

IMPACT REPORT



2022





2023 2024 2025 2026 2027



Our Never-Ending Journey

Since 2009, Schmidt Ocean Institute has been committed to excellence in oceanographic research. Over one thousand international scientists have participated in eighty-one expeditions on R/V *Falkor*, revealing stunning details on what lies in our Ocean. Join us in looking back at our body of work from the past decade and ahead to our future, as we continue the never-ending journey of Ocean exploration.









Visions of the Future

A Note from our Founders Eric and Wendy Schmidt

For all of human history, the horizon has captured our attention, daring us to venture out to sea to find what might lie beyond, or below. The year 2023 is no different—except those who venture now have a bigger ship.

Research vessel Falkor (too) will help us advance what has been Schmidt Ocean Institute's aim from our earliest days: to seek and share knowledge, and understanding, of our Ocean. Scientists worldwide, including those from communities and countries too long underrepresented in marine research, have joined our expeditions and shared remarkable findings that exceeded all our ambitions. We have no doubt that the scientific community will do it again in

this Ocean Decade, a critical historical period for exploring and understanding the source of all life. Indeed, the research conducted aboard Falkor (too) has a purpose: to help us make better decisions for our future survival on the Earth.

Schmidt Ocean Institute's commitment to sharing knowledge, partnering across continents, and bringing understanding back ashore will carry forward to our new ship. Falkor (too)'s scientific and communications abilities are unrivaled, and we can't wait to watch, alongside all of you, as the seekers aboard Falkor (too) peer beyond the horizon of what weknow today.

Photo: Schmidt Ocean Institute Co-Founders, Wendy and Eric Schmidt. | By Ben Gibbs



Photo: R/V Falkor (too) | By Alex Ingle

Remastered

Procedural Updates and New Additions

Beyond refitting and celebrating the renaming of R/V Falkor (too), Schmidt Ocean Institute (SOI) reviewed and updated a number of our programs and operations, including how we accept research proposals and where we will conduct research in the next decade. The 10-year Expeditions Map, displaying areas of operation for R/V Falkor (too), will be updated annually to continuously provide a decadal view of where the vessel will conduct research. Along with the seven topics outlined in our strategic framework, researchers now have the information they need to apply for shiptime.



10-Year Sol Expeditions Map

Schmidt Ocean Institute (SOI) released its 10-year Expeditions Map in January 2023, highlighting where R/V Falkor (too) will conduct research over the next ten years. SOI will work in waters around all seven continents focusing on one geographical region each year, exploring and answering critical questions about the Ocean as outlined in our Strategic Framework. With this global view, our aim is to provide access to the Ocean for regional scientists and institutions and build community relationships in the areas closest to the science expeditions. The regions for the next decade are as follows:

2023 - Atlantic, Caribbean, and Eastern Tropical Pacific 2024 - South East Pacific and the Southern Ocean 2025 - Southern Ocean and South West Atlantic 2026 - South West and Tropical Atlantic and South West Caribbean 2027 - South East and Tropical Atlantic 2028 - South East Atlantic and Southern Ocean 2029 - Southern Ocean and South East Indian Ocean 2030 - South East and Central Indian Ocean 2031 - West Indian Ocean 2032 - South West Indian Ocean and Southern Ocean





Photo: Recovering AUV. | By Mónika Naranjo-Shepherd

New Proposal Process

One of the big changes to Schmidt Ocean Institute's (SOI) proposal process is that we will accept <u>Expressions of Interest</u> (EOI) submissions for R/V Falkor (too) science and technology projects on a rolling basis. EOIs may be submitted for collaborative, multidisciplinary projects to be conducted aboard R/V Falkor (too) at any time, for any location and year identified on the 10-year SOI Expeditions Map. Investigators may request R/V Falkor (too)'s full allotment of berths available for science in an EOI or may be partnered with additional projects at the full proposal stage to maximize the use of the vessel. Another substantial change to the proposal process is that as an alternative to written EOIs, video proposals may be submitted. This change supports SOI's commitment to being more inclusive and allows for greater international participation among non-native English speakers who may prefer to propose their scientific project visually or orally instead of in writing.





Celebrating a Seaworthy R/V Falkor (too)

Prior to our new research vessel's first voyage, Schmidt Ocean Institute (SOI) co-founder Wendy Schmidt, along with SOI staff, Advisory Board, crew and contractors, and members from the Freire Shipyard, including the Freire family, as well as representatives from various Shipyard contractors, gathered for a ceremony to formally rename the vessel as *Falkor (too)*.

The ceremony celebrated the immense effort it took to transform the former *Polar Queen*, an offshore industry vessel, into *Falkor (too)*, a platform for cutting-edge scientific research. Remarks were made on behalf of SOI by Dr. Jyotika Virmani, Executive Director, Mr. Andrew Boyer, Director of Engineering, and Captain Peter Reynolds. Mr. Guillermo Friere and Mr. D. Marcos Friere spoke on behalf of the Shipyard and presented Wendy Schmidt with a model of the vessel.

The pinnacle of the ceremony was remarks provided by co-founders Dr. Eric Schmidt and Wendy Schmidt. Dr. Eric Schmidt, who presented virtual remarks, focused on

the breakthrough technology onboard, the longevity of the vessel, and making history with the scientists and crew onboard. Wendy Schmidt then took the stage and read from The Neverending Story, reminding those present of R/V Falkor (too)'s ultimate mission to protect and serve the scientists and crew on their quest to better understand the Ocean. The ceremony also included a local orchestra who played the National Anthem of Spain, where the refit took place, the National Song of Cayman Islands, where R/V Falkor (too) is flagged, and the National Anthem of the United States of America, where SOI is based. Quayside, Priest D. Jose Alberto Montes Rajoy blessed the ship with ceremonial words, and Wendy Schmidt christened the vessel, R/V Falkor (too), by releasing a bottle of sparkling wine against its bow, an ancient tradition to bring safety to future voyages. After the ceremony was complete, and while the audience cheered, members of the local Orchestra struck up a stirring rendition of the theme song from the 1984 film, The Neverending Story.









hoto: R/V Falkor (too) sits in Freire Shipyard where she is undergoing an ambitious refit to transform her into a truly unique scientific research olatform. | By Alex Ingle



R/V Falkor (too)

For a few months in early 2022, R/V Falkor and its successor, R/V Falkor (too), berthed side-by-side at the Freire Shipyard in Vigo, Spain. The resulting photographs capture an indelible image: the new ship looming over its predecessor, filling the frame, the ambitions of an organization writ large. It's tempting to label this sparkling behemoth a "replacement" or an "upgrade." But R/V Falkor (too) isn't just Schmidt Ocean Institute's vessel of the future—it reimagines the possibilities for all oceanographic research vessels.

Few research vessels afloat outstrip R/V Falkor (too) for size. It plies the Ocean with a 110-meter length and a 20-meter beam. The aft deck sprawls across 960 square meters-larger than two NBA basketball courts combined. It's a blank canvas that's presided over by a massive 150-ton active heave-compensating crane able to rearrange equipment, containers, and control vans while in port or underway. These numbers represent a capacious and capable platform for launching research technologies that ride the edge of imagination.

