Foreword

BY MARCIA MCNUTT

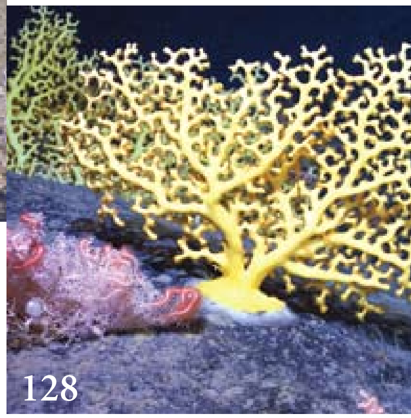
As I looked through the contributions to this special issue of *Oceanography* devoted to research on seamounts, I reflected on how productive, diverse, and intellectually fruitful this line of inquiry has proven to be. Perhaps this outcome might not have been obvious back when seamount research was in its infancy, motivated by concern for the navigation hazards that seamounts pose for submarines. Fortunately, this research direction, as is the case for many others, benefited from the enlightened attitude of the Office of Naval Research, which supported topical research studies broadly. Later investments by the National Science Foundation, other US agencies, and their European and Asian counterparts, enriched the science even further.

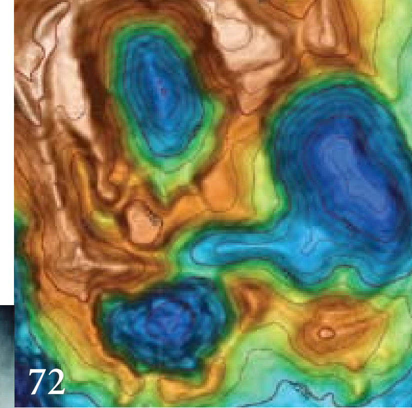
With the global view provided by satellite altimeters, it is possible to estimate locations, sizes, and numbers of seamounts in the world ocean. In this issue, Wessel et al. state that existing coverage for satellite altimeters is sufficient to detect 13,000 seamounts, but the total inventory of seamounts that rise 1 km or more above the seafloor may be as many as 100,000. Research on these numerous features can be broadly categorized as investigating: (1) how they sample the underlying mantle and deform the lithosphere when they are formed, (2) their effect on the ocean as they grow and age, and (3) their interaction with subduction zones when they meet their ultimate demise.

Marcia McNutt *is Director, United States Geological Survey, Department of the Interior, Washington, DC, USA.*

Koppers and Watts summarize much of what has been learned through seamount research under the first category: probing the rheology of the lithosphere, tracking plate motions, gauging variability in mantle melt production, and mapping chemical heterogeneity in the mantle. Under the second category, Staudigel and Clague present a model for how seamounts form as seafloor volcanoes and how their structural evolution might impact geochemical fluxes and microbial processes in the subseafloor. Lavelle and Mohn discuss the role of seamounts in altering the physical oceanography of the ocean by converting tidal energy into internal waves and turbulence and by acting as sources and sinks of eddies. Fisher and Wheat describe the important flux of heat and solutes between the crust and ocean at seamounts. This flow is both focused in active hydrothermal systems on young seamounts and continues as diffuse flow through the exposed flanks of older seamounts long after volcanism ceases. This fluid flux focuses nutrients and feeds a specialized microbial community (Emerson and Moyer). Shank reviews ways that seamounts provide oceanographic and geologic conditions to promote the maintenance of species through genetic connectivity, as well as promote the formation of new species. Morato et al. describe how seamount conservation offers an opportunity to protect sensitive marine habitats as well as provide a focus for interdisciplinary seamount research. Staudigel et al. point out that the greatest unknown in seamount research is topic (3), their interaction with subduction zones. These authors propose using $^{206}Pb/^{204}Pb$ as a tracer to quantify how much seamount material is being subducted and recycled into island arcs.

In my new role as the director of the US Geological Survey, I was pleased to see how many of the contributions in this special issue deal with very practical and societally important issues of seamounts. Staudigel and Clague





remind us that large seamounts can pose natural hazards, both through explosive eruptions and when tsunamis are triggered by landslides off their steep flanks as they erode. Watts et al. discuss the effect that seamounts have on the coupling between the overriding plate and the subducting plate when they enter a trench. A subject of some debate has been exactly what impact seamounts have on the size and frequency of great earthquakes as they are deformed in an accretionary arc setting.

Pitcher et al. review the situation for seamount fisheries, most of which are currently fished unsustainably. Compounding the problems are the facts that seamount targets are easy to find, are mostly in international waters and therefore unregulated, and involve species with low reproduction rates. There are a few good examples of nations taking action to protect seamount fisheries, and they need to be emulated if these ecosystems are going to survive.

Hein et al., on the other hand, are more optimistic on the potential of seamounts to offer raw-metal resources. For example, diffuse hydrothermal flow paves seamounts with hydrogenous iron-manganese crusts that contain high-tech rare metals such as tellurium, cobalt, bismuth, zirconium, niobium, tungsten, molybdenum, platinum, titanium, and thorium. Their concentrations are enriched up to one million to one billion times the occurrence in seawater, and severalfold higher than rare-earth-element ores found on land deposits.

By the time I was done thumbing through this special issue, it was clear that seamounts can no longer be viewed only as navigational hazards that need to be mapped and counted, but rather they are potential resources for the future. The initial investment in seamount research by the Office of Naval Research, not knowing where it might lead, has been richly rewarding for science and society alike.

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