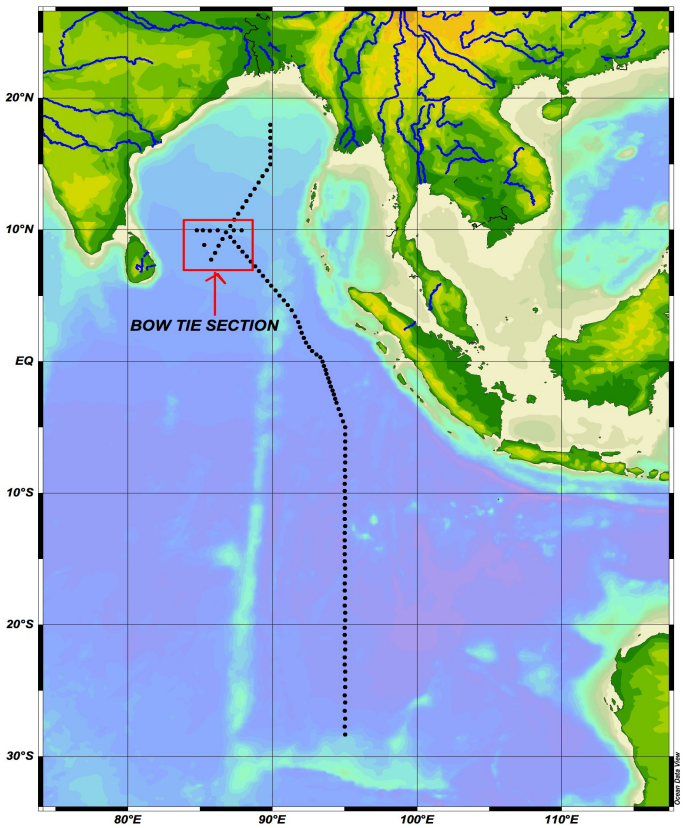
2016 I09N Cruise report, week 4

Ahoy land-dwellers!

Greetings from the Bay of Bengal. We have now left behind the Equatorial region of the Indian Ocean and have finished an intense sampling scheme between 3S and 3N, with stations spaced just 20 nm apart instead of the average 30nm. We completed 20 stations in just 6 degrees of latitude. Now we are covering the so-called "bow tie" section of the cruise, where the track makes a funny kind of knot around 10N (see plot below). This "bow-tie" section covers part of the I01E GO-SHIP cruise which was last occupied in 1995 but not again. During the I09N 2007 cruise, sections of the I01E track were also sampled, and we are repeating this track, going as far west as international waters will allow. The Bay of Bengal is an important source of fresh water to the global ocean and these stations are useful for estimating freshwater transports and budgets, among other things. The stations further west also have interesting carbon and nutrient concentrations, particularly in deep waters.

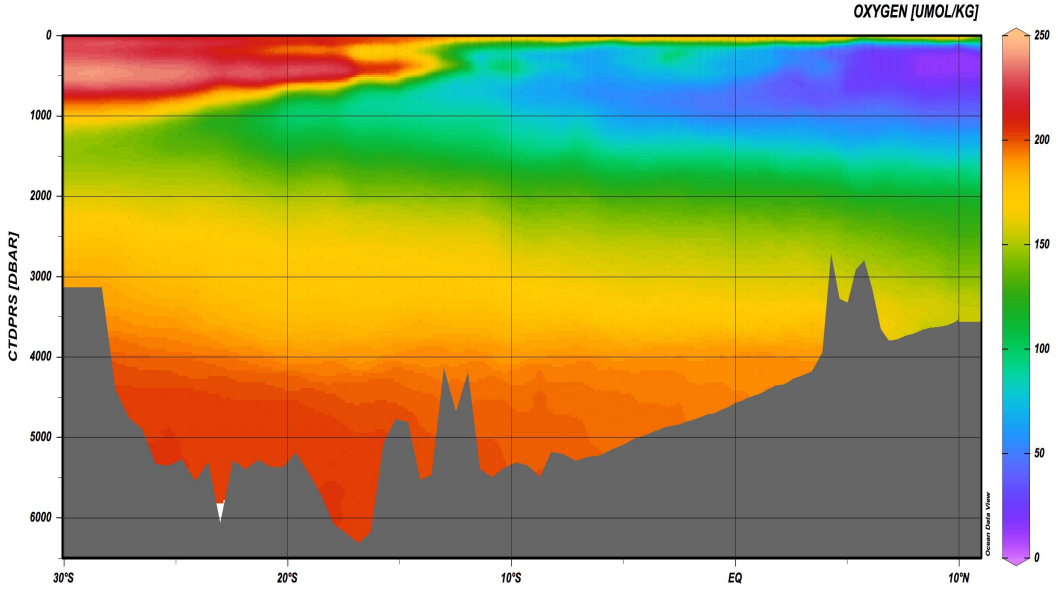


Cruise track for I09N 2016, with the "bow tie" section in a red rectangle. The blue lines in land areas show the location of major rivers

We are beginning to see some animals out there, finally. Still no sign of a whale yet, but some of us have seen the odd turtle, a small shark, and a school of dolphins splashing in the distance. To compensate for the lack of exciting fauna, the Indian Ocean is providing us with a non-stop series of amazing sunrises, sunsets and starry skies, as well as ongoing calm seas.