In addition to the endlessly adaptable aft deck, the ship features two moon pools and multiple launch-and-recovery systems for vehicles—including one for ROV SuBastian. After six years of taking a global audience deep into the crushing unknown, the newly overhauled robot will be lifted directly from the sea into an interior hangar filled with eager scientists—no longer retrieving samples under the blistering equatorial sun or lashing Ocean rains.

Now a short journey awaits those samplebearing scientists after leaving the comfort of the hangar. During the refit process, an entire floor of cabins was removed and rebuilt into the true heart of *Falkor (too)*—eight distinct and dedicated laboratory spaces. The first stop might be the 105-square-meter Main Lab, a versatile and configurable space that can adapt to the multidisciplinary needs of any science party. From there, maybe the Cold Lab. Or the Dirty Wet Lab. Or the Robotics Lab. Science needs space, and Falkor (too) has it in unprecedented abundance.

As a state-of-the-art mobile research it transports an entire village to unveil the mysteries of our vast and deep Ocean. Powered by the world's largest Voith-Schneider propulsion system, R/V Falkor (too) tirelessly treads the Ocean. With an ice rating up to 15 centimeters and an endurance that can outlast most detailed expedition plans, its range is truly global—ensuring its place at the forefront of oceanographic research across our one Ocean and every continent on Earth. And while it's true that R/V *Falkor* literally floated in the shadow of the new ship for those few special months in Vigo, Spain, the amazing discoveries and unprecedented research accomplished on the original *Falkor* will never be forgotten. As the transition of cross-decking equipment took place, one could almost imagine a conversation between the two Luck Dragons—a sage elder passing along wisdom to an enthusiastic protégé as they both prepared for the next step in their never-ending journeys.

facility, the ship bristles with numerous oceanographic, atmospheric, and navigational sensors. The high-performance computing system on board this research vessel allows for unparalleled real-time data-processing capabilities for researchers. Built into the hull is a 19-meter gondola packed with the latest sonar systems. Technological advancements are ceaseless, but R/V Falkor (too) is designed to be as future-proof as possible—with extra space, including on the specially built foreand main-mast, reserved for sensors not yet imagined. Despite the marvels of electronics and robotics, at its core, Ocean science is people-powered. It's built on the efforts of an interdisciplinary global community, and R/V Falkor (too) dramatically increases our ability to bring that community to sea. With berths for 96 people, it more than doubles the original ship's 44-person limit. This means more scientists, artists, and berths of opportunity for students and stakeholders. When R/V Falkor (too) sails,





Main Photo: Eric King (Director of Operations, right) and Peter Reynolds (Captain, left) stand alongside Falkor (too) holding the general arrangement plans. | By Alex Ingle

Circular Photo: Members of RV Falkor (too)'s engineering team stand in the Voith Schneider Propeller (VSP) system. | By Alex Ingle

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The Future Faces of Ocean Science

Schmidt Ocean Institute's Interns

Each year, Schmidt Ocean Institute supports science communication and data interns to foster the next generation of Ocean stewards. We recently touched base with our former interns for an update on their careers since finishing their internship with SOI, and are proud of all they have accomplished.

Photo: Masters student Michelle Guraieb of Scripps Institution of Oceanography pulls organisms from a rock sampled from the ocean floor in the California Borderland. | By Brady Lawrence





Tyler Smith is pursuing a B.S. in Marine Technology at Northwestern Michigan College after having been inspired by ROV SuBastian. Having previously earned an M.F.A. in Creative Writing at Louisiana State University, his communications background stretches from journalism to video production to teaching undergraduate writing courses. After graduating, he plans to work with deep-sea robotics systems for oceanographic research, writing screenplays, and finding a way to bridge the two.

Bailey Skinner 2022 Data Intern

Bailey is an Oceanographer at the Naval Oceanographic Office (NAVO) in Mississippi, where she collects and processes acoustic data aboard naval ships. Her job involves organizing decades of archived acoustic data to be more accessible across NAVO. Her experience at SOI has been an asset in her new role, especially in applying her increased programming knowledge to data projects.

Brandon Chan 2021/22 Science Communications Intern

As an SOI intern, Brandon Chan worked on his Ph.D. at UCLA, studying the impacts of climate change on phytoplankton physiology and ecology. Since then, his lab has moved to the University of Connecticut, where Brandon is continuing his Ph.D. and getting used to New England winters. Brandon was recently accepted into the National Science Foundation's Graduate Research Fellowships Program.



2022/23 Science Communications Intern

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Brittany Washington 2021 Science Communications Intern

Brittany is working toward her Master of Science at Brooklyn College and plans to start a Ph.D. in biogeochemistry this fall. In addition to her research, she is a freelance journalist and multimedia producer and has contributed to projects with *The New Yorker*, A24, HBO, REI, and The New York Academy of Sciences. She plans to continue her work across communicating science during her Ph.D. studies.

Amara Davis 2020/21 Science Communications Intern

After completing her internship, Amara received her Master of Science from Savannah State University, with her thesis on the Bahama lobster fishery. She was selected as a NOAA Knauss Fellow in 2021 and conducted her fellowship with Sea Grant in Washington, DC. She is now the Communications and Outreach Coordinator at Sea Grant.

Shannon McClish 2019/20 Science Communications Intern

Shannon is continuing her Ph.D. at the University of Hawai'i and working on understanding the strength and variability of the biological carbon pump in the seasonal sea ice zone of the Southern Ocean. In addition to her research activities, she has been a guest speaker in undergraduate and elementary school classes.

Photo: Izzy Baker viewing microbial mats collected from the seafloor under a microscope in R/V *Falkor*'s Wet Lab. | By Kevin T McHugh



Katherine Herries 2018/19 Science Communications Intern

Katherine currently works as a Water Pollution Inspector for the Missouri Department of Natural Resources. She communicates with the public daily, explaining state laws and regulations for keeping waterways clean for recreational and industrial uses. After her time at SOI and prior to her work in Missouri, Katherine worked for the U.S. Environmental Protection Agency (EPA), informing senior-level scientists and the EPA Director of new guidelines and innovative research on human health and environmental risk assessment.

Victoria Sindorf 2017/18 Science Communications Intern

After Victoria's internship, she worked as the Education Manager for a coastal property of The Trustees of Reservations—the oldest and largest land conservation organization in Massachusetts. Using skills she gained during her internship, Victoria created educational programming about the coastal environment—communicating through social media channels, maintaining the website, and creating interpretive materials. She recently moved to Iceland.

Holly Lauridsen 2016/17 Science Communications Intern

Communicating scientific ideas is a significant part of Holly's current role in the medical device industry as a Product Specialist for W.L. Gore & Associates. She focuses on new disease research at the company, where her role involves educating leadership about the state of research, pathways for success in emerging disease studies, and how to connect research to new strategies.





A Limitless Ocean of Data SOI's Work with Data

Schmidt Ocean Institute (SOI) is committed to collecting and disseminating high-quality oceanographic and atmospheric data.

Open data sharing is a core principle of Schmidt Ocean Institute (SOI). Through openly sharing our data, we improve the accuracy of data-driven tools, enhance the value of outcomes from data applications, and increase the speed at which the scientific community obtains new Ocean knowledge. SOI has been collecting data and making it publicly available via data centers since 2015. The value of our data grows by making it easier to find, more accessible, interoperable, and reusable.

