A16S Chief Scientists' update #5. Jan. 26, 2014

The weekly report and additional pictures from the cruise can be found at: http://www.aoml.noaa.gov/ocd/gcc/A16S_2014 bottom left hand under "during cruise"

Les Forcats de la Mer

After 34 days we are feeling very much like prisoners of the sea. Our hands are numb from sampling sub-zero (centigrade) waters, our bodies are numb from the bitter winds that howl through the staging bay; our heads are numb from sleepless nights from either the fog horn or being bounced around in our bunks in stormy seas. There is a cruel sense of justice that the best staterooms on the ship that are reserved for scientists with seniority experience the most noise from the horn and the rocking and rolling, while those "down below" sleep soundly.

However, there remain times of excitement of being out at sea. One came yesterday morning when the first iceberg was sighted, 13 miles out. We passed the majestic ice mountain within a mile (see Figure 1). Currently we are steaming along South Georgia Island, our first site of land since we left Recife. Our tight schedule and diplomatic concerns regarding the islands disputed status between the UK and Argentina prevents us from visiting, much to the disappointment of most on the ship.

Our work is progressing well. We've used about a day of our banked weather days as the ship had to slow down and CTD package deployments were delayed in two bouts of stormy weather. Both systems, thankfully, passed through in about a day. We've completed our first major objective of successfully completing basin wide coverage of the Western South Atlantic basin and will spend our last week of science operations traversing the Antarctic Circumpolar Current (ACC), the largest current on earth. It goes around the entire Antarctic continent and its strength and meanders have a major effect on the earth's climate system. There remains much uncertainty about variability of the ACC and with the lowered acoustic Doppler profiler (L-ADCP) on the CTD package we'll get a high-resolution snapshot of the current structure from top-to bottom. After the last station at 60 ˚S we'll be bucking the prevailing winds and currents on our 6-day steam to Punta Arenas, Chile.

Our scientific endeavors are going well with only minor issues that have been corrected with great cooperation and shared expertise of all. Preliminary data is streaming in and is providing us a first glimpse of this high quality multi-disciplinary data set to study changes that are occurring in the ocean. Some of the findings are fortuitous like when the underway scientific seawater supply feeding our automated instruments measuring surface seawater parameters stopped working. It ended up that a strainer at the intake was completely clogged with salp and got reclogged within hours. The explosions of salp population in this area are caused by occupying a niche available due to a precipitous decline in krill over the past decade for reasons not fully understood. Krill is a primary food source for whales while salps have little nutritional value. Such changes in species abundance thus cascade through the food chain.

One way we study the interactions between ocean and atmosphere is by measuring man-made gases in the ocean. We have good records of production of the compounds over time and using

these trace gases we obtain quantitative information of how and where other gases such as carbon dioxide released from fossil fuel burning are entering the ocean. One such gas that we have recently begun to measure on the GO-SHIP CLIVAR repeat hydrography cruises is sulfur hexafluoride (SF_6). Its commercial applications are as a gaseous electrical insulator and, interestingly as the gas in cushioning pockets of higher-end running shoes. Figure 2 shows a contour plot of SF_6 levels in the ocean as measured on this cruise. High concentrations are found in surface water particularly in the colder waters at high latitude with rapid declines towards the deep. The additional conduit for pollutants into the ocean is through deep-water formation along the Antarctic continent. These waters sink to the bottom and move slowly northward as can be seen by the elevated SF_6 concentrations at the southern end of the section. An interesting side bar are the observations of elevated SF_6 levels in the center of the Brazil basin near 28 ˚S. These result from a study commenced 17 years ago by J. Ledwell of WHOI and colleagues, where SF_6 was deliberately injected in the deep ocean to study water movement and diffusion.

Currently we are doing a CTD cast at Station 103 at 55 ˚S, 35 ˚W. All is well onboard; there is still coffee; spirits remain high; and we have only about 10 more stations to go. The end is in sight.

Rik & Leticia, Chief Scientists GO-SHIP/CLIVAR A16S

CLIVAR: CLImate VARiability Program
GO-SHIP: Global Ocean Ship-based Hydrographic Investigation Program
WHOI: Woods-Hole Oceanographic Institution
PMEL: Pacific Marine Environmental Laboratory

Figure 1. A spectacular view of our first iceberg sighting on January 25 (53 ˚S, 36 ˚W). Photo by resident photographer, Daniel Hauerland, Seaman, Ronald H. Brown.

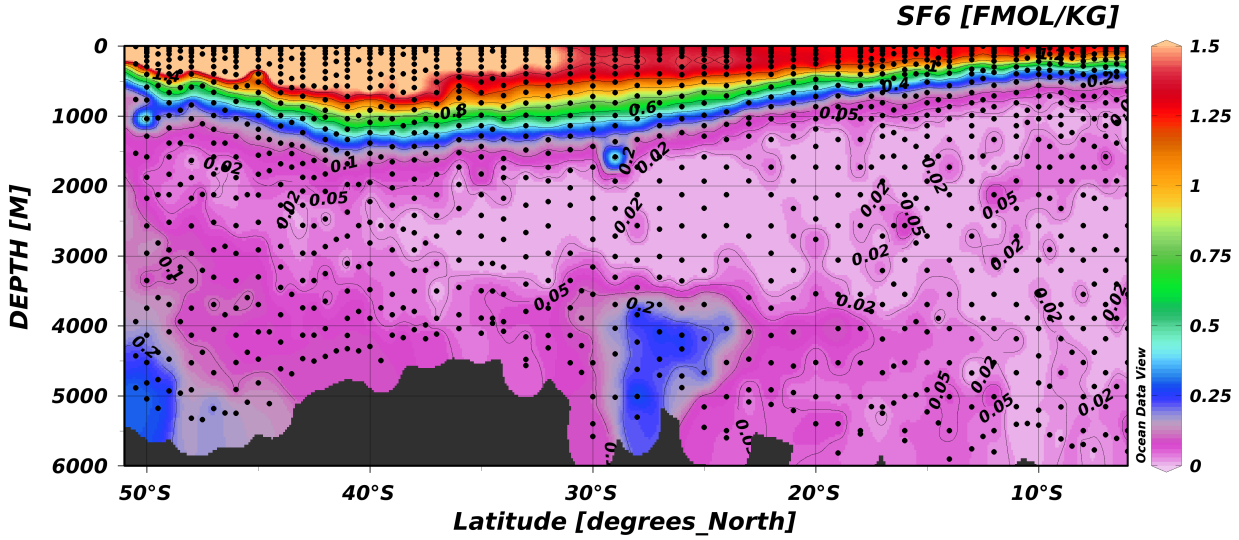

Figure 2. Cross-section of sulfur hexafluoride concentrations in the ocean. The quantities are minute and analyses require specialized highly sensitive instruments and separation procedures. The black dots are sampling locations. The units are femtomolar (10^{-15} mol/kg). The purple colors (0- 0.1 femtomolar) are levels near detection limit. Preliminary data and plot courtesy of David Wisegarver, PMEL. *Big John approves of this message.*