Logistics Planning Outline for the 2010/2011 NBP/ODEN 2-boat Operation

In an attempt to coordinate the science between the ODEN and the NBP for next year's 2-boat operation, the information below will be compiled and passed out during the planning meeting in November.

Principal Investigators: Kuria Ndungu
Project leader onboard NBP/ODEN (if other than P.I.):
Participants onboard : Kuria Ndungu Student or technician Total: 2

Please give a brief cruise synopsis. Include the following: research objectives and proposed cruise track.

Primary productivity and the associated uptake of carbon over large areas of the Southern Ocean including coastal Antarctica, is thought to be co-limited by the micro nutrient iron (Fe) and light. The main aim of the proposed project will be to study the source(s) of Fe and other trace metals in the virtually unexplored Amundsen Sea and how its (Fe) chemical speciation affects biogeochemical processes and phytoplankton dynamics in the region. We will accomplish this by determining Fe speciation and lead (Pb) isotope signatures on sea and glacial ice meltwater to help understand the sources of atmospheric metals to sea ice and, via seasonal melting, to the Amundsen Sea Polynya. The study will be based on two major hypothesis:

(i) That aeolian deposition is a significant source of Fe that fuels the high productivity observed at ASP and that organic complexation dominates Fe speciation in sea-ice and glacial-ice melt water helping keep Fe in solution. This plays a major role on its (Fe) cycling and bioavailability.

(ii) Lead in the Amundsen surface sea-ice and glacial-ice and Amundsen Sea Polynya water will have a South American industrial aerosol signature. Thus Pb isotope data can be used as a tracer to elucidate if South America is a source of Aeolian transport of other trace metals including Fe to the Amundsen sea. The information obtained from the study will help us understand trace metal input into the Amundsen Sea and to derive potential impacts of climate change on the biogeochemistry of this region. The project will be carried out in close collaoboration with with the Amundsen Sea Polynya International Research Expedition (ASPIRE), an international multidisciplinary team made up of trace metal and carbon chemists, phytoplankton physiologists, microbial and zooplankton ecologists.
Polynyas, are foci for both energy and material transfer between the atmosphere and the polar ocean. The broader aim of ASPIRE is therefore to investigate why and how the coastal Antractic Polynya in the Amundsen Sea is so much more productive than other polynyas, and whether interannual variability can provide insight to climate-sensitive mechanisms driving carbon fluxes there. Thus the source of nutrients, especilly Fe, that fuel the high productivity in ASP is a key biogeochemical question of the multidisciplinary study.

We and members of the ASPIRE groups would join the NBP and Oden in Punta Arenas in November. Upon departure, we expect the ships to transit the Drake Passage and enter the sea ice of the Amundsen Sea region. Our proposed cruise track would take us to the ASP along the most time efficient, sea ice conducive, route across the Amundsen continental shelf. Brief hydrographic stations on the way into the polynya, across the eastern side of the shelf, as close to the deep troughs as possible (see eastern white track on map below) are

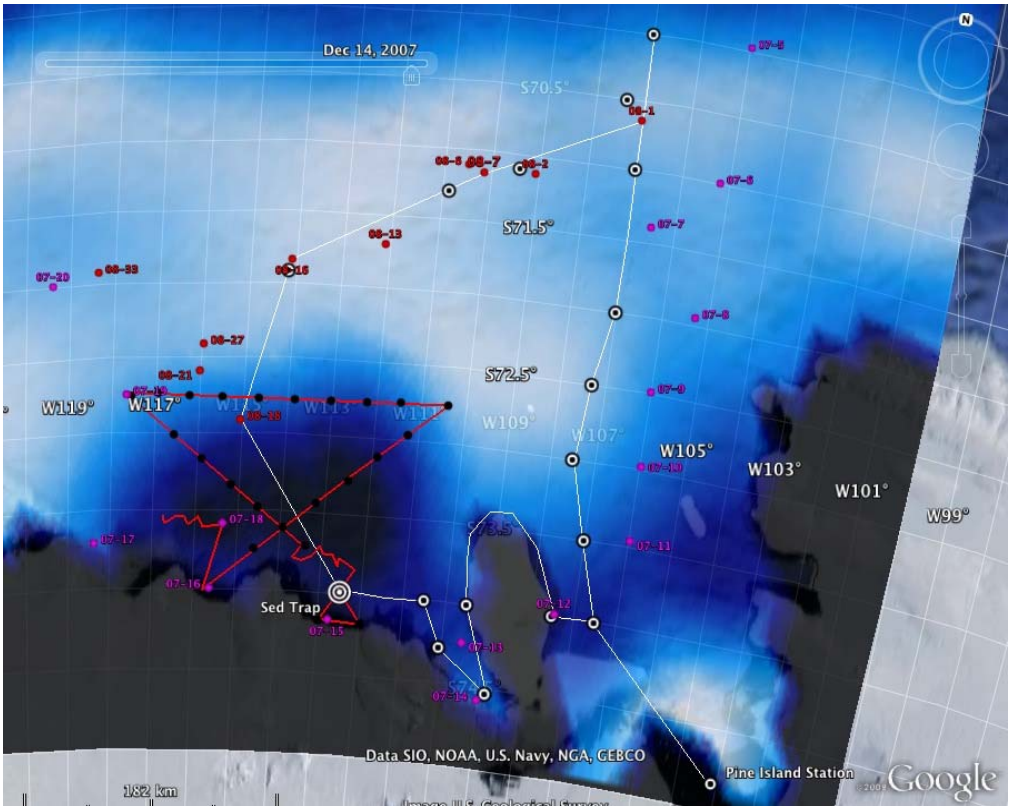
If ice is heavy, we anticipate entering as we did in 2008 and then aim directly for the sediment trap station. We then anticipate 14 days of open water station occupations and sampling.