SOI is committed to collecting and disseminating high-quality oceanographic and atmospheric data. During 2022, SOI developed its first Data Strategy that will result in a more robust data pipeline for SOI-collected data. Achieving the strategy's goals will require the creation of sophisticated tools and platforms that improve data access, automation of quality assurance and control processes, and software application development to derive additional value from our data.

Photo: Sunrise on the bridge of R/V *Falkor (too)* during the transit toward the Mid-Atlantic Ridge. | By Mónika Naranjo-Shepherd

The six themes of SOI's Data Strategy are: *data data products, novel data methods.*

In addition to improving the flow of data from the new science and communication systems on board R/V *Falkor (too)*, several new data platform developments and collaborations took place in 2022.



Dive Vault

In order to make ROV *SuBastian* dive videos easier to find and more accessible, <u>Dive Vault</u> was developed in-house as an open-source tool for exploring SOI's You Tube livestream video library. Dive Vault displays the locations of all the dives performed by ROV *SuBastian*. The application allows users to explore the archive of videos through a web-based map interface, making it simple to find and review past dives based on geographical areas of interest. As dives are performed on R/V *Falkor (too)*, they will also be added to this platform.



FathomNet and Ocean Vision AI

FathomNet, developed by researchers at the Monterey Bay Aquarium Research Institute (MBARI), is an open-source image database that can be used to train, test, and validate AI algorithms to help understand our Ocean and its inhabitants. SOI is currently working on methods to contribute imagery collected by ROV *SuBastian* to the FathomNet database. Also developed by MBARI, in partnership with the Ocean Discovery League and others, is <u>Ocean Vision AI</u>, a machine learning platform that identifies and processes underwater imagery. Using FathomNet and Ocean Vision AI together, images and metadata are quickly annotated and made accessible, increasing the useability of visual data.

Photo: In the Control Room monitoring ROV SuBastian while diving in the Gulf of California.| By Mónika Naranjo-Shepherd

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The six themes of SOI's Data Strategy are: data collection, data use, data accessibility, data solutions,





SOI collaborated with the Schmidt Futures Technologists for Global Transformation (TGT) program, formerly known as the Associate Product Manager program. The TGT program provides careerbroadening opportunities to early career technologists to solve systemic global challenges for public benefit. SOI's Data Solutions Architect worked closely with a TGT participant to review, advise, and develop a strategy for creating a portal that would allow public access and efficient distribution of SOI's scientific imagery.

As part of our open-source initiatives, SOI has established a GitHub organization that will assist in the dissemination and collaboration of open-source code, tools, and tutorials. GitHub and similar collaborative version control platforms are ubiquitous in the data and earth science community. SOI, with other data partners, compiled a list of open Ocean data repositories, <u>awesome-data-repos</u>, which is posted on the SOI GitHub. The initial list was based on supplemental materials from Disrupting Data Sharing for a Healthier Ocean, with additional compilation work from representatives of multiple organizations, including HUB Ocean. The Ocean community can comment, add, and edit the list, and multiple users have already done so.

University of Chicago

SOI continued its collaboration with the University of Chicago Data Science Institute, which trains students to become the next generation of data scientists. Using data provided by SOI from R/V Falkor and ROV SuBastian, students worked on multiple projects, including developing methods for merging ROV sensor and imagery data into analysis-ready data, which various user groups can utilize for research and machine learning. Students also created machine learning models, incorporating techniques, code, and annotated images from FathomNet, to more rapidly identify objects and scenes of interest in ROV videos.

Schmidt Futures

Open Source Collaboration via GitHub

Photo: Screens in the Control Room depict a very intersting feature found on the latest satellite imagery. | By Alex Ingle

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Reflections from the Past

A Note From Our Executive Director

The past year was centered on transformation as we bid farewell to R/V Falkor in Italy —where she is now R/V Gaia Blu with the Consiglio Nazionale delle Ricerche-and watched R/V Falkor (too) complete its metamorphosis. The ship, formerly known as the Polar Queen, transformed from a platform designed for the offshore industry, installing wind farms in northern Europe, to a state-of-the-art research vessel. The refit took place in Vigo, Spain, at the Freire Shipyard-the same shipyard that designed and built the Polar Queen in 2011. We were all kept up-to-date during the refit with an incredible ten-part video series, The Making of a Research Ship, which,

amongst other things, captured the installation of the 19-meter gondola under the hull, the conversion of an entire deck from cabins into eight state-of-the-art lab spaces, and the first complete overhaul of ROV SuBastian since it was built in 2015. There were trials and tribulations but also great triumphs. R/V Falkor (too) finally materialized as a global-class Ocean research vessel due to the extraordinary efforts of our dedicated crew, operations team, contractors, and the Shipyard. As the year came to a close, we celebrated a completed R/V Falkor (too) and the continuation of our never-ending journey with a new ship dedicated to science and Ocean exploration.

Photo: Dr. Jyotika Virmani (Executive Director of Schmidt Ocean Institute) in Research Vessel *Falkor (too)'s* main lab. The newly refitted ship has eight specialized labs for Ocean research. | By Ben Gibbs

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Transformation also occurred across Schmidt Ocean Institute as we planned for the next ten years, guided by our Strategic Framework. This included an updated proposal process for ship time and the release of our 10-year Expedition Map for Falkor (too), which illustrates the regions around the world where we will operate over the next ten years-primarily in the Southern Hemisphere. We announced a new partnership in June with the National Geographic Society at the High-Level Meeting of the Ocean Decade Alliance at the UN Oceans Conference in Lisbon, Portugal. Throughout the year, we also continued our ongoing collaborations with existing partners like Nekton on our joint Ocean Rising initiative.

I hope you will enjoy the look back on this past year and the forward momentum outlined within our ten-year reflective Impact Report. We anticipate the coming year to be a gamechanging one as we advance our quest to boldly explore our unknown Ocean and better understand its mysteries.

Photo: One of five major art works created by Artist-at-Sea Ellie Hannon.| By Conor Ashleigh

By The Numbers 10 Years of R/V Falkor



81 expeditions with **1,845** days of science



Sailed **521,000** km a distance of **13** times around the world

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Mapped **1.34 million** km² of seafloor discovering **17** underwater features



Collected 6,194 samples resulting in 26 new species named and 633 TeraBytes of data to advance scientific understanding 463,089 people connected via 684 presentations, podcasts, Ship-to-Shores



Hosted 1,056 scientists, 340 students, and 43 artists



Conducted 481 underwater dives with ROV *SuBastian*, totaling 2,415 hours of deep sea exploration 67

Reached more than 470 million on Facebook, Twitter, YouTube, and Instagram





Science accomplishments shared through 202 scientific publications, and 5,135+ articles



Exhibited **160** works from our Artist-at-Sea collection at **20** shows in **16** cities

A Scientific Anthology Expeditions from the past Ten Years

Take a look back at some of Schmidt Ocean Institute's expeditions from the past ten years and what they accomplished in support of our mission to catalyze the discoveries needed to understand our Ocean, sustain life, and ensure the health of our planet.