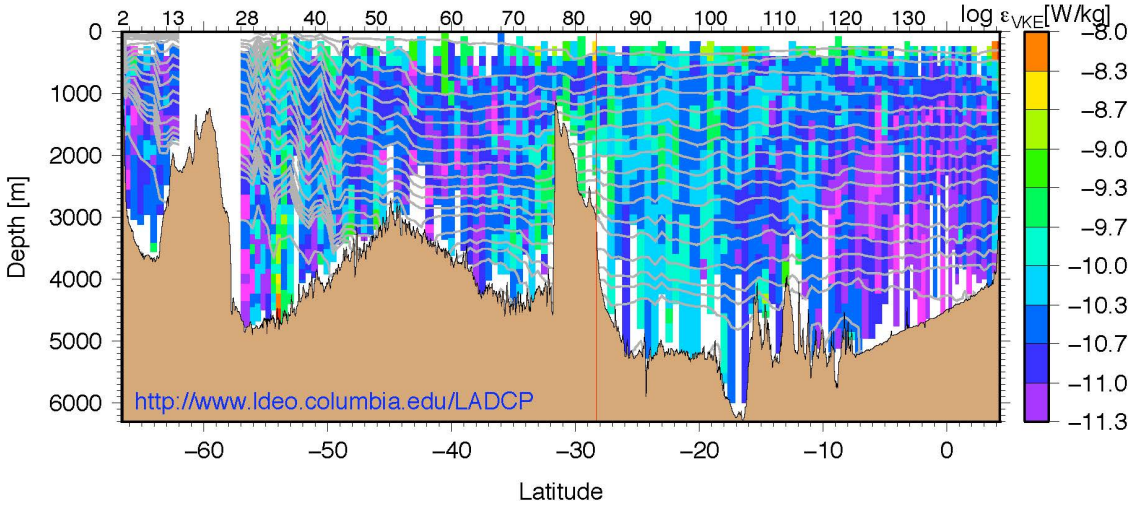
The CTD is deployed as the sun sets in the horizon. Picture courtesy of Steven Baer

For those of us who have not worked in the Indian Ocean before, the oxygen values we are seeing have been a surprise. Starting at around 10S, subsurface values began to drop significantly and we have actually measured O_2 values as low as 10 μmol/kg, compared to values of ~200 μmol/kg at the same depths in our first stations. This means that subsurface waters in this area are highly hypoxic, and close to the suboxic range (concentrations lower than 5 μmol/kg). In the suboxic range most organisms cannot survive. Similarly low O_2 concentrations had been measured in this area in previous cruises so this is not a dramatic change that occurred in the last decade.



O_2 concentration (µmol/kg) measured during I09N between stations 84 and 170. While O_2 levels along the transect at depths deeper than 3000 dbar have remained fairly consistent, changes in the upper layers, particularly in the 200-1000 dbar range are substantial.

On this week's report we also wanted to talk a little about the LADCP (Lagrangian Acoustic Doppler Current Profiler) measurements. The LADCP is installed on the rosette and provides zonal as well as meridional current velocities. These currents are important not only for physical oceanographers, but also for researchers working with nutrients and carbon, because knowing them helps scientists in determining nutrient distribution and transports.



LADCP-derived turbulence levels (W/kg) from vertical velocity measurements, using a novel finestructure parameterization method (Thurnherr et al., GRL 2015), which yields unbiased results at latitudes of 10 degrees and higher but overestimates turbulence levels close to the equator. Grey contours show arbitrarily spaced neutral surfaces. The red vertical line separates the two cruise legs.

Our LADCP scientists on board and back on land, Takaya Uchida and Andreas Thurnherr, have summarized the main results from the LADCP records so far:

1) There are strong currents along the Diamantina Escarpment (southern flank of Broken Plateau, near 30S) essentially all the way to abyssal depths. From this single occupation it is not clear whether the northwestward flow along the Diamantina Escarpment is part of the mean circulation or if it is a transitory feature. The flow above the topography crosses the plateau in a southwesterly direction; the flow below the crest depth appears to flow along the topography (probably because of PV conservation). Based on this observation we hypothesize that the southern limit of the high-EKE (Eddy Kinetic Energy) wedge seen in the figures below is set by the topography.

2) The strong currents associated with the Diamantina Escarpment are associated with significant turbulence and mixing. Based on the VKE (Vertical Kinetic Energy) parameterization the turbulence levels around the Broken Plateau are similar to the turbulence levels in the ACC region, although they do not extend above 1000m.

3) The VKE-derived turbulence levels under the entire region of high surface EKE (roughly 17-30S) are elevated across the entire water depth.

The zonal equatorial undercurrents between the latitudinal bands of 5S~5N which are specific features in the equatorial regions can also be clearly observed.

As always, here are the links to our blogs for those of you who want to learn more about what's going on in our cruise:

http://goship-i09n-2016.blogspot.com/

http://fayamanda.weebly.com/i09n-cruise-blog

Onwards!
Carmen and Leticia, chief-scientists I09N