

A Research Strategy for Seabed Critical Mineral Resources

Committee

Richard Murray

Chair

Richard W. (Rick) Murray is Senior Scientist (emeritus) at the Woods Hole Oceanographic Institution, after serving for five years as Deputy Director and Vice President for Science & Engineering. Prior to arriving at WHOI, he was a Professor of Earth and Environment at Boston University (BU) from 1992–2019, where he held many leadership positions. Murray's research interests are in marine geochemistry, with an emphasis on sedimentary records of climate change, volcanism, tropical oceanographic processes, and in the seafloor biosphere. From 2015-2018 Murray served as Director, Division of Ocean Sciences at the National Science Foundation. In addition to his NSF duties, he served as a Co-chair for the Subcommittee on Ocean Science and Technology, as part of the Office of Science and Technology Policy in the Executive Office of the President, during both the Obama and (first) Trump administrations. He is a former Councilor of The Oceanography Society, a former member of the Board of Directors of the American Geophysical Union, and currently is Vice Chair of the Board of Trustees of the Sea Education Association (SEA), Vice Chair of the Research and Education Coalition for Ocean Sciences (RECOS), and a member of the Board of Directors for the Society for Women in Marine Science (SWMS). He was recently a committee member for the NASEM 2025-2035 Decadal Survey of Ocean Sciences, Forecasting the Ocean. Murray received a B.A. in geology from Hamilton College and graduated from the Sea Education Association program in Woods Hole (Class W-71). He received a Ph.D. in geology and geophysics from the University of California at Berkeley.

James P. Barry

Member

James Barry is a Senior Scientist and Chair of the Science Division at the Monterey Bay Aquarium Research Institute (MBARI) where he has been involved in deep-sea research since 1992. Barry's research relies on remotely operated robotic submersibles and other subsea technology to observe and study the biology and ecology of the fauna inhabiting seamounts, hydrothermal springs, methane seeps, deep-sea wood falls, and abyssal sediments. His laboratory and field studies have often focused on the response of marine organisms and communities to changing ocean conditions associated with local processes (e.g., topographic effects on ocean currents), human activities (e.g., deep-sea carbon storage), or climate-change (e.g., acidification, warming, deoxygenation). In addition to his research program, Barry has been involved in national and international studies to assess the global impacts of climate change in ocean ecosystems and has helped inform policymakers on ocean issues. He received a B.S. in zoology from San Jose State University, M.S. in zoology from Moss Landing Marine Laboratories and San Jose State University and a Ph.D. in biological oceanography from Scripps Institution of Oceanography. He has previously served as a member of the committees on the Review of the National Ocean Acidification Research Plan and the committee on Development of an Integrated Science Strategy for Ocean Acidification Monitoring, Research, and Impacts Assessment.

James G. Bellingham

Member

James G. Bellingham is the Executive Director of the Institute for Assured Autonomy and a Bloomberg Distinguished Professor of Exploration Robotics at Johns Hopkins University. Previously, he served as Director of the Center for Marine Robotics at Woods Hole Oceanographic Institution and as Chief Technologist and Director of Engineering at the Monterey Bay Aquarium Research Institute. He founded the Autonomous Underwater Vehicle Laboratory at the Massachusetts Institute of Technology and co-founded Bluefin Robotics Corporation. Dr. Bellingham is a pioneer in autonomous marine robotics, leading advances in the design, deployment, and coordination of robotic systems for ocean exploration and observation. His work spans research, entrepreneurship, and national defense advising, with extensive operational field experience from the Arctic to the Antarctic. He was elected to the U.S. National Academy of Engineering in 2021 and is a recipient of the Navy Superior Public Service Award, the Lockheed Martin Award for Ocean Science and Engineering, The Silver Crab Award, and the Blue Innovation Award. Dr. Bellingham earned his B.S., M.S., and Ph.D. in Physics from the Massachusetts Institute of Technology. He has served on numerous Academies committees including co-chairing the Multi-Domain Autonomous Systems for U.S. Naval Forces workshop and serving as a member of the Naval Studies Board.

Edward A. Boling

Member

Ted Boling is a Partner at Perkins Coie LLP, and was previously the General Counsel of the White House Council on Environmental Quality, Associate Director for the National Environmental Policy Act, a Deputy Solicitor in the Department of the Interior, and a Senior Trial Attorney in the Department of Justice. He is experienced in environmental review and authorization of federal infrastructure projects and environmental mitigation and conservation programs. He counsels companies, agencies, and non-governmental organizations navigating regulatory and funding programs to advance renewable energy, transmission, transportation, water, critical minerals, and manufacturing projects. He holds a B.A. in political science from the University of Mary Washington and a J.D. from Washington University in St. Louis. He currently serves as the Chair of the Standing Committee on Environmental Issues in Transportation Law.