Photo: The bow of Reseach Vessel Falkor photographed by drone off the NW coast of the United states. | By Shelton Du Preez





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Papahānaumokuākea Monument Chief Scientist: Dr. Christopher Kelley, University of Hawai'i at Mānoa

In 2014, R/V Falkor spent over 70 days mapping the Papahānaumokuākea Marine National Monument in the Hawai'i Archipelago. The data resulted in complete high-resolution maps for all nineteen seamounts in the Monument. The maps revealed a new 4000-meter tall seamount, named Schmidt Seamount, in honor of the support the science team recieved from SOI. Additionally, the data uncovered that <u>Pūhāhonu is the largest shield volcano on Earth.</u> The resulting seafloor map was shared with the National Oceanic and Atmospheric Administration's (NOAA) Ocean Exploration, whose team used the map to predict the locations of the highest concentration of biodiversity inside the Monument. A subsequent expedition with the NOAA vessel, Okeanos Explorer, discovered *Tosanoides obama*, a tropical fish named for United States President Barack Obama. All of these new discoveries and data (collected by both SOI and NOAA) ultimately led to the expansion of the Monument in 2016.



In 2020, at the height of the global pandemic, R/V Falkor spent 48 days exploring and extensively mapping the northern region of the Great Barrier Reef. During the expedition, systematic mapping of the region led to the discovery of a 500-meter-tall detached reef, the first to be located in this part of the world in over 120 years. ROV SuBastian then dove on the newly unveiled feature to explore the reef from the base to the top. The dive was live-streamed and has been viewed over 450,000 times in the past two years. Discovering such a sizable structure on a well-known underwater feature, such as the Great Barrier Reef, reveals how much more we still don't know about what lies in the Ocean.

Photo by Schmidt Ocean Institute



Northern Depths of the Great Barrier Reef

Chief Scientist: Dr. Robin Beaman, James Cook University

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Investigating Life Without Oxygen in the Tropical Pacific

Chief Scientist: Dr. Mak Saito, Woods Hole Oceanographic Institution

In 2016, scientists onboard R/V *Falkor* collected nearly 100 protein samples in the Central Pacific Ocean, which, to this day, represents the most significant contribution of data to the Ocean Protein Portal. The protein dataset was recently used to investigate how microbial protein distributions change across time and space. The research sheds light on previously understudied microbial energetic pathways that underlie Earth's life-sustaining biogeochemical cycles.

Photo by Mónika Naranjo - Shepherd



In 2017, R/V *Falkor* traveled to the Phoenix Islands Protected Area, <u>currently</u> the largest and deepest UNESCO World Heritage Site, to explore and document never-before-seen seamounts and atolls. The primary research goal was to study the deep-sea corals that live on these features for the first time. In addition, samples of deep-sea bacteria were collected, analyzed, and found to have "immuno-silent properties," meaning they are not detectable by the immune systems of animals living on land. The discovery suggests that the Phoenix Islands region may harbor significant resources for immunotherapy, which could aid in recovery from cancer and other diseases. Studying these "immuno-silent properties" was the purpose for R/V *Falkor's* return and continued research in 2021. In 2021, the Kiribati government announced its plans to open up the protected area to commercial fishing, a reversal of the 2014 decision, citing economic concerns.

Photo by Schmidt Ocean Institute



Discovering Deep Sea Corals of the Phoenix Islands

Chief Scientist: Dr. Erik Cordes, Temple University

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Hunting Bubbles: Understanding Plumes of Seafloor Methane

Chief Scientists: Dr. Anna Michel & Dr. Scott Wankel, Woods Hole Oceanographic Institution

In 2018, R/V Falkor traveled to the Cascadia Margin to test an underwater bubble capture system using ROV SuBastian. The system collected methane bubbles rising from the seafloor and measured their chemical composition and dynamics. The scientists combined the data from the bubble capture system with other sources, including multibeam sonar and a fieldportable-laser-based spectrometer. The scientists successfully demonstrated a technological approach for examining methane transport throughout the water column, that combined the use of multibeam sonar, a field-portable laser-based spectrometer, and a robotic surface kayak. They found elevated methane levels throughout the water column including at the surface, suggesting that methane reaches the air-sea interface at these shallow seep sites.

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Photo by Schmidt Ocean Institute



Photo by Kevin T McHugh



Solving Microbial Mysteries with Autonomous Technology

Chief Scientist: Dr. Karen Casciotti, Stanford University

In 2018, the science team on board R/V Falkor investigated how chemical cycles and micro-organisms interact in the Eastern Tropical North Pacific, a known oxygen-deficient zone in the Ocean. Marine oxygen-deficient zones play a large role in the global nitrogen cycle, removing fixed oxygen from the Ocean, and yet, are highly productive regions due to coastal upwelling. In the lab, the science team developed a new method to limit the contribution of various biogeochemical processes, such as anaerobic ammonium oxidation and denitrification, to observe nitrate and pH maximums in the upper anoxic layer of the water column. They found a nitrite and pH maxima emerged in the oxygen-deficient zone's upper core, distinct features that were observed and analyzed due to the high-resolution sampling on board R/V Falkor, which give insight into the dissolved inorganic nitrogen dynamics in the region.





Tracking the Tasman Sea's Hidden Tides

Chief Scientist: Dr. Amy Waterhouse, University of California San Diego, Scripps Institution of Oceanography

In 2015, for the first time in R/V Falkor's history of operations, R/V Falkor worked alongside another vessel, the R/V Roger Revelle, to conduct a comprehensive study of the Tasman Sea internal tide beam. General observations of this tidal beam, a regularly occurring internal wave produced by tides, and its interactions in the Tasman Sea were first published by the science team in 2018. Researchers subsequently used the data collected from the Tasman Sea to understand how these internal waves interact with background active flows to inform a new type of global reduced-physics model. An improved model will lead to a better understanding of the generation, propagation, and dissipation of these waves, which are challenging to accurately observe and forecast at a global scale.

Photo by Judy Lemus



Photo: ROV SuBastian launch.

By Shelton Du Preez

Studying the Sea-Surface Microlaver 2

Photo by Judy Lemus

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Chief Scientist: Dr. Christopher Zappa, Lamont-Doherty Earth Observatory - Columbia University

Building upon the first study of the sea-surface microlayer on board R/V Falkor in 2016, a team of scientists and engineers conducted unmanned aerial vehicle (UAV) operations that achieved vertical take-off and landing while the ship was in transit. The AUV's were equipped with highly accurate sensors that measured the sea-surface microlayer at high-resolution scales. The sea-surface microlayer is the interface between the atmosphere and Ocean, thus playing an important role in Earth's Ocean biogeochemical cycles and air-sea interactions. The UAVs were used to locate Trichodesmium blooms (harmful algae) and floating rafts of pumice thought to have been from an undersea eruption near Tonga. The main role of the UAVs and their sensors was to collect physical oceanographic data at the air-sea interface. Over the 250 hours of flight time, the three UAVs collected sea surface temperature imagery, surface-emitted radiance and irradiance, solar irradiance, albedo, turbulent momentum flux, turbulent sensible and latent heat flux and ocean skin temperature data, which is still being analyzed by the researchers at Columbia University.





