NOAA Teacher at Sea
H. Turtle Haste
Onboard NOAA Ship McARTHUR II
June 4 – 9, 2007

NOAA Teacher at Sea: Turtle Haste
NOAA Ship MCARTHUR II
Mission: Ecosystem Survey and Seafloor Recovery Evaluation in the Central California National Marine Sanctuaries, Leg 1 - CalCOF1 Survey
Day 3: June 5, 2007

Weather Data from Bridge
Visibility: 6 miles
Wind Direction: Northwest
Wind Speed: 10-20 knots
Sea Wave Height: 2-4 feet
Swell Height: 3-5 feet at 10 second intervals
Surface Water Temperature: 13.96 – degrees Celsius
Air Temperature: 16.1 – degrees Celsius
Sea Level Pressure: 1017.6 millibars

Science and Technology Log

Bongo Nets-
Upon arriving at station 60-50, Kit Clark and I began the zooplankton tows with the oblique Bongo nets, also referred to as the "bongos." The process involved is to tow the nets an oblique angle acquired by calculating the wire put out with the angle it is towed at. There is an angle measuring tool that looks like a level attached to the payout line that is monitored. Adjustments are made depending on the angle to achieve an angle of 45 degrees +/- 3 degrees for the nets to reach an approximate depth of 200 meters. The bongo device itself has a 22 kg weight attached to the bottom of the yoke frame to cause it to sink. As the ship is traveling at 1-2 knots, a fixed amount of cable is paid out; the net is held at depth for 30 seconds and then is retrieved at a constant rate of 20 meters per minute.

The Oblique Bongo nets.

Upon retrieval of the bongo, samples are hosed into the cup at the end of the net to collect as much material as possible. A volume displacement measure is acquired by subtracting the amount of water the zooplankton displaces in a 1000 milliliter cylinder. The time to reach depth, time at depth, and retrieval time are recorded to monitor angle and depth. Samples are preserved in

formalin and balanced with a pH buffer. Both starboard and port nets are evaluated for overall trends in organisms and recorded at each station.

A tow was made at each station along the 60 survey line after the first station. The first station had too many crab pots and was too shallow to acquire a depth of 200 meters. At night, the anticipated nocturnal rising of krill occurred to present a sample dominated by krill as compared to the daytime samples of copepods. Daylight hours also presented samples of ctenaphore tendrils that "gunked" up the net. An obvious difference between daylight and night tows was the presence of krill in greater numbers. This is expected as especially near Monterey Bay over the canyon is known for Humpback and Blue whales who stop to feed on their migration. Kit noticed that the krill out past the continental shelf and along most of our tows with the exception of the ones conducted in Monterey Canyon were not as "fat and well fed" as the ones within the canyon area itself. Krill over the canyon are in overall better condition due to a localized upwelling feature in the canyon that brings nutrient rich deep water up to increase the productivity of phytoplankton.

Kit Clark identifies various zooplankton caught in a Bongo net to Charlotte Hill.

Kit Clark strains zooplankton from the bongo nets to evaluate the displaced volume of organisms trapped while towing.

A general list of zoo plankton collected:
Euphausiid (krill) and Copepods
Pteropods (sea butterfly)
Heteropods (Gelatinous Molluscs)
Velella velella (By the Wind Sailors) a surface traveling creature
Doliolids and Salps
Ostracods
Argyropelecus aculeatus (Hatchet fish)
Atolla (deep water jelly)
Cephalopods
Tomopferiids
Myctophild
Ichthyoplankton
Flashlight fish
Siphonophore
Radiolaria

CTD casts-

Speaking of deep waters, two of the CTD casts were made to 4500 meters. One of the activities I have used with students is identifying water masses in the Atlantic by physical characteristics. We use Temperature-Salinity (T-S) diagram at specific depths to identify water masses based on the density. I was hoping to collect water samples from various depths in the Pacific as well to use in the same activity. In discussions with Dr. Collins of the US Naval Post-Graduate school I learned that the Pacific is less uniquely identifiable than the Atlantic. The layered masses of the central Atlantic would not be as easily recognizable. We spent several days discussing the formation and circulation of deep waters in the Pacific in an attempt to understand the interaction between the atmosphere, chemistry, and surface current contribution to deep water mixing. From these discussions I learned that there are actually three sources of North Atlantic Deep Water (NADW). Furthermore, I learned that the mixing of NADW and Antarctic Bottom Water (AABW) in the Pacific created what is known as Common Deep Water (CDW) and that it is more difficult to actually identify Pacific water masses that I originally understood.

The bottles on the CTD rosette. In the foreground is the bottle containing 4380 meter water at 1.518 degree water, the background contains the water from near the surface at 14.169 degrees.