mment [duck1]: Is this a better to articulate this choice?

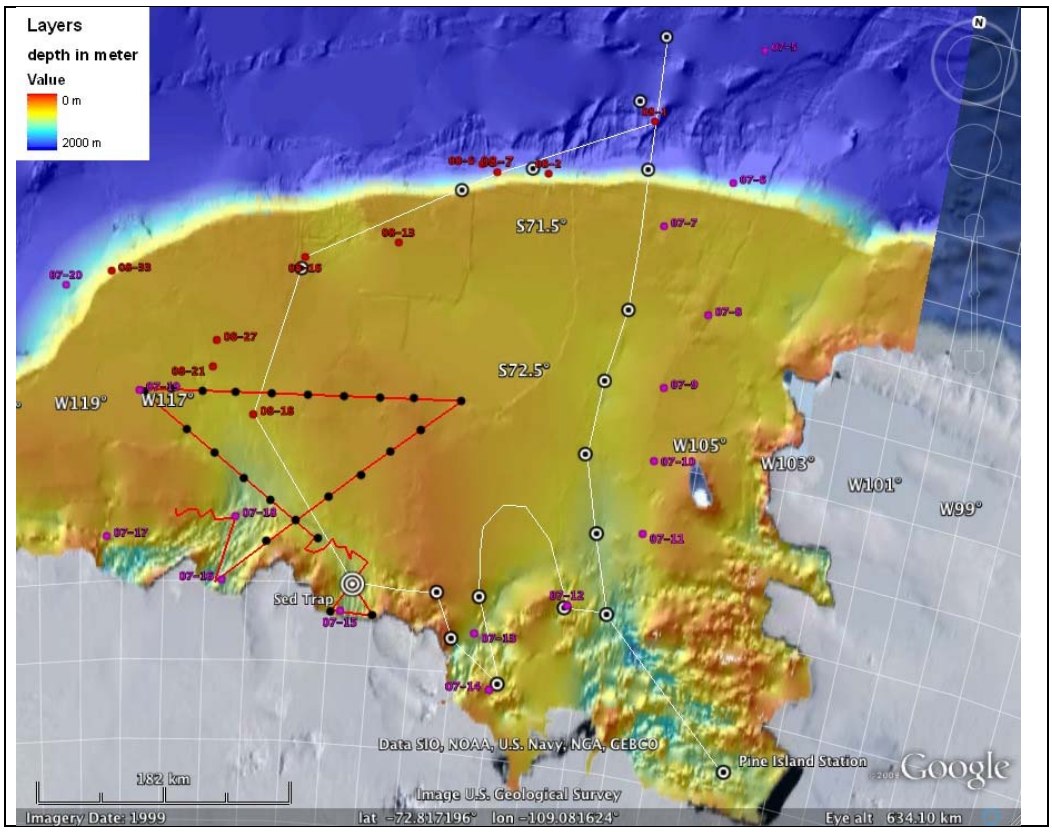
Once in the ASP, our priority would be pre-planned high-resolution hydrographic **transects** through the open water (straight red lines on map below), to detect within-polynya gradients; and

If sea ice conditions allow, and the Pine Island Polynya is open, any extra time should be spent there. Sampling along the ice shelf is also desirable if time allows.

Given that we will only have one cruise to the region instead of the originally proposed three cruises (with interannual variability), we have modified our proposed cruise track to better sample within polynya gradients as follows (red = high priority, white = lower priority), shown with sea ice coverage for 12/15/07. Pink stations are from OSO 2007-08. Red stations are from OSO 2008-09.