Exploring the Mariana Trench Chief Scientist: Dr. Jeffrey Drazen, University of Hawai'i at Mānoa

In 2014, R/V *Falkor* visited the Mariana Trench to study extreme deep-sea ecosystems, and the physiological adaptations organisms have evolved to withstand living in a high-pressure environment. During the expedition, <u>the deepest living fish</u> at the time of discovery, <u>the Mariana Snailfish</u>, was filmed and collected. The snailfish is translucent and uses small pressure-stabilizing molecules to survive under high pressure. Specimens from the expedition are still being utilized to study <u>how and</u> where organisms live in high pressure environments, their interactions in the deep-sea community, and the <u>hadal ecosystem</u>. Scientists continue to research the <u>snailfish's bone structure and how individual molecules</u> within the bone react and respond to intense pressure. Additionally, fauna collected had significant levels of <u>mercury</u> and <u>plastic</u> in their systems. The presence of pollutants in snailfish reminds us again that human actions impact animals living in the deepest part of our world.

Photo by Schmidt Ocean Institute

Photo by Chloe Weinstock

In 2019, R/V *Falkor* aided in some of the first-ever research in Costa Rica's deep waters. The goal of the expedition was to document the ecosystems on seamounts surrounding the Cocos Island National Park, which was, at the time, thought to be a key information gap in preventing the expansion of the protected area. Many Costa Ricans, including government officials, saw their country's deepwater ecosystems for the first time during the expedition when SOI live streamed the exploration. The data collected contributed to the expansion of the <u>Cocos Island National Park in 2021</u>. The park expansion protects critical biodiversity hotspots and provides safe habitat for species, distributing the benefits of a healthy ecosystem across the entire Eastern Tropical Pacific region. Researchers continue to use the data collected to examine the distribution of deep-sea corals on Costa Rica's seamounts. The exploration also yielded several new species, including the <u>hungry scale worm</u> and new species of <u>mussels</u> and <u>ribbon worms</u>.

Photo by Schmidt Ocean Institute



Costa Rican Deep Sea Connections Chief Scientist: Dr. Erik Cordes, Temple University

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Adaptive Robotics at Barkley Canyon and Hydrate Ridge

Chief Scientist: Dr. Blair Thornton University of Southampton

In 2018, the science and engineering team on board R/V *Falkor* tested four robotic vehicles working together in tandem: ROV *SuBastian* and three autonomous underwater vehicles (AUVs). The research took place at Barkley Canyon in the Northeastern Pacific Basin. The expedition conducted mission planning with multiple robots and demonstrated that the simultaneous use of these robotics could facilitate adaptable underwater surveys for ocean exploration. Different capabilities of the robots were utilized to image the seafloor and gather in situ chemical measurements. During the expedition, the team analyzed the large datasets collected by the robots and were able to adapt their mission plans rapidly. Once on shore, an algorithm was developed to improve the speed at which seafloor features can be identified and annotated, compared to when humans annotate seafloor features with no computer assistance.

Photo by Mónika Naranjo - Shepherd

Photo by Mónika Naranjo - Sheperd

In 2021, R/V Falkor ventured off the coast of San Diego, California, to test three next-generation technologies integrated onto ROV SuBastian. The technologies were focused on studying the Ocean's midwater organisms. Animals from the midwater are notoriously challenging to study as they often disintegrate by the time collections reach the surface. The first technology was a refined version of the Rotary Actuated Dodecahedron (RAD2), developed by Dr. Phillips and his collaborators, a sphere-like origami robot that surrounds and captures delicate open-ocean animals like jellyfish, preserving their tissue in their natural environment. The second piece of technology, developed by engineers at Monterey Bay Aquarium Institute, was a laser and optics instrument called the Deep Particle Image Velocimetry (DeepPIV). The DeepPIV creates a sheet of light and makes 3D scans of underwater animals, measuring their fine-scale movements. Lastly, the scientists tested the Eye Remote Imaging System (EyeRIS), a new real-time 3D imaging lens also developed at the Monterey Bay Aquarium Research Institute. The three technologies were used to rapidly characterize delicate animals living in the midwater environment and demonstrate an effective workflow for studying this part of the water column. The samples and data collected from this expedition are still being analyzed by the research team.

Photo by Jovelle Tamayo



Designing the Future 2 Chief Scientist: Dr. Brennan Phillips, University of Rhode Island





Biodiverse Borderlands Chief Scientist: Dr. Lisa Levin, University of California San Diego, Scripps Institution of Oceanography

In 2021, R/V Falkor sailed to the Southern California Borderlands to study ecosystems affiliated with mineral-rich environments. The science team's goals were to establish mineral and biological baselines, examine conditions that influence the biodiversity of the region, and inspect the therapeutic potential of deep-sea microbes affiliated with these mineral-rich areas. The team also expanded their initial science goals and spent two days exploring a nearby Dichlorodiphenyltrichloroethane (DDT) waste barrel disposal site, where dumping took place between 1947-1982. ROV SuBastian collected sediment cores around the barrels to study the DDT's effect on microbes and animals in the environment. Following the expedition, researchers from the Scripps Institution of Oceanography secured multi-million dollar funding from NOAA to continue to investigate how the DDT dumpsite affects southern California's marine ecosystems. They will analyze samples from the barrel's surfaces, surrounding sediment and push cores, and video footage to assess the distribution and concentration of DDT in the environment.

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Photo by Schmidt Ocean Institute



R/V Falkor's first adventure in Australia's waters took place in the canyon system offshore southwestern Australia. This was the first ROV-based deep sea exploration of the Bremer canyon system and Perth Canyon. Comprehensive physical and chemical measurements of the canyon waters were coupled with ROV surveys to give the science team a baseline understanding of the environmental conditions, including the anthropogenic impacts. The team closely studied the anthropogenic impacts of the canyons, quantifying the presence of macro-litter seen during the ROV surveys. Their analysis showed that these Australian canyons were much less impacted compared to other canyons worldwide and that the megabenthos, including deep water corals, were not yet affected by macro-litter. This is good news for the stewardship of the deep-sea environment and provides baseline information for monitoring a relatively pristine area.



The Great Australian Deep-Sea Coral and Canyon Adventure

Chief Scientist: Dr. Julie Trotter, University of Western Australia

Photo by Schmidt Ocean Institute

Deep Sea Continuum

The Schmidt Ocean Institute advances innovation within the Ocean community through its grants, partnerships, and leadership. We view this work as a continuum that pushes the boundaries of Ocean technology, science, and public engagement.

Photo: An exploratory, educational virtual aquarium experience, free for use in the classroom and at home by ocean enthusiasts. It showcases Deep Sea encounters and discoveries during Schmidt Ocean Institute deep-sea expeditions. Produces by World Ocean Observatory.





Grants



Antarctic Whale Monitoring Project

An effort to monitor the effects of construction noise on humpback and minke whales in Antarctica continued in 2022 and will wrap up in 2023. With support from SOI, Dr. Ari Friedlander and researchers from the University of California, Santa Cruz, are analyzing the data collected from passive acoustic devices deployed around Palmer Station. The data will reveal whether human activities, like construction, are impacting these animals. The theme of this year's World Listening Day (July 18th) was "Listening Across Boundaries" and SOI posted a blog about the research on our <u>website</u> to share the team's work on bioacoustics.



Florida Institute of Oceanography

MATE ROV

SOI and The Schmidt Family Foundation provided grant funding to the Florida Institute of Oceanography to finalize the scope of and build partnerships in a brand-new program, Peerside, aimed at broadening access and ongoing involvement in the ocean environment through increased and sustained support. The program will provide college students interested in Ocean STEM with a mix of at-sea and on-shore training, and mentoring focused on career development. Monterey Bay Aquarium Research Institute's (MBARI) has donated the research vessel *Western Flyer* to the program. Additional funding from the Office of Naval Research is supporting the development of a dedicated remotely operated vehicle for the vessel and is providing opportunities for students to gain exposure to careers in ocean science, engineering, and marine operations.

