Canadian National Committee for SCOR
Comité national canadien pour SCOR

Scientific Committee on Oceanic Research

CANADIAN OCEAN SCIENCE NEWSLETTER
LE BULLETIN CANADIEN DES SCIENCES DE L'OCÉAN

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Contents

OCEAN SCIENCE PROGRAMS

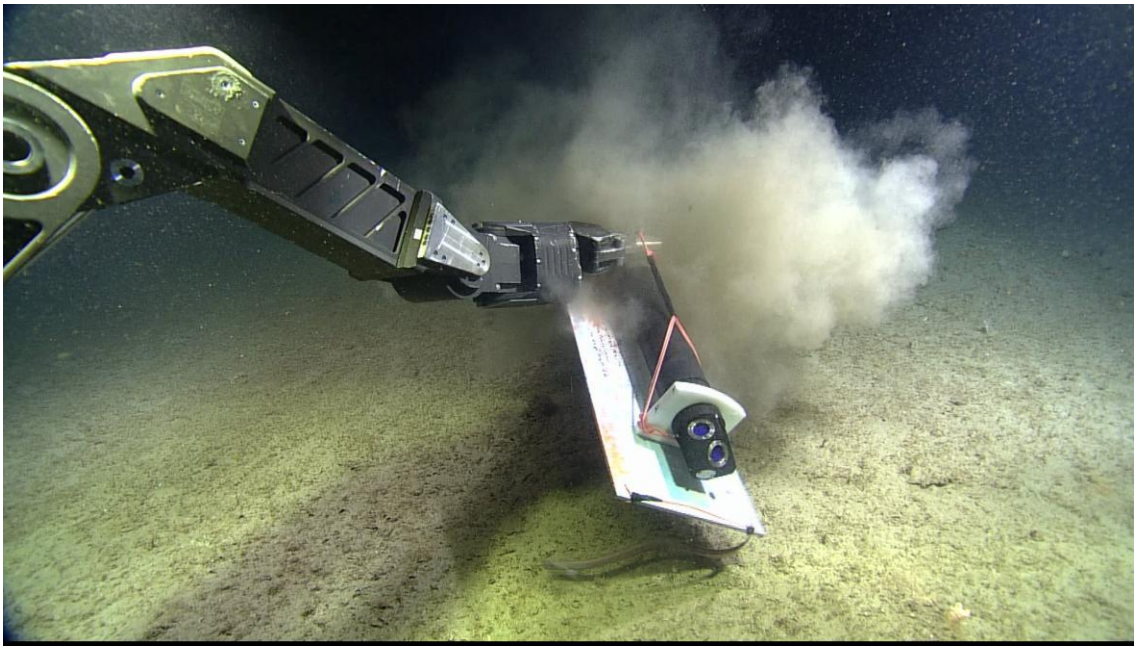
July 2010 ROPOS ROV Cruise to Flemish Cap and Orphan Knoll

submitted by Evan Edinger, Rodolphe Devillers and Len Zedel; Memorial University, St. John's, NL

A three-week scientific cruise on CGCS Hudson with the ROPOS (Remote Operated Platform for Ocean Science) ROV was completed in July 2010, exploring deep-sea coral and sponge habitats on Orphan Knoll and on the east side of Flemish Cap, two large areas in international waters east of Newfoundland. This cruise was the result of a collaboration of researchers from Université du Québec à Montréal, Memorial University of Newfoundland, Northwest Atlantic Fisheries Centre, and the Bedford Institute of Oceanography. Use of the ROPOS ROV enabled visual and interactive exploration at depths up to 3000 m. The voyage had a number of highlights largely covered by media, including the first-ever ROV investigation of a seamount in Newfoundland waters, an un-named seamount southeast of Orphan Knoll, with the summit in approximately 1850 m water depth, and the potential discovery of a number of new coral and sponge species. Scientists who were not at sea on Hudson were able to participate effectively in real-time through use of satellite communication. The satellite feed was also used to stream live video from the ROV to exhibits at the Canadian Museum of Nature in Ottawa and The Rooms (Newfoundland and Labrador provincial Museum) in St. John's, as well as the auditorium of the Bedford Institute of Oceanography. This allowed visitors of the two museums to see in real-time the images collected by the ROV, but also to ask questions in English or French to scientists on-board Hudson.

