OCEAN SCIENCE

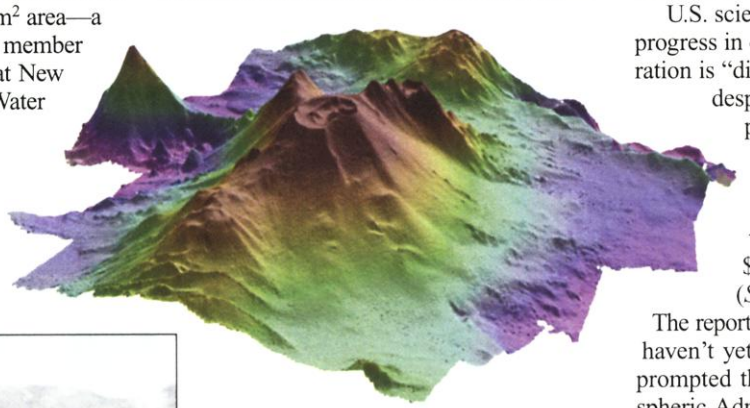
Marine Researchers Hope to Sail Off Into the Unknown

Researchers and officials from 20 nations gathered in Paris last week to discuss how best to spark a new, cooperative age of global marine discovery

PARIS—A volcano 2500 meters high and 20 kilometers across would be a major terrestrial landmark. But nobody knew this lava behemoth, its flanks teeming with new and unusual sea life, even existed until last month, when marine researchers surveyed a slice of the Pacific sea floor 1000 kilometers north of New Zealand. It was first spotted during a 22-day mapping voyage by the research vessel *Tangaroa* that turned up more than 50 new subsea peaks in a 24,000-km^2 area—a "stunning" haul, says expedition member Ian Wright, a marine geologist at New Zealand's National Institute of Water and Atmospheric Research.

If marine researchers meeting here last week* get their way, such voyages of pure discovery will soon be an international priority. A panel assembled by the U.S. National Academy of Sciences, on orders from Congress, invited nearly 100 researchers and legal experts from 20 nations to discuss a proposed global ocean exploration initiative that would send marine scientists where they have never been before. The goal: to spark cooperative projects "that may not test a specific hypothesis but would search for new knowledge," says marine law expert John Norton Moore, a panel member and director of the University of Virginia's Center for Oceans Law and Policy in Charlottesville.

That open-ended approach would be something of a break from current practice. The high cost of oceanographic research and a desire for long-term data have pushed marine scientists to pursue tightly focused studies that return repeatedly to well-researched areas. Rare are the expeditions that hark back to an earlier era, when marine explorers set out without knowing exactly where they were going or what they would find. As a result, exploration advocates say, marine scientists remain centuries behind their terrestrial colleagues in efforts to map and understand their realm. But a new generation of sensors, submersibles, and data-crunching systems could close the gap, they argue. "Now is the time to revive the exploration mode," says Marcia McNutt, head of the Monterey Bay Aquarium Research Institute in Moss Landing, California.



Rising opportunities. Scientists aboard New Zealand's *Tangaroa* (*left*) discovered a submerged, 2500-meter-high volcano this month.

Such ideas received a mostly warm reception from the multinational group at the meeting. "Exploration is important because it yields surprises, and surprises are the spice of life," said Victor Smetacek, a plankton ecologist at Germany's Foundation for Polar and Marine Research in Bremerhaven.

But the enthusiasm was tempered by a range of concerns, and participants didn't agree on such key details as how much a global exploration effort might cost, who would participate, and who would set priorities. Some participants worried about how funding agencies might rate research that isn't based on a testable hypothesis, and how developing nations could justify supporting projects that promise few immediate benefits. Others warned that explorers could face potentially hazardous legal waters, as coastal nations become increasingly reluctant to let foreigners operate off their shores. The challenges "make international genome research look simple compared to ocean exploration," says Su Jilan, a physical oceanographer at China's Second Institute of Oceanography in Hangzhou and chair of the United Nations' Intergovernmental Oceanographic Commission.

The complexity, however, didn't faze biologist Shirley Pomponi, vice chair of the academy panel and director of research at the Harbor Branch Oceanographic Institution in Fort Pierce, Florida. At the end of the 3-day meeting, Pomponi pronounced herself pleased—and a bit surprised—by the support shown for the concept. She's also confident that researchers could work out acceptable arrangements. "There's a consensus that an international effort is a good idea, and that's a strong start," she said.

U.S. scientists buoyed hopes by reporting progress in overcoming concerns that exploration is "dilettante science." Two years ago, despite worries that funding for exploration might take funds away from mainstream marine science, a presidential panel led by McNutt recommended that the government start spending $75 million a year on exploration (*Science*, 6 October 2000, p. 25). The report did spark change, although funds haven't yet started flowing at that level. It prompted the National Oceanic and Atmospheric Administration (NOAA) to set up a new exploration office, which will have spent nearly $30 million by the end of this year on select expeditions to everything from shipwrecks to deep-sea mounts, and on efforts to draw accurate seabed maps and create databases of sea life. "We have shown that we can draw new money in for exploration," says Craig McLean, the program's director. McNutt's report also caught the eye of Representative James Greenwood (R–PA), who wrote the legislation requesting the academy study.

Exploration advocates have also swayed views at the U.S. National Science Foundation (NSF), which once expressed qualms about unfocused marine research. It now says that exploration has its place. "Exploration advances the breadth of knowledge, while basic research advances the depth of knowledge," says James Yoder, who heads NSF's ocean research programs.