The two casts were made at the farthest points from shore with the collection of water in the bottles to be used specifically for evaluation of dissolved oxygen and nutrients. Dr. Collins asked for my input to for the overall bottle collection depths to ensure that I would have a set of samples from similar depths to match the Atlantic set I use.

The Pacific deep water cast bottles are from the following meter depths for the first cast: 4462, 4000, 3500, 3000, 2500, 2000, 1500, 1000, 7500, 500, 250, and 19

The Pacific deep water cast bottles are from the following meter depths for the second cast: 4380, 4000, 3500, 3000, 2500, 2000, 1500, 1000, 7500, 500, 250, and 14

The Atlantic deep water samples that I already have are from the following meter depths and associated water masses: 4000 (Antarctic Bottom Water), 2000 (Antarctic Intermediate Water), 1000 (North Atlantic Deep Water), 500 (Mediterranean Intermediate Water), and 100 (North Atlantic Central Surface Water).

Once the CTD was brought on deck, I noticed that the bottles containing the deepest water, although insolated showed condensation. Even though I understand that the temperature of the deep water is considerable colder than sea water at the surface, the ability to observe this drove the point home. Erich Rienecker of MBARI suggested that I feel the water around the rosette of bottles to really understand the temperature difference. This was the first time I had the opportunity to work with the CTD as I was working specifically with the Bongo nets. The bottle from 4380 meters had a temperature of 1.518 degrees Celsius and the surface bottle (14 meters)

had a temperature of 14.169 degrees Celsius. This visual and tactile experience made a difference to me.

Another activity that the MBARI folks made sure that all of the science team and MCARTHUR II crew members had the opportunity to participate in was to send a decorated Styrofoam cup down in a mesh bag to “squish” it, or remove the air as a result of the pressure differential. Science team members spent quite a bit of time decorating cups. We even sent down a cup decorated with Flat Stanley.

Charlotte Hill of the US Naval Academy prepares a cup to be sent down to -4500 meters with the CTD.

NOAA Teacher at Sea Elsa Stuber prepares a cup to be sent down to -4500 meters with the CTD.

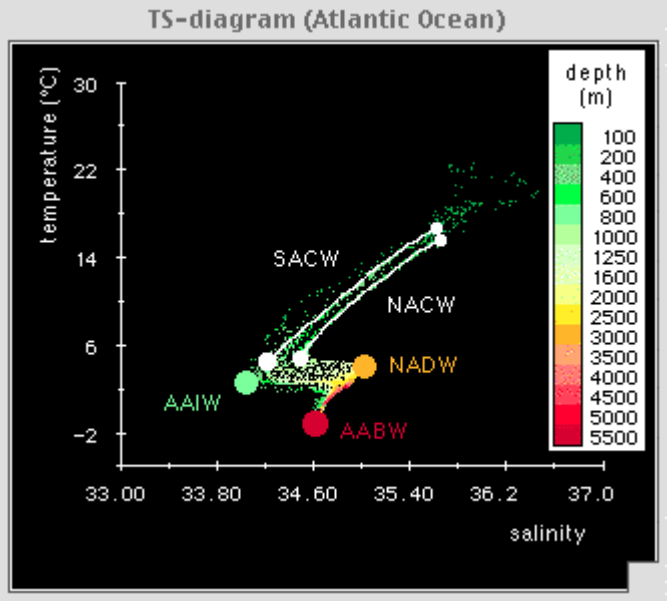
The CTD on the fantail of the MCARTHUR II with Styrofoam cups in the green mesh bag for the second deep cast of -4500 meters.

This is a “regular” Styrofoam 10 oz cup and the two cups that returned from -4500 meters. The far right cup has a Flat Stanley drawn on it.

Addendum: Glossary of terms

Zooplankton – Wikipedia has a good general description of most of the organisms listed. I found specific information as I used Google for the unique species, although some of the more specific critters were really hard to find. For further information visit: Scripps Institution of Oceanography http://www-sioadm.ucsd.edu/plankton/. A census of plankton is being conducted through the Census of Marine Life http://www.cmarz.org/.

Temperature- Salinity (T-S) diagram identifies lines of constant density in g/cm3.



AABW = Antarctic Bottom Water
NADW = North Atlantic Deep Water
AAIW = Antarctic Intermediate Water
SACW = South Atlantic Central Water
NACW= North Atlantic Central Water

Water Mass - a body of water with a common formation history. "This is based on the observation that water renewal in the deep ocean is the result of water mass formation in contact with the atmosphere, spreading from the formation region without atmospheric contact, and decay through mixing with other water masses." from http://www.es.flinders.edu.au/~mattom/ShelfCoast/notes/chapter10.html

Flat Stanley – A character from a story by Jeff Brown who has adventures as a result of being flattened by a bulletin board. Classes read the story, send out their versions of Stanley to friends and associated with a scrapbook to record his adventures. See: http://www.flatstanley.com/