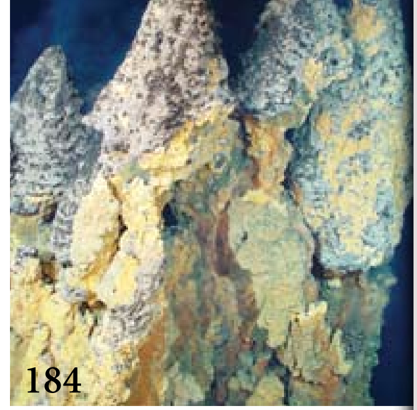


Seamount Sciences: Quo Vadis?

Seamounts are fascinating natural ocean laboratories that inform us about fundamental planetary and ocean processes, ocean ecology and fisheries, and hazards and metal resources. The more than 100,000 large seamounts are a defining structure of global ocean topography and biogeography, and hundreds of thousands of smaller ones are distributed throughout every ocean on Earth. Seamounts can be like oases, isolating some ocean species, or like stepping stones, helping disperse others. Seamounts reveal the remarkable: deep-ocean erupting volcanoes, deep-sea hydrothermal vents hosting extraordinary microbes, and unusual ecosystems that thrive only in the deep and dark ocean.

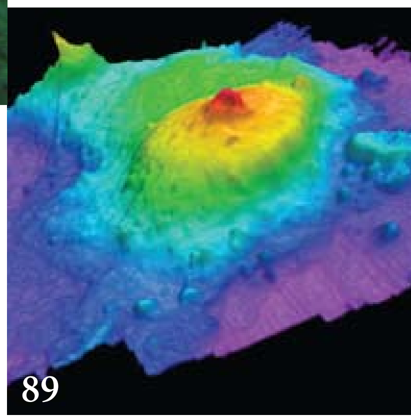
As we review the progress seamount sciences has made, we discover that exploration, though still limited to a small fraction of all seamounts known to exist, has produced a bounty of exciting and extremely broad science. Seamount researchers are at the beginning of a steep learning curve, collecting data that will help us better understand how Earth and its ocean work. It is time to pause and ask how seamount research should proceed. What are the next steps seamount sciences need to take to maintain the consistent yield of scientific discoveries? What are the most exciting and important research topics? What new approaches and technologies will bring the highest return on the investment of research time and talent?

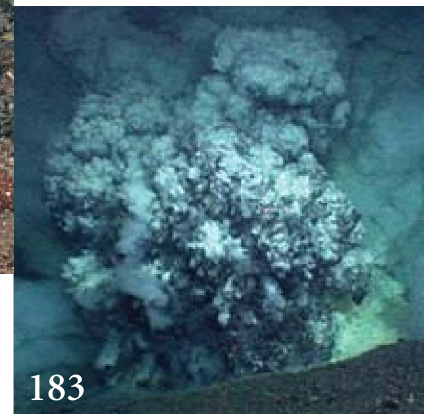
Similar to other fields trying to understand complex systems, seamount sciences depend on effective multidisciplinary science integration and research coordination that is at its best when aided and supported by community-wide, national and international networks. There are major logistical challenges related to exploring seamounts that cover vast areas, distributed over two-thirds of the planet, that demand sharing resources and coordinating science efforts. Networks of seamounts scientists need to help design and advocate tools and databases for the effective use and integration of diverse seamount data, whether they are bathymetric maps, or ecological or oceanographic data. Seamount science networks can play a key role in advising policymakers, resource managers, and conservationists.

One of seamount sciences' most profound problems is the extremely limited availability of high-resolution maps of the seafloor. Satellite bathymetry offers some important insights into seafloor depth, but the results are based on gravity measurements that cannot replace shipboard depth measurements. A systematic, sustained effort is needed to map all of the ocean. Sandwell and Wessel (2010) make an interesting case that much progress can be made *very* cost effectively by optimizing the use of oceanographic vessels (see Box 3 on page 34 of this issue). They developed a survey tool that helps ship operators identify unmapped seamounts close to the great circle path of their journeys, allowing them to make slight corrections to their charted course to cover unmapped seamounts. Even minor additional expenses in ship time can make a big difference. Systematic application of such a tool could make a significant contribution to mapping the seafloor.

Seamount research has substantial potential to improve understanding of how the solid Earth works as a dynamic system. Most of the globally distributed, 140-million-year geological record of volcanism, plate motion, and marine hazards remains unexplored. Studying seamounts will help us understand plate motion, convection within Earth's mantle, why and how mid-plate volcanism occurs, and how it records and possibly influences the chemical evolution of the planet.

Seamounts are hotspots for geochemical exchange between the solid and liquid Earth, and they are hotspots of marine life and productivity. Are these functions related? What are





the geochemical fluxes, and how do they potentially support biological productivity at seamounts? Combined seamount hydrological, geochemical, and biological work is needed to explore the relationships among the biosphere, hydrosphere, and lithosphere.

Seamounts play a key biogeographic role whereby seamount morphology, local ocean currents, and species ecologies combine to isolate some biological systems so that they become sites of species production, high biodiversity, and endemism, and in other cases they provide stepping stones, establishing connectivity between seamounts. Exploring such biogeographic relationships requires the close collaboration of oceanographers, ecologists, and geneticists, and has great potential for increasing understanding how the ocean works as a biological system.

Lastly, human intervention is threatening seamount habitats, in particular, through invasive fishing. Seamount scientists now play a role as conservationists, documenting the effects of these practices, working toward protecting seamounts, and exploring how the effects of irresponsible fishing may be mitigated and replaced by a sustainable and substantial human harvest of restored seamount resources. This need for conservation-related work, however, also provides a focus for integrative seamount sciences. Protecting seamounts for science can help preserve sensitive habitats, and enable establishment of marine observatories that offer a focal point for integrative seamount sciences. We hope that this special issue of *Oceanography* will catalyze such an initiative and engender critical interdisciplinary and conservation-oriented research of these fascinating mountains in the sea.

REFERENCES

Sandwell, D.T., and P. Wessel. 2010. Box 3: Seamount discovery tool aids navigation to uncharted seafloor features. *Oceanography* 23(1):34–36.

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