Conference and Meeting Sponsorship

This past year, SOI was honored to provide travel support to several important conferences, symposiums, and workshops, including the Symposium on Advances in Ocean Observation in Azores, Portugal, IEEE OES AUV Symposium in Singapore, and the 4th Marine Imaging Workshop in Brest, France. The financial support enabled participants to attend meetings they would not otherwise have had the opportunity to participate in. Additionally, SOI co-hosted the International Research Ship Operators Meeting's Welcome Reception in Honolulu, Hawai'i, providing an opportunity for global research ship operators to share vessel operational plans and future directions.



SOI continued to support the global <u>MATE ROV Competition</u>, which celebrated its 20th anniversary in Long Beach, California, with 854 students and mentors from 15 countries participating through a unique combination of in-person, telepresence, and virtual reality (VR) experiences. SOI's Expedition and Community Outreach Specialist, Hannah Nolan, was present to support the competition and participate as a judge. The competition helps to develop the students ROV skills like engineering and piloting, solving real-world problems, and increases accessibility to marine technology for students globally. The <u>VR</u> World portion of the competition was established in 2021 and allows competitors to access the competition venue remotely. In VR World, students from all over the globe create avatars to meet and interact with one another. The 20th World Championship theme, the UN Decade of the Ocean, focused on ocean science for sustainable development and various challenges aligned with the <u>17 UN Sustainable Development Goals</u>.

Photo: Stalked barnacle.| By Schmidt Ocean Institute





Nautilus Ocean

With ongoing support from SOI, Nautilus Magazine's <u>Ocean</u> <u>Channel</u> celebrated its second year, producing 100 articles with more than one million page views. The Channel has become a content incubator, exploring complex Ocean topics, and will expand its distribution and content in 2023. In 2022, Nautilus produced two print issues of the Ocean Channel magazine, in addition to web-based articles. The printed June issue was distributed at the UN Ocean Conference in Lisbon, Portugal, as part of a collaboration with the UN Decade of Ocean Science for Sustainable Development. Additionally, Nautilus Ocean and SOI worked together to co-host two Artist-at-Sea exhibits at the Explorers Club in New York City, New York, where the first print issue was distributed, and at the Ciencia Viva Museum in Lisbon, Portugal (see Artist-at-Sea section for more information).

Ocean Coalition

The Ocean Coalition is a joint initiative between Schmidt entities Schmidt Ocean Institute, 11th Hour Racing, The Schmidt Family Foundation, and Schmidt Marine Technology Partners. The Coalition aims to support education-based programs focused on improving inclusion, diversity, and equity early in the marine science career pipeline. In 2022, the Coalition supported 12 programs and three conferences addressing career retention issues across the U.S. and affiliated territories. Program funding provided opportunities for fellowship support and mentoring (University of Hawai'i; Black Women in Ecology, Evolution, and Marine Science; Ocean Discovery League; Minorities in Shark Science), ocean science workshops and youth engagement (University of Virgin Islands; Blueprint Foundation; Youth Maritime Alliance), early career networking and support (Deep Ocean Early Career Researchers), and community-based education programs (Fishadelphia; Gulf Reach; Mystic Aquarium; MATE ROV).



Ocean Keeling Curve

The Ocean Keeling Curve is the longest continuous record of the Ocean's changing carbon chemistry, dating back to 1983. In the second year of support to Dr. Ralph Keeling and Dr. Andrew Dickson at the University of California, San Diego (UCSD), analysis of backlogged water samples from past years, the collection of new water samples, and additional analysis for Dissolved Inorganic Carbon (DIC) and alkalinity were achieved. Seawater measurements from the water samples collected from Bermuda and Hawai'i show that ocean acidification continues unabated due to rises in atmospheric CO_2 levels.

TBA21-Academy 2022 Ocean Fellowship SOI supported TBA21-Academy's 2022 Ocean Fe

SOI supported <u>TBA21–Academy's 2022 Ocean Fellowship</u>—a collaborative effort to engage with artists who have an Indigenous perspective on the Ocean and Ocean issues. The program welcomed five fellows to a two-month in-person training at the Ocean Space in Venice, Italy, as part of a year-long remote program. The fellowship focused on exploration of societal relationships with the Ocean. Fellows included <u>Matti Aikio</u>, a Sámi visual artist from the Sápmi (Finland); <u>Liryc Dela Cruz</u>, an artist and filmmaker from Tupi (Philippines); <u>Ursula Johnson</u>, a Mi'kmaw interdisciplinary artist from Eskasoni First Nation of Unama'ki District Nova Scotia (Canada); <u>Fernanda Olivares Molina</u>, a 30 years old Selk'nam artist who is part of Ensayos, a transdisciplinary research collective in Tierra del Fuego (Chile); and <u>Aqui Thami</u>, a Janajati/Indigenous artist who positions her art as a medium of healing (Nepal).

World Ocean Observatory - Virtual Aquarium In March, World Ocean Observatory launched the long-an

In March, World Ocean Observatory launched the long-anticipated DEEP SEA <u>Virtual</u> Aquarium, which had been in co-development with SOI since 2021. The immersive aquarium provides an educational, interactive online platform for Ocean exploration featuring imagery collected from R/V *Falkor* expeditions. The virtual aquarium attracted more than 6,000 visitors upon its launch and won a 2022 platinum MarCom Award. World Ocean Observatory has since updated and added new features to the site. The aquarium currently has three exhibited environments that allow users to immerse themselves in deep-sea ecosystems that humans cannot access. The environments include a 2,000-meter deep hydrothermal vent, a whale fall at 1,500 meters depth, and 3D models of species found in these deep-sea habitats. Work to expand the site will continue with SOI's support, including plans to develop a lobby, theater, and new exhibits in 2023.



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Strategic Partnerships



National Geographic Society

In June, SOI and the National Geographic Society <u>announced a formal</u> <u>partnership</u> to advance diversity and equity in Ocean exploration at the UN Ocean Conference in Lisbon, Portugal. The partnership will provide seagoing opportunities aboard R/V *Falkor (too)* to underrepresented, historically marginalized participants, local scientists, and National Geographic Explorers, who will begin occupying berths in 2023. The partnership will amplify the voices of underrepresented marine scientists and storytellers and provide leadership opportunities in Ocean science.



NOAA Ocean Exploration

SOI continues to collaborate with NOAA Ocean Exploration and Ocean Exploration Trust on the Deep Ocean Education Project (DOEP) website. The website merges each organization's most engaging content for educators and community groups to build lesson plans, learn, and explore in one space. In 2022, the team focused on growing the library and updating available resources, such as expanding the resources and materials offered in Spanish. Over 500 people have created accounts with DOEP since the website's launch.

In January, the three organizations met virtually alongside a group of traditional knowledge holders, educators, and community leaders in the Pacific Islands to gather advice on how to best work with and serve the local communities when research vessels are operating in Pacific waters. Their recommendations for respectfully working and engaging in project co-design in the Pacific Islands are compiled in *Kupe's Wake Recommendations Report*.

