Ocean Layering: Density, Salinity, Temperature, and Circulation

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Activity: Global vertical layers

See '02c.handout.atlsections.color' (http://earthref.org/cgi-bin/erda.cgi?n=1008)
or '02c.handout.altsections.gray' (http://earthref.org/cgi-bin/erda.cgi?n=1007)
See '02t.handout.atlsections.answers' (http://earthref.org/cgi-bin/erda.cgi?n=1012)

Goal:

Students interact with observations in the Atlantic to help them understand deep ocean currents and vertical layering.

Instructor Prep:

Print out copies of the handout.

Implementation:

- Orient the students to the figures using the 9th slide in '02c.slides.globallayers' (http://earthref.org/cgi-bin/erda.cgi?n=1009). On their handout, the top figure is temperature, the bottom axis tells you what latitude you are looking at from Antarctica to Alaska, the left axis tells you how deep the water is from the surface to 5200 m depth, and the colors tell you what the temperature is. Blue is cold water, 0-5°C, and red is warm water, 25-30°C.
- Go through the first part of the first question together, estimate the surface temperature at 50°S. Explain that 50°S and -50° are the same. Have students label 'south' and 'north' below the figures if they are confused. Where is the surface? The surface is at zero m depth. What color is it? Blue. What does blue mean? 0-5°C.
- Give students time for the remainder of the worksheet.

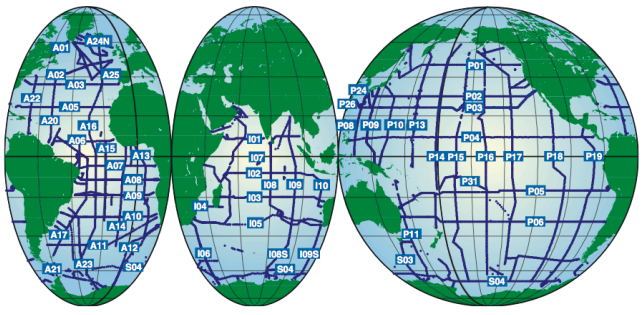
Conclude:

- Go over #3 and #5 briefly. For #3, water is more likely to sink near 50°S than 10°S because the water there is very cold and very dense. Water at the surface is not that different from the water on the bottom at 50°S. For #5, use the last slide in '02c.slides.globallayers' (http://earthref.org/cgi-bin/erda.cgi?n=1009).

More Information:

Data collection:

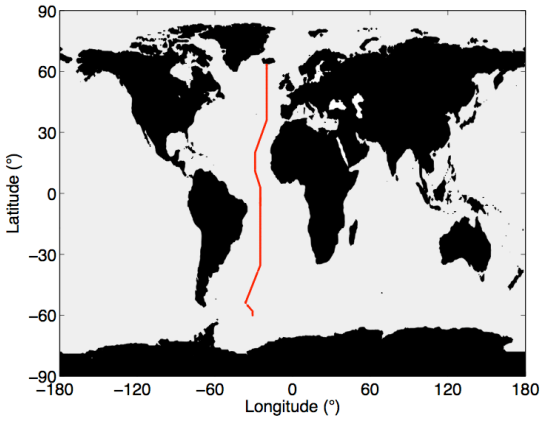
The data was collected as part of the World Ocean Circulation Experiment (WOCE). WOCE is a multinational program that observed one profile from the surface to the bottom every 50 km along several transects (see figure). The goal was to take a 'snapshot' picture of the ocean. Each section takes a dedicated ship of about 20 crew, 30 scientists, 1-2 months, and 1 million dollars. Ship's are expensive and cost $25,000-30,000 per day to operate.



All of the sections taken from 1990-1998 as part of WOCE. Some sections have been observed prior to and after as well. The figure is from "WOCE observations 1990-1998: a summary of the WOCE global data resource" published in 2003 by the WOCE International Project Office.

One country alone could not complete all of these observations. Much more than temperature and salinity were measured. Bottles were sent to the bottom of the ocean so that water can be brought up from different depths and analyzed. More information can be found at: http://woce.nodc.noaa.gov/wdiu/index.htm. The slides in '02t.slides.globallayers' (http://earthref.org/cgi-bin/erda.cgi?n=1014) briefly explain how the observations are collected as well.

Where is this particular section from?
The section is from the Atlantic and was taken in two segments, from the south Atlantic to 5°S in Jan-Feb 2005, and from 5°S to Iceland in June-July 2003. The section does not start right at Antarctica because the ship used was not equipped to operate near ice.



The Atlantic section for the activity is in red.