Jeffrey Drazen

Member

Jeff Drazen is a professor in the Department of Oceanography in the School of Ocean and Earth Science and Technology at the University of Hawai'i at Manoa. He is recognized internationally for his research on deep sea ecology, food webs, and fisheries. He has participated in more than 60 research expeditions with over 1000 days at sea, often as chief scientist. Drazen's work has included environmental baselines in mining regions including leading the first midwater baseline in the Clarion Clipperton Zone for The Metals Company. He has evaluated the environmental risks of deep-sea mining to seafloor and midwater ecosystems, including the overlap between deep-sea mining and fisheries and risks to the fished species. Drazen has presented results to stakeholders and policy makers at meetings of the International Seabed Authority and Regional Fisheries Management Organizations. He is an advisory board member for the European JPI Oceans Mining Impact3 project and he participates in a NOAA National Marine Fisheries Service working group on offshore critical minerals. He received a B.A. in biology and marine science from the University of San Diego and a Ph.D. in marine biology from Scripps Institution of Oceanography at University of California San Diego.

He has published numerous articles in scientific journals on potential impacts from deep-sea mining on both seafloor and midwater communities.

Jessica Fitzsimmons

Member

Jessica Fitzsimmons is a Professor of Chemical Oceanography in the Department of Oceanography in the College of Arts and Sciences at Texas A&M University. Her primary research focus is trace metal biogeochemistry in the coastal and open ocean, including understanding the cycling of both micronutrients and pollutants, especially in particle-rich plumes associated with hydrothermal vents, glacial melt, and seabed mining activities. Recent research working with seabed mining industry includes measurements of baseline conditions within sites identified for seabed mining and assessment of environmental impacts of trial mining activities on water column chemicals. Her technical expertise is in trace metal clean shipboard collection of seawater and other environmental samples, as well as the analysis of multi-element concentrations, isotopes, and speciation of a wide range of trace metals in seawater, marine particles, and sediments. Dr. Fitzsimmons is a Chancellor's EDGES Fellow at Texas A&M University and a Kavli Fellow with the National Academies of Sciences, Engineering, and Medicine. She received a B.A. in Chemistry and Marine Biology from Boston University and a Ph.D. in Chemical Oceanography from the Massachusetts Institute of Technology Woods Hole Oceanographic Institution's Joint Program.

Christopher R. German

Member

Christopher German is a Senior Scientist at the Woods Hole Oceanographic Institution (WHOI) and was the Chief Scientist for Deep Submergence from 2005 to 2014. Prior to WHOI, he was a Natural Environment Research Council scientist at the Institute of Oceanographic Sciences Deacon Laboratory (1990-95) and Southampton Oceanography Center, UK (1995-2005). His expertise is in the exploration for, and study of, seafloor hydrothermal systems using advanced robotics to study their geological controls, their impact on ocean biogeochemistry and their relevance to the search for habitability and chemosynthetic life beyond Earth. He received four early career awards (1988-2000) followed by a medal from HM Queen Elizabeth II "for services to Marine Science" in 2002 and a Research Prize from the Humboldt Foundation, Germany (2014-2015). He has served as President of the UK Challenger Society for Marine Science, as Co-Chair of both InterRidge and the Census of Marine Life Chemosynthetic Ecosystems Panel, and on NOAA's Ocean Exploration Advisory Board and NASA's Planetary Sciences Advisory Committee. He received his B.A. in natural sciences and Ph.D. in marine geochemistry at the University of Cambridge, UK, and was a postdoctoral research fellow at the Massachusetts Institute of Technology. He previously served as a member of the Planetary Sciences and Astrobiology Decadal Survey 2023-2032: Panel on Ocean Worlds and Dwarf Planets.

Steven Mana'oakamai Johnson

Member

Steven Mana'oakamai Johnson is an Assistant Professor in the Department of Natural Resources and the Environment at Cornell University, also serving as an affiliate faculty in Cornell's American Indian and Indigenous Studies Program. Dr. Johnson's research and teaching focus on human-environment relationships, particularly ocean systems and the Pacific Islands. He has served as a technical contributor for the Pacific Islands Regional Climate Assessment (Micronesia Chapter) and a chapter author on the 6th National Climate Assessment (Ocean and Marine Resources). He received a Ph.D. in geography from Oregon State University and was a postdoctoral researcher at Arizona State University working on marine conservation planning in Hawai'i.

Johnson was a panelist on the "Our Oceans in Peril: The Imposition of Deep Seabed Mining and other Extractive Practices" discussing the importance of including Pacific Island nations and voices in the deep-seabed mining conversation around leasing decisions in 2025. He also led the drafting of a letter for scientists and conservation professionals to sign advocating for better inclusion of local knowledge and expertise in proposed deep sea mining activities in the waters of the Mariana Islands archipelago, submitted to the Bureau of Ocean and Energy Management in January 2026.

Ian Lange

Member

Ian Lange is Professor and Viola Vestal Coulter Chair of Mineral Economics at the Colorado School of Mines. His research focuses on energy, environmental, and resource economics. Previously he served as Chair of the U.S. Commodity Futures Trading Commission's (CFTC) Role of Metals Markets in Transitional Energy Subcommittee, Senior Economist for Energy at the Council of Economic Advisors for both the Trump and Biden administrations as well as spending time at the U.S. Environmental Protection Agency and the U.S. Department of Energy. He received a B.A. in economics from the University of Illinois-Chicago and a Ph.D. in economics from the University of Washington.