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Ocean Rising and Nekton

Ocean Rising is an ongoing SOI initiative with Nekton to inspire the public through popular culture including the arts, broadcast media, social media, sports, gaming, and business. This year, two workshops were held in London to brainstorm with industry experts on how to best incorporate the Ocean into fashion and music. Each of these sectors is critical in defining popular culture and can be influential in bringing the Ocean to a general public audience. The fashion-focused workshop included breakout sessions with representatives from the Apparel Impact Institute, The R Collective, Conde Nast, and others. Climate and music organizations, such as Reverb, Julie's Bicycle, Earth Percent, and Music Declares Emergency, and artists and their management, labels, and festival organizers attended the music industry workshop. SOI, Nekton, and members of both the fashion and music communities will continue to work together through 2023 to raise awareness about the Ocean, implementing the workshop suggestions.



Seabed 2030

SOI has partnered with The Nippon Foundation - GEBCO Seabed 2030 Project since 2019 and continues to support their goal of a high-resolution map of the seafloor with the addition of the 19-meter gondola and full-ocean depth sonars on R/V *Falkor (too)*. At the UN Ocean Conference in Lisbon, Portugal, Seabed 2030 announced that 23.4% of the seafloor had been mapped. SOI's Executive Director, Dr. Jyotika Virmani, was also featured in one of Seabed 2030's <u>partnership videos</u> that was released last year.

Photo: A coral sample and brittle star are brought into the Main Lab for analysis.| By Alex Ingle



Supporting Students in Marine Technology with **MTS/IEEE-OES**

Marine Technology Society (MTS), the Institute of Electrical and Electronics Engineers Oceanic Engineering Society (IEEE-OES), and SOI continued to partner in 2022. The three organizations worked to support students and early career marine technology professionals through the International Student Poster Competition awards at the MTS/IEEE Oceans 2022 Chennai Conference. SOI's financial contribution provides a small monetary prize to the student poster competition winners. Yang Weng, from the University of Tokyo, Japan, won first place for the poster Sim-to-Real Transfer for Underwater Wireless Optical Communication Alignment Policy between AUVs. Zhiding Yang, from Memorial University of Newfoundland, Canada, won second place for the poster A Temporal Convolutional Network for Wave Height Estimation from X-band Radar Data, and Fabricio Bozzi, from University of Algarve, Portugal, won third place for the poster Vector Hydrophone Passive Time Reversal for Underwater Acoustic Communications.

As part of this partnership, SOI has committed to sponsoring MTS-Seattle Chapter events. At one of these events, SOI Senior Director of Operations, Eric King gave a presentation on the refit of R/V Falkor (too).

Photo: Hydrothermal vent documented in a field in the Guaymas Basin (Gulf of California). By Schmidt Ocean Institute

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In June, SOI staff attended the UN Ocean Conference in Lisbon, Portugal, where the theme was Scaling Up Ocean Action Based on Science and Innovation for the Implementation of Goal 14: Stocktaking, Partnerships, and Solutions. SOI staff spoke at and participated in 15 events, including the High-Level Ocean Decade Alliance Meeting, the Ocean Decade Forum, and several youth-focused events, like a panel on Ocean and pop culture at the Youth and Innovation Forum. During the conference, SOI exhibited 20 pieces from our Artist-at-Sea collection at the Ciencia Viva and Gulbenkian Museum.



UNESCO/ The Ocean Decade

SOI continued to participate in the UN Decade of Ocean Science for Sustainable Development in several ways, including attending the 2nd Foundations Dialogue in Morocco, which resulted in the Bouknadel Statement, of which SOI is a signatory, and an Ocean Funders Collaborative of which SOI is a member. The statement calls for foundations working with the Decade to focus on co-design, communications, and capacity development.

Additionally, SOI's Executive Director, Jyotika Virmani, continued to co-chair the Decade Ocean Technology and Innovation Working Group. SOI Director of Communications and Engagement Strategy, Carlie Wiener, also continued to cochair the Decade Communications Advisory Group.

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ESSENTIAL INNOVATION AND INFRASTRUCTURE FOR OCEAN KNOWLEDGE

Moderated by Jyotika Virmani, Executive Director, Schmidt Ocean Institute; Co-Chair, Ocean Decade Technology and Innovation Informal Working Group





Leadership

SOI staff participated in 76 events throughout the year and served as panelists, moderators, presenters, and interviewees in podcasts. In total, SOI staff reached a global audience of over 15,000. Events included the National Ocean Exploration Forum in Austin, Texas, which sought to identify and share national exploration priorities for the United States over the next decade. SOI staff served on the planning committee for the Forum, moderated breakout sessions, and synthesized discussions for the Workshop Report. SOI staff served on the planning committee for Capitol Hill Ocean Week in Washington, D.C., and several others participated in the event.

Photo: Jyotika moderating the panel "Essential Innovation and Infrastructure for Ocean Knowledge" in Portugal during the UN Ocean Decade Forum.



FLAM<mark>N</mark>GO



Scientific Ocean Vehicle Alliance (SOVA) The Scientific Ocean Vehicle Alliance (SOVA), formed in 2020 by SOI's Lead Mechanical Engineer, Jason Williams, is a community of operators, managers, engineers, and technicians involved in the development and operations of scientific Ocean vehicles. The group shares knowledge and lessons-learned to optimize the overall operations of marine science vehicles, increase efficiencies, and standardize operational procedures for conducting Ocean science across organizations. In addition to the annual meeting in April, the alliance gathered two more times virtually to discuss ROV umbilical management, staffing, and internship programs. Members also have access to a private discussion forum to exchange ideas in between formal meetings. SOVA's plans for 2023 include meeting in person for the first time since the formation of the alliance (exactly three years after SOVA formed), hosting topic-focused workshops, and expansion to include the international scientific vehicle community.

The Ditchley Foundation and Open Data Sharing

One of SOI's key tenets is the open sharing of data and information. In October, SOI in partnership with The Ditchley Foundation, hosted a workshop, Credit where Credit is Due: Authorship of Open Ocean Data, at Ditchley Park in England. The workshop gathered attendees from across Europe with various perspectives on the data pipeline, including publishing, academic research, data sharing, and scientific funding, to discuss how to best recognize and reward the dissemination of acquired data and knowledge. Participants identified barriers and discussed implementable solutions for making data sharing easier, acknowledging data sharing as a form of productivity, and giving proper credit to those that contribute. Their recommendations for cross-sectoral and sectorspecific solutions to encouraging open data sharing are compiled in Credit where Credit is Due; Authorship of Open Ocean Data.

Pink Flamingo Society (PFS)

PFS promotes the safe, efficient, and environmentally responsible operation of research vessels primarily funded through philanthropy in support of the global oceanographic scientific research community. SOI first convened the group in 2019, and continues to engage with the fourteen member organizations. In 2022, the group met at the Monterey Bay Aquarium Research Institute (MBARI) in Moss Landing, California to discuss opportunities for collaboration in 2023 and beyond. During the meeting, SOI staff gave presentations related to data sharing, DEI initiatives, participation in the UN Ocean Decade, and moderated discussions focused on the challenges and opportunities facing the group of philanthropic research vessel operators. The current Chair is Vincent Pieribone, OceanX, and co-Vice Chairs are Chris Scholin, MBARI, and Romain Trouble, Tara Foundation. SOI's Senior Director of Operations, Eric King, serves in the Leadership Group as the immediate past chair, and Carlie Wiener chairs the Communications Working Group.

