NOAA Teacher at Sea
Diana L. Griffiths
Onboard UNOLS Ship ROGER REVELLE
June 22 – 30, 2005

NOAA Teacher at Sea: Diana L. Griffiths
UNOLS Ship ROGER REVELLE
Mission: Recovery of WHOTS-2 mooring and deployment of WHOTS-3 mooring
Day 2: Friday, June 23, 2006

Interview
Dr. Roger B. Lukas
Professor of Oceanography
Dept. of Oceanography and Joint Institute for Marine and Atmospheric Research
University of Hawaii at Manoa

After taking a CTD sample earlier this afternoon, I spoke with Dr. Lukas, the research scientist on this cruise who is leading the recovery and replacement of the mooring components below the WHOTS-3 buoy. The following is a summary of our discussion.

Dr. Lukas encouraged to me to communicate to my students how imperative it is to set up means of continually confirming the accuracy of scientific data. The data from the mooring, for example, is compared with six or seven different profiles in order to verify the accuracy of its data and to determine when an abnormal reading has occurred (i.e. a sensor breaks or fishing lines are caught in an instrument).

Dr. Lukas, aboard the REVELLE collecting water samples from the CTD.

Organisms both in the sample and in the surrounding water can shift the conductivity calibration in a CTD (Conductivity Temperature Depth) instrument. Therefore, the calibration of these instruments must be constantly checked and monitored. Throughout the day today at two-hour intervals, Dr. Lukas has been sending down CTD's that provide a continuous profile of the salinity and temperature of the ocean from the surface to the maximum depth of the cast. There are sampling bottles on the rosette of the CTD that close at a depth of 10 and 200 meters. The water from these samples is brought to the surface and is used to calibrate the conductivity of the CTD. The conductivity readings (which are used to determine salinity measurements) are compared to readings taken from the sampled water via an analytical instrument called an Autosal. The Autosal is located in a lab on the ship near the main science lab. This instrument is contained in a water bath for stabilization and is kept in a temperature-controlled room. Any atmospheric pressure variations that might occur during the Autosal conductivity tests do not have enough of an effect on the conductivity determinations to create inaccuracies in salinity readings. The Autosal itself is calibrated against standard seawater which is quite expensive ($55 for a small vial) but whose salinity is known to the nearest part per million (ppm).

Salinity, or the number of grams of dissolved salts in a kg of seawater, is detected in one part per million (ppm) and is not taken as a direct measurement. Instead, both the temperature of the sample and its conductivity are measured. This is because the conductivity of seawater is affected by three variables: temperature, pressure, and salinity. Temperature affects conductivity ten times more than does salinity. Basically this means that temperature measurements must be extremely accurate in order to obtain precise salinity measurements. If a temperature reading were to be off by 1°C this would produce an error in the salinity determination by a factor of ten. This would render the salinity measurement entirely useless. Salinity measurements are related to a scale known as the Practical Salinity Scale where, for example, a reading of 35 units would be equivalent to the conductivity of 35 grams of salt in 1 kg of water. The scale is practical because the ratio of ionic chemical compounds in the ocean remains relatively constant.

Ultimately, the salinity readings produced by the instruments contained in the MicroCATs in the mooring are being compared to numerous measurements taken off of the ship via the CTD's profiles. The CTD's readings are being calibrated against water samples taken by closing bottles on the CTD frame at different depths, which are then measured in the Autosal, which is, in turn, calibrated against standard seawater samples. The multiple checks on the temperature measurements taken at sea are not a stringent as those of the salinity readings because the temperature instruments do not have nearly the same rate of calibration drift. Unless they are broken, they will only drift approximately one millidegree per year.

There are different types of oceanographers who study various parameters of the ocean. Dr. Lukas is a physical oceanographer as opposed to one who studies the biological or chemical aspects of the ocean. Physical oceanographers study such factors as current, waves, wind, heat content, temperature, and salinity. However, there is overlap amongst the different areas of science. A chemical determination, such as salinity, can actually be quite pertinent to the physical study of the ocean. Alterations in salinity correlate with changes in density. Variations in density gradients across the ocean cause flow or ocean currents. Other factors that affect the ocean currents include the depth of the water; wind, which drags water along; and the rotational motion of the earth. For example, if a current is moving northward, the rotation of the earth causes causes an apparent force to affect the water thus drawing it eastward and changing the direction of the current. Additional smaller factors that affect the current include turbulence in both the air and the sea. Turbulence is chaotic eddying motions that cause mixing amongst masses of water at different temperatures and salinities.

Dr. Lukas has a Bachelor's degree in Mathematics, and a Masters and PhD in oceanography. The work that he has done in earning his PhD gives him the ability to lead a research project, such as the Hawaii Ocean Time-series (www.soest.hawaii.edu/HOT_WOCE). However, Dr. Lukas noted that one does not need a PhD to be a vital part of a research team. We have people working as part of the science team on this cruise who are at the Masters, Bachelors and Associates degree levels.

When asked about what he likes about his work, Dr. Lukas told me that he enjoys several aspects of his job. He enjoys going to sea and the fact that his work leads him to discover new things. He also values the freedom that his occupation affords him. If he is successful in obtaining funding for a proposal, he has the freedom to carry out a project of his own design. His work has taken him to a variety of places including Papua New Guinea, the Philippines and the Bay of Bengal!

It became very evident in talking with Dr. Lukas that he is devoted to this work that he so enjoys. He puts many hours into his profession. As he stated, he and Dr. Weller have continual "time and a half" jobs. His occupation involves many different aspects including being at sea, gathering data and preparing for such science cruises. He spends large chunks of time working with his research group of eight members. This work involves managing and training the members of the group as well as dealing with various personnel issues. Approximately 20% of his time is spent teaching at the graduate level. This is a smaller percentage than many of his colleagues. Dr. Lukas spends time developing projects and proposals and a significant amount of time completing the science for those that are funded. This science includes analyzing data, writing papers, attending meetings, etc. Finally, another large aspect of his job is of a more global, community nature. Like many of his colleagues, he reviews the work of other scientists. He is a member of various committees including those that make recommendations to funding agencies. He has numerous meetings each year, some of which require extensive travel. He travels to Washington D.C. several times a year, and has worked to raise awareness in congress concerning global issues relating to the ocean and our environment.

Finally, I asked Dr. Lukas if he had any advice for students interested in oceanography. He replied that, "There is no such thing as too much math or science!" One of his team members was nearby and commented that although math might seem boring in high school it becomes so important later on. Dr. Lukas confirmed that it is a tool that allows scientists to accomplish a lot. This is clearly evidenced by the work that he is able to complete.