The main focus of the cruise was to study coral distribution and abundance, associated invertebrate and fish faunas, and the geological origins and ages of the substrates supporting coral habitat. In addition, subfossil corals were collected from the top of Orphan Knoll which, together with water samples collected by submersible pump and CTD, will be used to reconstruct changes in intermediate depth water mass characteristics during the late Pleistocene and Holocene. Two additional goals of the cruise were related to marine acoustics. First, near-bottom multibeam sonar was used to measure high-resolution seabed roughness in relation to coral and sponge habitats. Second, ADCP current meters were deployed in coral habitats in The Gully, at the edge of the Scotian Shelf, to study the effects of corals on boundary-layer turbulence.

Coral and sponge distribution and abundance proved to be strongly driven by the nature of the substrate; large fields of mud were devoid of epibenthic life, places with boulders or bedrock provided habitat to some and rock cliffs were filled with a diversity of corals and sponges. Several of the corals and sponges encountered were unknown to the taxonomists on board the ship, and could constitute previously undescribed species or the occurrence of known species outside of their known range. Fish biodiversity on the Flemish Cap, Orphan Knoll, and seamount was low and was typical of the mid-bathyal depth range. Volcanic features encountered on the seamount included pillow basalt, lava tubes, and possibly eroded lava plugs near the summit. The enigmatic 100-200 m high mounds atop Orphan Knoll, appear to have limestone bedrock cores, surrounded by broken talus and drifted ice-rafted debris and hemipelagic sediment. Additional unexpected geological finds were the discovery of a field of manganese nodules and thick manganese oxide crusts covering bedrock features on Orphan Knoll. Those nodules that are rarely brought back for study in such a good shape will provide a record of changes in ocean composition over the past million years.



Deploying Nortek Aquadopp current profiler at 700 m depth. Using ROPOS there is no need for any mooring hardware so that the instrument can be placed directly on the bottom. An additional capability not available with any other deployment approach is that the exact placement of the instrument can be explored visually before placing the instrument. The navigation of the ROPOS ROV provides sufficient accuracy that the current meter can be found and picked up by the ROV.

Deep-water corals and sponges near the summit of an un-named seamount southeast of Orphan Knoll (depth 1800 m).

New Guides to Calculating Absolute Salinity Available

Adoption by the international community of a new procedure for calculating Absolute Salinity (S_A) was described in the March issue of the Newsletter (No. 49; click). Two simple new publications describe the parameter and its measurement. *What every oceanographer needs to know about TEOS-10 (The TEOS-10 Primer)* introduces the measurement, explains how to calculate it, lists its advantages and disadvantages, and provides a two-page summary of the theory behind it. The Primer was written by Rich Paulowicz, a Canadian member of SCOR WG-127 and co-author of the TEOS-10 standard.

The Primer and a 22-page guide to the on-line computational toolbox are both available from the TEOS-10 website (click).