Disseminating the Depths

Schmidt Ocean Institute is committed to engaging the world in oceanographic research through our outreach and communications programs. Over the past ten years, we have established an Artist-at-Sea program, contributed to museum exhibitions, and shown short films worldwide. The following is some of the award-winning work our communications team conducted and assisted with this past year.

Photo: Artist-at-sea Kirsten Carlson sketched and produced watercolors during the "Sea to Space expedition" in 2017, which studied the various colors of the Ocean as seen by remote sensing (including NASA satellites). | By Kirsten Carlson

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Artist-at-Sea



First Remote Artist-at-Sea

In 2022, the Artist-at-Sea program continued during the refit of R/V *Falkor (too)*, welcoming its first remote artist, <u>Taiji Terasaki</u>. The Hawai'i-based multimedia artist worked with nine images of species photographed by ROV *SuBastian*, such as the glass octopus and vampire squid, to create his *Vanishing Point* series. *Vanishing Point* walks the line between life's appearance and disappearance in the depths by merging six individual glass panels with the same species printed on them, each image gradually decreasing in opacity to form one whole artwork. One piece from the collection debuted at the UN Ocean Conference Artist-at-Sea exhibit and was donated to the <u>Ciencia Viva museum</u> in Lisbon, Portugal. Three other pieces from the collection were showcased in a six-month art installation at the Port of Seattle.



Half-Light

Previous Artist-at-Sea, Ellie Hannon, and SOI multimedia correspondent Conor Ashleigh debuted an installation of immersive paintings, short films, and ceramics in the <u>Half-Light exhibit</u> at the Maitland Regional Art Gallery in New South Wales, Australia. The exhibit was based on their time on R/V *Falkor* during the 2021 <u>Australian Mesophotic</u> <u>Coral Examination expedition</u>. Half-Light takes a subsurface plunge offering views into natural spaces that humans are unable to visit in the Ocean's twilight zone.

Photo by Conor Ashleigh







2022 Exhibitions

Three Artist-at-Sea exhibits were held in 2022, showcasing more than 60 pieces from SOI's growing collection. In March, in collaboration with Nautilus, a oneweek exhibit was held at the Explorers Club in New York City, New York, during the UN Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction. The opening event welcomed conference dignitaries and five previous Artist-at-Sea participants, including a musical performance by Ben Cosgrove, who sailed on R/V *Falkor* during a transit in 2016. In June, two separate art exhibitions were displayed at the Ciencia Viva and Gulbenkian Museums as part of the UN Ocean Conference in Lisbon, Portugal. The last exhibit of the year was held at the Port of Seattle, which continued into 2023.

Photo by Madison McGaw

Photo: Artist-at-Sea Sarah Caudle holds a teaching session / workshop on resin pieces others on the transit in R/V *Falkor*'s wet lab. From L-R, D'Amy Steward, Chris Teufel, Lizzy Taber, Sarah Caudle, Roger Peet. By Logan Mock-Bunting



Awards

Australia's <u>SSSI Hydrography Commission's Hydrographic Excellence</u> <u>Award</u> was bestowed to SOI for R/V *Falkor*'s operations and contributions to mapping the seafloor in Australia, including the discovery of a new coral reef during an expedition led by Dr. Robin Beaman from James Cook University. He received the award at the 2022 NSW & ACT Asia-Pacific Spatial Excellence Awards dinner, on behalf of SOI staff, R/V *Falkor* crew, and science team.

In June, SOI accepted the Conservation Innovation Award on behalf of SOI co-founders Eric and Wendy Schmidt for their important Ocean work through The Schmidt Family Foundation, Schmidt Marine Technology Partners, SOI, and 11th Hour Racing. The award was bestowed upon them by the National Marine Sanctuary Foundation and was awarded during Capitol Hill Ocean Week in Washington, D.C.

SOI was also honored to receive four MarCom Awards in 2022, an international competition for marketing and communications professionals. The awards included two platinum for the Virtual Aquarium website (in partnership with the World Ocean Observatory) and the Depths of Ningaloo short documentary film, a gold for the 2021 SOI Impact Report, and an honorable mention for the Making of a Research Vessel YouTube series that showcases the refit of research vessel *Falkor (too)*.

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Photo courtesy of Robin Beaman





Museum Exhibits

Since 2016, SOI has been sharing expedition content with museums and aquariums across the globe. In 2022, expedition content was included in five exhibits. The traveling exhibit AI: More than Human, featured footage from the 2018 New Approaches to Autonomous Exploration expedition and was hosted at the Guandong Science Center (China) from January to June and the Afundación (Spain) from September to February (2023). Both locations received a combined total of 249,448 visitors. Other exhibits that featured SOI content included Ocean Wonders—Australian National Maritime Museum, Into the Deep: Exploring our Undiscovered Oceans—Monterey Bay Aquarium (United States), and the Deep Sea Showcase— Western Australia Museum.

Photo: Half-Light exhibit at the Maitland Regional Art Gallery (Maitland NSW Australia). | By Maitland Regional Art Gallery

Photo: OceanWonders Exhibit | By Robin Beaman





Previous expedition results and partnership announcements made the headlines in 2022, with 198 news stories reaching 940 million people in 25 countries.

SOI images were used in an impressive array of educational and public projects in 2022. A new simulation game based on real-life ROV dive missions, *SubROV*, was released in December by José Luis González Castro. Two of the game's missions are based on ROV *SuBastian* dives that took place during the <u>Biodiverse Borderlands</u> and <u>Deep Sea Corals of the Phoenix Islands</u> expeditions. Many of the graphics and artwork were inspired by species filmed with ROV *SuBastian*. You can learn more about SubROV or <u>download the game here</u>.

Another example is a coffee table book by Phaidon Press, *Ocean: Exploring the Marine World.* This 352-page illustrated timeline of Ocean art includes an SOI photo of a hydrothermal vent discovered on the <u>Microbial Mysteries</u> expedition. SOI's deep sea footage was also used during a concert titled <u>Deep Sea Dreams</u> at the Kunstverein Offenbach in Germany. Additionally, Australian surf-inspired streetwear brand, <u>Jungles Jungles</u>, used SOI imagery through a collaboration with Nautilus Magazine. The designers created a clothing line, "No Species is an Island," to raise awareness for the 30×30 campaign, an initiative focused on reserving 30% of the Ocean as marine protected areas by 2030.













Schmidt Ocean Institute

Mydrothermal Vent, 2019 Photograph, dimensions variable

Looking like a scene from screne fution, this derived/op environment list 2,000 metes (2,37 m) bales the Oil of Coldiensi, hower pick plomes of sporthened, manner with hurd like like from the ocean from: The spothinding image was taken by a dop-was charge a formalise from hurd like like like and andring a formalise from hurding to environ microbiologist Mandy Jayn, bayn discover discovered periodeling and the shaft and scheme the discovered periodeling and the shaft and scheme the discovered periodeling and the shaft as well as environment like the state of the state of

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Photo: Inside the wet lab on R/V *Falkor*, Dr Nerida Wilson inspects a gorgonian fan that was collected on Tuesday 20th April 2021 (dive 414). | By Conor Ashleigh



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