Here is the same cruise track with bathymetry to highlight the importance of the trough systems:



Briefly describe sampling methods and major systems and equipment (collection method (i.e standard CTD, plankton nets, MOCness Nets, etc…)

Major logistic considerations for this project are:

- trace metal clean van and metal-clean seawater pump (from ASPIRE project).
- A trace metal clean CTD/rosette system (trace metal clean winch, cable, and rosette- also from ASPIRE project)
  - Trace metal clean water sample bottles (Niskin-X or GoFlo) for trace metal clean CTD casts
  - Trace metal clean surface water sampling towed fish and ancillary supplies
  - Trace metal clean system (trace metal clean winch, cable, and rosette)
  - In situ pumps for large volume filtration (battery powered, self contained)

One of our primary objectives is to determine the sources of iron and other trace nutrients to the phytoplankton of the Amundsen Sea. We would also like to cleanly sample water for Pb and Pb isotope analysis. This requires sampling seawater both in and outside the ASP in a way that will not contaminate the samples with Fe and Pb (using a **Trace Metal Clean (TMC) CTD/rosette system with Kevlar cable and clean winch**). In addition to the ASP, we will sample key water masses across the continental shelf and along ice shelf fronts. We also will deploy a **TMC *in situ* pump** / **towed fish** that requires a boom extending at least 15 ft off the rail to support the PI-supplied sheave, line, and tube.
own).

Sampling methods and sites when ship in motion

Site/area/transect	Type of sampling to be performed, volume of H_2O collected
Transect to/from/in Amundsen Sea Polynya	Underway seawater intake
Transect across the Drake Passage	Underway seawater intake

Sampling methods and sites from stationary ship

Sampling site	Type of sampling, weight/volume of samples and equipment, etc.	Time per station
Transect to/from/in Amundsen Sea Polynya	CTD Rosette 10 liter Niskin conventional ship's rosette and TMC rosette, in situ pumps	3-6 hr

Sampling method and sites away from the ship, on ice: **NA**

Sampling site	No. of persons	Type of sampling, weight/ volume of samples and equipment, etc.	Time per station

Deployment/retrieval of equipment

Site		Time per station

Which are the most prioritized sampling areas/methods?

Site/area	Method/type of sample	Other info
Amundsen Sea Polynya	CTD Rosette, pumps, nets	Multiple hydro stations (10-20)
Amundsen Sea Polynya	Floating trap deployment	Following drogue, sampling every ~6 hours for 2-3 days
Eastern trough	CTD Rosette	
Ice shelf edge	CTD Rosette	
Pine Island Polynya	CTD Rosette	

The following equipment needs to be installed onboard
(describe in detail, also needed connections to electricity, water, gas etc):

We will set up an electrochemical system (Potentiosatat and electrochemical cell stand) for measuring Fe concentration that requires gas (nitrogen) and stable power (240V)
We will also set up a flow injection system consiting of a pump, electrically actuated valves and fluorescence detector that also requires stable power (240 V)
A UV digestor consisting with a Hg lamp requires 240V mains power

The lab space needed for this project for trace metal analysis (i.e. Fe and Al) will be in the clean tent (ca. 3 m bench space)

Lab space	Wet lab	Dry lab	Bio Lab
Meters of bench space			
Power needs (VA) 220/380 V			
Cold water (yes/no)			
Hot water (yes/no)			
Sewage (yes/no)			
Compressed air (yes/no)			
Gas (yes/no)			
Fume hood (yes/no)			
Sea water intake (yes/no)			
Other (specify)			

Special lab areas needed:

Clean air room	TMC ”tent” will be constructed in forward portion of wet lab

Storage of equipment and samples:

	Space needed (m^2/m^3)
Container	
Freezer -20°C	0.2

The following chemicals, gases or other hazardous substances will be used, including radioisotopes or other substances which may constitute a threat of contamination for sensitive analyses:

Substance	Weight/vol.	To be used for:
Hydrochloric and Nitric, acid	1 liter	trace metal sampling and cleaning
Alcohol (MeOH)	0.5 liter	cleaning
Mercury	Ca 5 ml	polarography

Hazardous waste:

Substance	Weight/vol.	Comments
Acids	5L	SW diluted HCl
Acidic seawater with dilute mercury	1L	From Polarlographic analyzer

Disturbance to or sampling of organisms: **NA**

1. Species (scientific and English name)	
2. Handling/sampling method	
3. Storage or handling onboard	
4. Possible risks to health or environment	
5. Consideration required from the ship/other researchers	Oden – Benthic sampling can be incompatible with trace metal clean sampling.

Cargo to be taken onboard the ship:

The RV/IB Nathaniel B. Palmer will sail from Punta Arenas, Chile to McMurdo Station, Antarctica. All cargo will travel through Pt. Hueneme in the USAP cargo systems. Once

the vessel arrives at McMurdo Station, all cargo including samples will be shipped back via the cargo vessel the *M/V Tern,* unless specific requests are made for -80C samples that require COMAIR shipments due to the lack of -80C freezers on the *M/V tern.*

Type, handling/storage	Weight (kg)	Volume (m3)
Instruments	50 kg	2
Sampling bottles	500 kg	2

Cargo and samples to be taken off the ship:

Type, handling/storage	Weight (kg)	Volume (m3)
-20C frozen samples for speciation	100	0.2

Other support needed onboard Oden(NBP), or in preparation phase:

Nitrogen	20L
Zodiac Support	Yes

Data transfers and email Request transfers for glider data to NBP as part of enhanced bandwidth protocol