

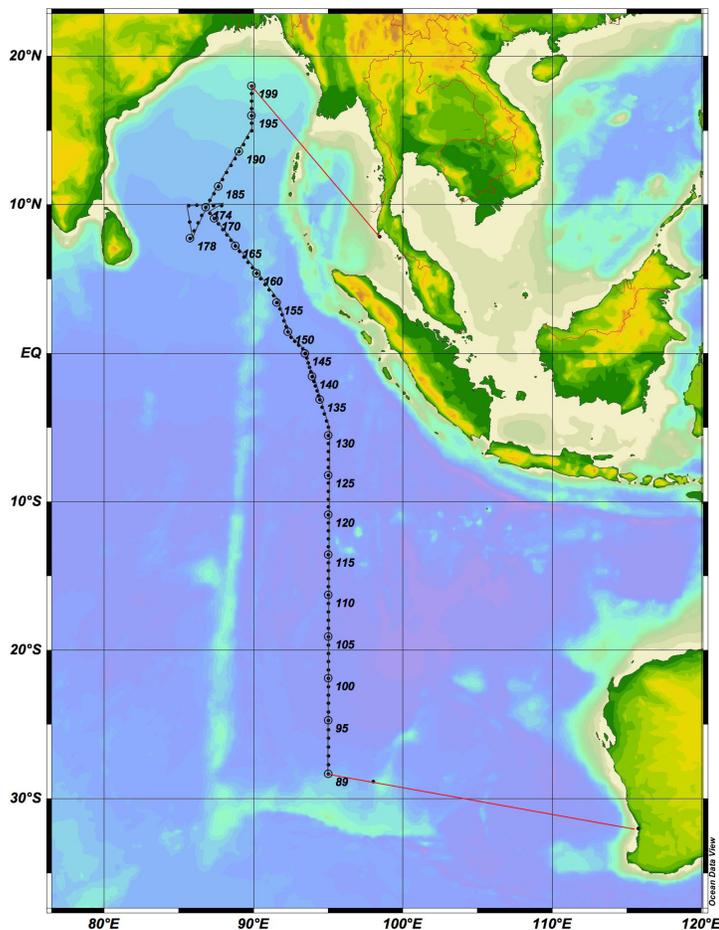
Researchers Sample Indian Ocean along GO-SHIP IO9N Transect

AOML researchers joined an international team of scientists aboard the R/V *Roger Revelle* in March and April to sample the physical, chemical, and biological parameters of the Indian Ocean. The cruise was undertaken in support of the Global Ocean Ship-Based Hydrographic Investigation Program (GO-SHIP), an international initiative to decadal sample all ocean basins. By regularly resampling ocean transects, researchers can quantify changes in the ocean's storage and transport of heat, freshwater, salinity, carbon, nutrients, oxygen, and trace gases, providing insights into how a changing climate is impacting the physics, chemistry, and biology of the world's oceans.

Leticia Barbero, a University of Miami-Cooperative Institute scientist with AOML's Ocean Carbon Group, served as chief scientist, while Robert Castle of AOML led the effort for dissolved inorganic carbon (DIC) measurements. The current IO9N survey represented the third occupation of an Indian Ocean transect previously sampled in 1995 and 2007.

The IO9N line began northwest of Freemantle, Australia at 28°S and ended in the Bay of Bengal at 18°N, a distance of more than 4000 miles. Along the cruise track, the research team sampled the full water column at more than 100 stations. Ship-based hydrography is essential for documenting changes in the water column, especially the deep ocean below 2 kilometers. These deeper levels make up roughly 52% of the ocean's volume and cannot currently be measured by autonomous instruments.

Conductivity-temperature-depth and oxygen (CTD-O₂) sensors connected to a water-sampling package generally called the rosette,



Cruise track of the 2016 IO9N GO-SHIP Indian Ocean transect from Freemantle, Australia northward into the Bay of Bengal (28°S to 18°N).



Robert Castle of AOML (far left) waits his turn to obtain water samples from the CTD for dissolved inorganic carbon analysis.

CTD, or simply “the package,” were used at each station to collect samples at 36 depths. These samples provided precise measurements of salinity, temperature, and oxygen down to 6000 meters, more than 3.5 miles below the ocean surface. Water collected at each depth also determined total DIC, pH, nutrient concentrations, chlorophyll levels, and a variety of other parameters.

Great care was taken to measure a number of high priority, level 1 core parameters such as carbon, nutrients, salinity, temperature, etc. In addition to these core parameters, however, a number of level 2 (highly desirable factors) and level 3 (ancillary measurements) parameters were gathered as well. As an example, trace metals, which are metals such as iron found in extremely small concentrations in the ocean, were measured at 24 locations along the cruise track. At the same locations, water samples were gathered to perform incubation experiments to determine nutrient uptake rates, as well as phytoplankton community and genomics composition in surface waters.

The science plan also included a number of activities to assist other research programs. For example, an optics cast was performed daily, timed to the passage of the MODIS-AQUA satellite that provides images of ocean color. The optics casts will be used to calibrate these satellite images. Additionally, eight Argo profiling floats were deployed at select locations along the cruise track in support of the ARGO program.

After more than a month at sea spent diligently gathering an array of data around the clock, the intensive IO9N sampling effort ended with a port call in Phuket, Thailand. The survey along the IO9N GO-SHIP transect supports global ocean observational efforts by providing critical data that will serve as a baseline to assess changes in the ocean's biogeochemical cycle in response to natural and anthropogenic activities. These collective observations are needed to improve knowledge of the complex interaction between the oceans and global climate.

- GO-SHIP Program—<http://www.go-ship.org/>
- US Repeat Hydrography Program—<http://ushydro.ucsd.edu/>
- The R/V *Roger Revelle*—<https://scripps.ucsd.edu/ships/revelle>