Justin E. Manley

Member

Justin Manley is an innovative technologist and executive with experience in startup, public corporation, academic, and public sectors. Mr. Manley has been working with marine technology and robotics since 1990. After professional roles at MIT, supporting NOAA, and in the private sector, Mr. Manley founded Just Innovation Inc. in 2015. He supports a variety of clients with a focus on uncrewed and undersea systems. He is an advisor to Terradepth, an ocean data services startup, and a co-founder of Seahawk Robotics which is commercializing drones that fly, float, deploy payloads and dive. This entrepreneurial experience is shared with other startups through his work as a Venture Partner at AiiM Partners, a climate impact fund. Mr. Manley is a technical advisor for Impossible Metals, a seabed mining company. Mr. Manley is extensively involved in the marine technology profession through a variety of leadership roles. He is a Senior Member of IEEE, a Life Member and Past-President of the Marine Technology Society (MTS), a Fellow of the Institute for Marine Engineering Science and Technology (IMAREST) and a founding member of Marine Education for Inspiration and Innovation (MATEII). He is dedicated to innovation, serving as a mentor to many startup companies and a judge for several XPRIZES. Mr. Manley holds two patents in uncrewed systems oversight and security. He received a B.S and M.S. in Ocean Engineering from the Massachusetts Institute of Technology.

Beth Orcutt

Member

Beth Orcutt is the Vice President for Research (VPR) at the Bigelow Laboratory for Ocean Sciences. She is a globally recognized expert on the environmental impacts of deep-sea mining and has authored many highly cited papers on understanding the ecosystem services provided in the deep sea by the microscopic realm of life. Using seafloor exploration assets and deep-sea observatories, her research has focused on discovering how “deep biosphere” microscopic life thrives in strange environments and how their living impacts global processes. Orcutt is the Associate Director of the Crustal Ocean Biosphere Research Accelerator, spurring deep sea research to inform decision making. She received a B.S. and Ph.D. in Marine Sciences from the University of Georgia.

Orcutt has made numerous public statements regarding knowledge gaps around impacts of seabed mining. She co-authored “Assessment of scientific gaps related to the effective environmental management of deep-seabed mining” in Marine Policy in 2022 that discussed key knowledge gaps related to deep sea mining and led “Impacts of deep-sea mining on microbial ecosystem services” in Limnology and Oceanography in 2020 on the potential impacts of deep-sea mining on microbial ecosystem services. .

Thomas Peacock

Member

Thomas Peacock is a Professor of Mechanical Engineering at the Massachusetts Institute of Technology (MIT), and a Fellow of the American Physical Society. His research focuses on understanding environmental fluid dynamics with an emphasis on environmental flows and ocean transport as applied to ocean interventions, such as seabed minerals and ocean carbon dioxide removal. Peacock led scientific teams conducting fundamental research on deep-sea mining sediment plumes in the Pacific Ocean in 2018 and the Clarion Clipperton Zone in 2021 and 2022, resulting in leading peer-reviewed publications. He has engaged broadly on the topic of seabed minerals with the International Seabed Authority, World Economic Forum, OECD, various U.S. Government agencies, industry, NGOs and philanthropic organizations, and provided Congressional testimony. He is a recipient of an NSF CAREER Award in Physical Oceanography. He received a B.S. in Physics (with Honors) from The University of Manchester and his Ph.D. in Physics from The University of Oxford.

Peacock is a member of the ISA Intersessional Expert Group for the development of binding environmental threshold values, and scientific advisor to the EU TRIDENT Program researching innovative tools for deep-sea mining impact assessment. He is a scientific advisor and co-founder of atdepth MRV, a startup that provides modeling and monitoring services across the ocean space, and a scientific advisor to Wetstone, a startup seabed mineral exploration company. From 2019 through 2023 Peacock was a rapporteur for a panel of scientists convened by Global Sea Mineral Resources; in this role he produced a report for the technical trials of a nodule collector vehicle in the Clarion Clipperton Zone. He gave Congressional testimony about deep-sea mining scientific research for a hearing on April 2025.

Masako Tominaga

Member

Masako Tominaga is an Associate Scientist with tenure at Woods Hole Oceanographic Institution. She is an expert in deep submergence geophysics and her research activities center on diverse approaches to geophysical "imaging" of subseafloor architecture and geological processes that facilitate solid Earth-Ocean interactions. Her expertise in marine geology spans the vast history of Earth's Ocean basins, including the tectonic and magmatic evolution of the Pacific seafloor from Jurassic time to present. She also specializes in the study of hard-rock physical and magnetic properties on rock/sediment samples acquired by scientific drilling and coring/dredging/direct sampling by deep submergence platforms. She was the lead proponent of the 2024 NSF-sponsored FUTURE of U.S. Marine Seafloor and Subseafloor Capabilities Workshop, which led to the creation of the University-National Oceanographic Laboratory System (UNOLS) Seafloor Sampling Working Group. Tominaga received her Ph.D. in Geological Oceanography from Texas A&M University, College Station, in 2009.

Caroline Bell

Staff Officer