

The J. Robert Beyster and Life Technologies 2009-2010 Research Voyage of the Sorcerer II Expedition

A global ocean sampling voyage of genomic discovery in the Baltic, Black, and Mediterranean Seas



Previous Global Ocean Sampling Expeditions

Objective

The Expedition's goal is to evaluate the microbial diversity in the world's oceans using the tools and techniques developed to sequence the human and other organisms' genomes. With a better understanding of marine microbial biodiversity, scientists will be able to understand how ecosystems function and to discover new genes of ecological and evolutionary importance.

were identified using a whole genome shotgun sequencing technique by which scientists clone (copy) random DNA fragments from the many microbes present in the sample.



2003 - 2008 Routes



Pilot Study

In February and May 2003 a pilot project was conducted in Bermuda's Sargasso Sea. The study's sequencing and analysis results, published in the journal *Science* in April 2004, revealed unexpectedly high microbial diversity in a region that is relatively nutrient-poor and thus thought to have very low diversity of microbial life. More than 1.2 million new genes and more than 1,800 species

Circumnavigation Expedition 2003-2005

After its launch in Halifax, Nova Scotia in August 2003, the Sorcerer II sailed south into the Gulf of Maine, then along the U.S. east coast sampling in the ecologically important Narragansett, Delaware and Chesapeake Bays. The vessel then passed Cape Hatteras and traveled around Florida into the Gulf of Mexico, through the Panama Canal and to Cocos Island and then onto the Galapagos Islands. The Sorcerer II then sampled across the central and south Pacific through French Polynesia, the Cook Islands, Tonga, Fiji, Vanuatu, New Caledonia, and in Australia, where the Sorcerer was based for approximately six months. From there, the Sorcerer II sampled across the Indian Ocean, sailing near Madagascar and then around South Africa. The final leg of the Expedition included sampling across the South Atlantic. The initial voyage ended with a trip through the Eastern Caribbean and back to the East Coast of the U.S.

Expedition 2007-2008

The Sorcerer II set sail in December 2006 leaving Virginia heading through the Chesapeake Bay, and then south along the East Coast of the United States. After a transit through the Panama Canal, the vessel headed north through Central America and on to Mexico sampling in the Sea of Cortez. The Expedition continued up the West Coast of the U.S. into Alaska. While in Alaska the Sorcerer II took samples in Glacier Bay National Park including water taken from melting glaciers there. After this Sorcerer headed south again to her home port of San Diego.

Throughout 2008, the Sorcerer II conducted extensive sampling in the waters off San Diego and the coast of California, Oregon and Washington. Much of this sampling was done onboard Sorcerer II but several sampling trips were conducted by JCVI scientists onboard other collaborators' vessels including those done with Scripps Institution of Oceanography, University of Washington, Oregon Health and Science University, and the California Cooperative Oceanic Fisheries Investigations.

Several JCVI researchers also participated in deep sea sampling cruises as part of expeditions onboard the *R/V Atlantis* which carries the deep sea submersible, *Alvin*. These expeditions were done in collaboration with scientists from Woods Hole Oceanographic Institution, University of Delaware, and other institutions. The JCVI scientists were interested in sampling the underwater geysers in the Pacific Ocean and the Sea of Cortez to capture the viruses living in these extreme conditions.

JCVI scientists also conducted several sampling trips to Antarctica where they sampled several stratified lakes to understand the microbial diversity in these harsh polar conditions.



Bodies of Water Navigated by Sorcerer II

During its time at sea The Sorcerer II navigated many different bodies of water including the Caribbean Sea, Pacific Ocean, Koro Sea, Coral Sea, Gulf of Carpentaria, Arafura Sea, Timor Sea, Indian Ocean, Sea of Cortez, Glacier Bay, Puget Sound, etc.

Funding

The Gordon and Betty Moore Foundation granted \$4.25 million to the Expedition to sequence the DNA collected along the coast of North America. The Department of Energy Office of Science has awarded approximately \$12 million for sequencing associated with the Expedition, as well as for other projects within the JCVI's environmental genomics, synthetic biology and biological energy groups. The JCVI is funding the majority of expenses associated with the voyage itself.

Access to Data/Public Databases

Genomic DNA sequence data from samples generated from the Sorcerer II Expedition are publicly available to researchers worldwide through two sources on the internet—GenBank, a data repository at the U.S. National Institutes of Health, and a new database for metagenomic data, CAMERA (Community Cyberinfrastructure for Advanced Marine Microbial Ecology Researcher and Analysis). CAMERA, funded by a grant of \$24.5 million over seven years from the Gordon and Betty Moore Foundation, is a state-of-the-art computational resource with software tools to decipher the genetic code of communities of microbial life in the world's oceans. The new resource will help scientists understand how microbes function in their natural ecosystems, enable studies on the effect humans are having on the environment, as well as permit insight into the evolution of life on Earth. This invaluable new resource has been developed by UCSD Division of the California Institute for Telecommunications and Information Technology (Calit2) who will lead the project in partnership with JCVI and UCSD's Center for Earth Observations and Applications (CEOA) at Scripps Institution of Oceanography.

No patents or other intellectual property rights will be sought by the Institute on genomic DNA sequence data.

Permits and MOUs

The initial JCVI/Expedition developed cooperative relationships with leading international researchers located in each sampling region. The collaborators consisted of representatives from 12 separate countries, as well as 36 different institutes, organizations, and universities. Additionally, the JCVI worked with collaborators or their Governments to develop memoranda of understanding (MOU). These MOUs are obtained in addition to research permits and sample export permits issued by the countries where sampling takes place and specify how the genetic resources may be used.

Collaborators

The Sorcerer II Expedition research team, led by Dr. Venter, is a multidisciplinary team of microbiologists, bioinformatics specialist, and DNA sequencing staff at the JCVI. In addition, host country collaborators in each region complement the expertise for sampling. Work was also performed in collaboration with researchers at various academic centers including: four campuses of the University of California—San Diego, Los Angeles, Davis, and Berkeley; University of Southern California, Salk Institute for Biological Studies, Burnham Institute, University of Hawaii, Brown University, Universidad Nacional Autonoma de Mexico, Bedford Institute of Oceanography, Smithsonian Tropical Research Institute, Universidad de Concepcion, Universidad de Costa Rica, and Rutgers University.