But getting governments on board isn't enough. Workshop participants said that academia and journal editors must also be persuaded to reward explorer-scientists with tenure and publications. "We need to address how we compare [traditional scientists] with people who explore—what are the criteria for successful exploration?"

CREDITS: NATIONAL INSTITUTE OF WATER AND ATMOSPHERIC RESEARCH

* International Global Ocean Exploration Workshop, sponsored by the Ocean Studies Board, U.S. National Academy of Sciences, 13 to 15 May.

asked Rene Drucker-Colin, vice chancellor of Mexico's Autonomous National University and head of that nation's Academy of Sciences. Whatever the criteria, funders should be prepared for failure, says Michael Meredith of the British Antarctic Survey in Cambridge: "There are going to be times when you don't find anything interesting."

Would-be ocean explorers will also need to convince some developing nations that exploration is in their national interests, says Muthukamatchi Ravindran, head of India's National Institute of Ocean Technology in Chennai. Some, he notes, may be suspicious that richer nations will use exploration as a cover to prospect for exploitable mineral or biological resources, or develop sea-floor maps for military uses. And past failures to share data fully may poison current efforts to gain access to some waters. "Exploration cannot be seen as an invasion [of national waters] with science as the spearhead," warns NOAA's McLean.

One way to defuse tensions, McNutt and others argue, is to make exploration data freely available, ideally in real time. Richer nations could also provide poorer partners with useful products—such as sea-floor maps of national waters—and technologies that would allow homegrown studies. "Technology transfer will be key," says Temel Oguz of the Middle East Technical University in Erdemli, Turkey. "In order to explore, I need new technology."

How to set such sharing rules, however, remains an open question. One idea floated at the meeting was to establish a formal committee under the auspices of the United Nations to set priorities and perhaps funnel funding. Such a high-level body, said Marta Estrada of Spain's Ocean Sciences Institute in Barcelona, would "help researchers leverage extra funds from their own governments." There was also support for a less bureaucratic arrangement, with nations and institutions cooperating as their interests overlap. Others argued against any structure that would complicate existing efforts to negotiate the sharing of ship, satellite, and submarine time.

Researchers had plenty of suggestions for exploration priorities. Many agreed that mapping of unknown areas—currently 90% or more of the ocean—will be essential. "You can't separate mapping from exploration—it's where you start," says Larry Mayer of the University of New Hampshire, Durham, who showed off cybermapping tools that allow users to "fly" through three-dimensional seascapes. There was also strong support for targeting the 20-million-km^2 Southern Ocean. "It has a pretty good claim to being the least explored place on Earth," says Meredith.

Some biologists, meanwhile, argued for going deep and getting small. "In general, the deeper we go the less we know—and the bigger the animal, the more we know," said Annelies Pierrot-Bults of the University of Amsterdam. Others emphasized the need to augment the "snapshots" taken by traditional exploration missions with long-term monitoring data collected by satellite and buoy systems.

The job of sifting through and organizing these ideas now falls to the 15-member academy panel, led by marine seismologist John Orcutt of the Scripps Institution of Oceanography in La Jolla, California. It hopes to weigh in on these and other issues—such as whether the U.S. should build a dedicated exploration vessel—by the end of the year, with a public report due in February 2003. That would allow the panel to feed into a major U.S. government report on ocean issues due next year, as well as ongoing European efforts to craft a new ocean research agenda.

Meanwhile, New Zealand scientists are settling down to analyze the reams of data from their recent expedition. One of the first tasks, says Wright, "will be to give appropriate names" to the newly discovered mountains. Ocean exploration advocates hope that such mass-naming exercises soon become commonplace. **–DAVID MALAKOFF**

CREDIT: NASA

SPACE STATION

Can Space Station Science Be Fixed?

A blue-ribbon panel reporting next month has the task of setting U.S. station research priorities. But will anyone listen?

If U.S. space station research were a child, it would be in foster care. For the past decade, it has been a victim of unrealistic expectations, abuse, and neglect. Politicians touted fanciful space-derived cures to justify spending billions of dollars to build the station, outside researchers disparaged the effort as worthless, and NASA managers blatantly "borrowed" its allowance.

In limbo. The space station is flying, but its science mission remains largely earthbound.

But these three groups—lawmakers, agency officials, and the scientific community—now say it's time for a realistic and credible research plan to give the much-maligned program a shot at a stable adolescence. Next month, a star-studded, 20-member scientific panel appointed by NASA Administrator Sean O'Keefe will propose a firm list of priorities for research aboard the orbiting lab now under construction. To be effective, the panel must make a case convincing enough to win the backing of a cash-strapped NASA, a parochial Congress, and a fed-up research community—a tall order.

The timing may be right, however. A new team of NASA managers is onboard, lawmakers are growing anxious, and the broader science community is becoming involved through the panel, chaired by Columbia University endocrinologist Rae Silver. This makes it an auspicious moment to fix a host of internal and external troubles plaguing the biological and physical research program at NASA, which is centered on the space station. Those troubles include chronic shortages—of money, flight opportunities, research equipment, scientific rigor, and respect—and an excess of disciplinary rivalry. "This is the time to change the system," says Joan Vernikos, former head of NASA life sciences.

One of the panel's toughest tasks may be to overcome entrenched skepticism among researchers, who have seen many previous recommendations come to naught. "We've revisited the same problem for the past 10 years," says Martin Fettman, a veterinarian at Colorado State University in Fort Collins and longtime space researcher who declined to serve on Silver's panel. "I'm tired of participating on committees whose reports collect dust."

Weighty advice

Silver acknowledges that her panel—which bears the unwieldy name of the Research Maximization and Prioritization Task