Weekly Update 2: LMG Cruise 11-01 Palmer LTER
07-14 January, 2011

Photo: physical oceanography mooring recovery at LTER Station 300.160 in high seas. Credit: Ken Legg, B-045.

LM GOULD departed Palmer Station at 0800 on 7 January to commence the annual midsummer LTER cruise from Anvers to Charcot Island. For most of the first week we sailed under clear and sunny skies over a mirror-calm sea. Later in the week the good conditions left suddenly, but we continued to work without delay in a high swell and 20-40 knot winds. The first phase of operations was conducted along the LTER 600 and 500 lines in the northern part of the LTER study region. After completing hydrographic and net sampling at the 600.100, 600.200, 500.200, 500.120 and 500.060 grid stations, we successfully recovered the moored time series sediment trap at grid reference 585.132. This trap was recovered, cleaned up, turned around and redeployed in record time, 5 hours from arrival to departure.

Next, we returned to the Palmer Station region to conduct our first extended process study near grid station 600.040 in the Palmer Deep, and encompassing the foraging area for Adelie penguins breeding near Palmer Station. Here we conducted repeated CTD/rosette and net sampling over a 48-hour period. Meanwhile the Rutgers (B-019), Cal Poly and Delaware teams at Palmer Station deployed Gliders and REMUS AUVs to provide closer surveillance of the

same region. Toward the end of the occupation we conducted several targeted zooplankton tows with guidance from the satellite tags deployed on Adelie penguins by the B-013 group at Palmer Station, and interpreted by Kristen Gorman aboard the vessel. Thus, our process experiment involved close coordination among many groups both from PAL LTER and also several outside collaborator groups.

Later in the first week we moved south to the 400 and 300 lines and occupied grid stations 400.100, 400.040, 300.100 and 300.040. Here we also successfully recovered four physical oceanography moorings at stations 400.100, 300.160, 120 and 100. These mooring operations were each accomplished in about 30 minutes from arrival to recovery, and in high seas. Captain Joe Abshire, MPC Stian Alesandrini and their teams deserve high praise for this heroic effort (see photo).

Individual reports from the LTER component and guest projects follow with further details.

B-013: Seabird Component. Project Leader: W.R. Fraser. Field Team Members: Shawn Farry (Field technician) and Kristen Gorman (PhD student).

The past week of cruise work for the B013 predator component consisted exclusively of at-sea bird surveys along the 600, 500, 400, 300 lines, and currently the 200 line. During our first process study at 600.040 we conducted over 17 hours of continuous bird observations from the bridge of the LMG between 06:00 and 23:30 each day of the process study. In addition, during this process study, we were able to coordinate ship zooplankton sampling within the location of yearly-averaged high density Adelie penguin foraging at the head of the Palmer Deep submarine canyon. The location of zooplankton sampling was directed exclusively by Adelie penguins outfitted with satellite tags in order to compare the breeding diet of Adelie penguins within the Palmer area with prey availability as determined by zooplankton sampling.

Within the last few days we have begun preparations for our 5 day field camp at Avian Island primarily including packing gear and organizing camp logistics.

B-019: Phytoplankton ecology. Project leader: Oscar Schofield. Field Team personnel: Michael Garzio (MS Student), Bethan Jones (Postdoc), Travis Miles (Tech), Grace Saba (Postdoc), Marie Seguret (Postdoc).

The phytoplankton efforts have revealed increasing productivity rates as the cruise progresses to the south. There is also a strong inshore to offshore gradient of decreasing productivity. The productivity appears to be dominated by diatoms. Fv/Fm measurements continue show that populations have high quantum efficiencies, however severe fluorescence quenching was observed during the daylight hours. The growing data set of inherent optical properties measured by the LTER will aid modeling the fluorescence quenching processes by allowing the radiative transfer equations to calculate the propagation of light down into the water column. Our group is also helping to coordinate glider operations for both the Gould and Palmer Station. The RU05 glider completed its spatial survey of Palmer basin as part of process station 1. This glider was recovered by the LM Gould. This glider was complemented with three gliders that were deployed in the local area by the research teams Palmer. The deep water glider launched at Palmer continues to make progress down the coast towards Rothera.

Current efforts are focused on developing a reasonable power budget to figure out the lifetime of the glider flight. The deep water glider did reveal a small filament of warm water south of Palmer at depth that appears to have the hydrographic characteristics of the Antarctic Circumpolar Current near the Palmer basin.

B-020. Zooplankton Component. Project Leader: Deb Steinberg. Field Team personnel: Joe Cope (Chief Tech), Kate Ruck (M.S. student), Caitlin Smoot (undergraduate intern), Kim Bernard (post-doc), Lori Price (M.S. student).

