for observatories and long-term experiments for studies ranging from convection in the mantle to the extent and distribution of the sub-seafloor biosphere.

Although the present phase of ocean drilling, the Ocean Drilling Program (ODP), will complete drilling operations in 2003, all major planning efforts for marine geoscience research call for a continuation of the capability to drill and recover sedimentary and crustal rocks, or to emplace instruments and experiments in sub-seafloor observatories. A focused planning effort involving over 600 ocean and earth scientists has identified the future scientific priorities for the Integrated Ocean Drilling Program (IODP); including research on (1) the Deep Biosphere and the Sub-seafloor ocean; (2) the Processes and Effects of Environmental Change; and, (3) Solid Earth Cycles and Geodynamics. The IODP objectives require a vessel for drilling deep sedimentary and crustal holes, a lighter vessel to provide widely distributed arrays of shallow holes to address climate and environmental objectives, and drilling capability for shallow water and Arctic research. An international panel of experts has reviewed the IODP science and facilities plan and strongly recommended implementing the program.

NSF and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan have agreed to co-lead the IODP by providing the primary drilling facilities and contributing equally to operations costs. NSF funds will be used to support the acquisition, outfitting and operation of the light drilling vessel. MEXT has completed construction of a heavy drillship for deep crustal drilling objectives. Commercial drilling vessels are not configured or routinely equipped to meet the requirements for a scientific research program. A major focus of the NSF-funded conversion of the light drilling vessel will be to modify the ship to provide space for

laboratories for geochemical, geologic and biologic analysis of samples and data. A second major objective of the conversion will be to improve habitability for cruises of up to 2 months duration, since industry vessels generally operate in a mode where personnel are rotated on a 2 to 3 week cycle. Finally, industry typically does not concentrate on recovery of the complete sediment section drilled, so upgrading of the drilling-coring capability of the vessel will be required. The U.S. scientific community has undertaken a detailed study of the requirements for the vessel based on science objectives of the IODP Initial Science Plan. A subsequent survey of industry drilling vessels by a marine engineer identified approximately 20 existing drill ships that could be modified to meet most, or all, of the primary criteria identified by the scientific community.

Conclusions

Federal agencies are asking for a large investment over the next decade to pay for renewal of the academic fleet, the U.S. component of the ocean observing system, NSF's Ocean Observatories Initiative, IODP, and other oceanographic facilities. The research vessels that FOFC has proposed, as well as the other facilities that NSF and other agencies have proposed, are critical to the ocean research enterprise of the nation. They will also be critical to many aspects of the ocean observing system that you have heard so much about. Together, these three elements -- ships, other research platforms, and an ocean observing system -- represent the foundation of ocean science discovery for the next several decades. And together they will provide the infrastructure that allows the ocean science community to make the transition from studying the ocean at time and space scales that we could in the past, to studying the ocean at the time and space scales we should in the future -- the scales necessary to understand 70% of the planet.