In the first week, we completed a number of full stations on the LTER 600, 500, 400, 300, and 200 lines and concentrated our operations at a 3-day process study station (station 600.040) in the Palmer deep canyon near the Adèlie penguin foraging area. At each station we performed a pair of net tows for larger macrozooplankton (e.g., krill, salps) and mesozooplankton (e.g. copepods). Macrozooplankton tows were sorted on board. We also took samples at selected stations for zooplankton lipid and gut fluorescence analyses. At the process study station we performed our first depth-stratified zooplankton sampling using the MOCNESS (Multiple Opening-Closing Net Environmental Sensing System) to investigate depth distribution of the abundant taxa over a diel cycle. We also performed two dilution experiments to measure microzooplankton grazing; this coupled with gut fluorescence measurements of the larger zooplankton mentioned above will allow us to quantify removal of primary producers by the zooplankton community. We also performed fecal pellet production experiments with krill (stations 500.060-*Euphausia superba*, 600.040- *Thysanoessa macrura*, and 400.040 *E. crystallorophias*) and salps (stations 600.020 and 500.120) to determine their role in flux of organic carbon to the deep ocean. At the process study station we also did some spatial net sampling of the historical penguin foraging area, paired with the Biosonics acoustic towfish. This will be used to calibrate the acoustics and Dr. Moline's Remus AUV which also has acoustics.

An interesting result thus far is we have found salps at nearly every station we have sampled, including inshore, highly productive stations. This has not historically been the case, but does support our hypothesis of salps increasing in numbers over the shelf and southward in the grid due to 'climate migration'.

The crew/ RPSC support on the ship continues to be excellent. We are having some technical problems with the winch used for the tows; it is not possible to get the wire speed down to less than 20 m/ min. on the way up. We need slower wire speeds (10 m or less) for the MOCNESS tows, so 20 m/ min is workable but not ideal. This is a problem the ship has been aware of and has had engineers out to assess, but the problem persists.

B-045: Microbial biogeochemistry. Project leader: Hugh Ducklow. Field Team personnel: Matthew Erickson (Chief Tech), Zena Cardman (Volunteer), Will Daniels (Volunteer), Kuan Huang, (PhD student), Kenneth Legg (Volunteer).

Our group collected water from every depth sampled at all CTD stations along the 600 to 300 grid lines in the first week of operations. We successfully recovered the moored, time-series sediment trap. We had failed to recover this trap last January (LMG 1001) and a replacement was subsequently deployed by Maggie Waldron and Dan Whiteley last March, with great

cooperation in the pinch from NSF, RPSC, ECO and Palmer Station. So it was a big relief to get it back this year! Preliminary visual inspection revealed visible particulate material in all trap cups, a small flux peak in November and very low flux in winter.

In addition to routine sampling of nutrients, dissolved oxygen and dissolved organic and inorganic carbon, we are analyzing live microbial populations by flow cytometry immediately after each hydrocast. Cytometric counts of autofluorescent populations (phytoplankton) and SybrGreen-stained cells (heterotrophic bacteria and archaea) show general enrichment at the surface and declines with depth, with subsurface maxima in more stratified areas. The two off-shelf stations (600.200 and 500.200) had very low abundance. We are also conducting net growth incubation experiments to reveal the balance between microbial growth and grazing, and supporting other investigators in the B-019 and B-020 groups by analyzing experimental samples.

Leucine incorporation rates ranged from 70-100 pmol leucine incorporated per liter per hour at surface, inshore stations to less than 5 at the off-shelf stations. There is a general correspondence between temperature and incorporation rates within stations, but some stations with colder surface waters had high incorporation rates in bloom conditions.

B-114: Ecological Physiology of Marine Crenarchaeota Populations from the WAP. J.T. Hollibaugh, University of Georgia and Lihini Aluwihare, Scripps Institution of Oceanography

We are collecting at two depths, the temperature minimum (70-120 m, depending on station) to sample Winter Water and 400 m (or 10 m off the bottom at shallow stations) as a depth representing the Circumpolar Deep Water (CDW). To date (14 January, 2011), we have collected 20 samples for DNA, RNA, biogenic Si, and CRD-FISH enumeration of crenarchaeotes. We have performed 14 ammonium oxidation rate measurements, some of these incubations are still in progress. We have had difficulty measuring ammonium concentrations, in part due to poor reproducibility of the shipboard spectrophotometry. We are freezing samples for subsequent analysis in our laboratory in order to obtain the ammonium data we require. The process station 600.040 allowed us to collect high volume (a few thousand liter) samples for archaeal and bacterial lipid analysis from Winter Water using in situ pumping. We also initiated incubations for cell-specific uptake and incorporation of a variety of organic N compounds and for measurements of ammonia oxidation rates on these compounds. We collected duplicate high volume samples for metatranscriptomic analysis and took samples for single amplified genome analysis. In addition, we collected a 200 L sample from 400 m for DOC isolation using PPL resin. The extracted DOC will be chemically and isotopically characterized for comparison to samples collected at other locations. Analysis of all of these samples is to follow at in the laboratories of the PI responsible for them.