NEPTUNE Canada's Network Instrumented and Operational

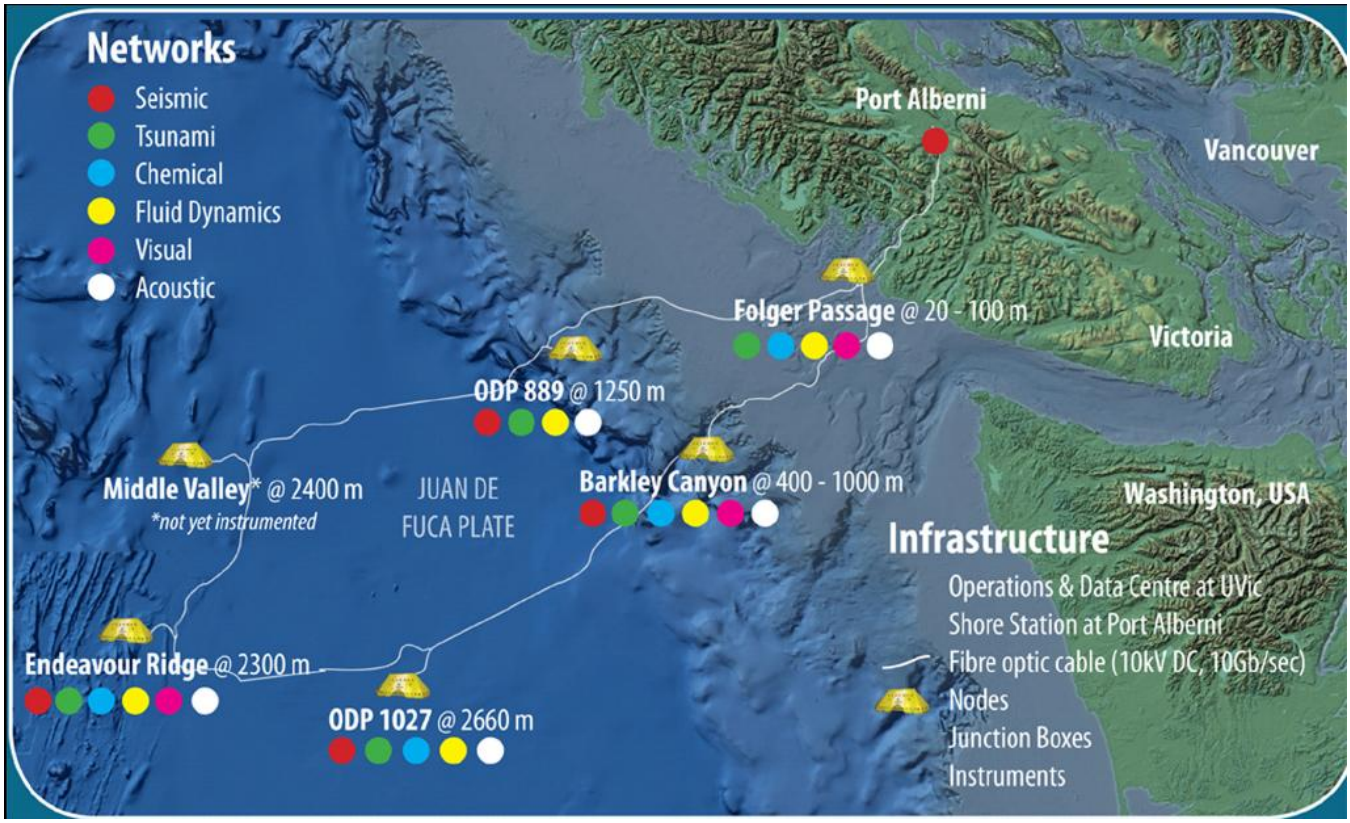
Submitted by Christopher R. Barnes, Mairi M.R. Best, Fern R. Johnson, Lucie Pautet and Benoît Pirenne; NEPTUNE Canada, University of Victoria, Victoria, BC

NEPTUNE Canada (NC) has now installed and is operating the world's first regional cabled ocean observatory, extending from the west coast of Vancouver Island across the northern Juan de Fuca Plate in the northeastern Pacific (see observatory map, next page). The observatory network provides continuous power and high bandwidth to collect integrated data on physical, chemical, geological, and biological gradients at temporal resolutions relevant to the dynamics of the earth-ocean system. NC and the sister VENUS coastal observatory are national facilities managed by Ocean Networks Canada (click) and led by the University of Victoria.

The building of this $100M facility integrates hardware, software, and people networks. Hardware progress includes: installation of the 800km powered fiber-optic backbone in fall 2007 (10kV DC and 10Gbsec communications); technological development of Nodes (Alcatel-Lucent) and Junction Boxes (OceanWorks International); acquisition/development and testing of over 130 instruments; development of mobile instrument platforms such as a 400m Vertical Profiler (NGK Ocean, Japan) and a Crawler (Jacobs University, Bremen); and integration of over a thousand components into an operating subsea sensor system.

Nodes, extension cables, junction boxes, and instruments were installed at 4 out of 5 node locations in 2009. The fifth node, at the most logistically challenging site at the volcanic ocean spreading Endeavour Segment of the Juan de Fuca Ridge, was partly instrumented in September/October 2010. The month-long cruise involved 24 ROV/ROPOS dives and resulted in two of three 6km trans-ridge cables being successfully laid from the node with a total of 41 instruments, two junction boxes, and thee interface adapters deployed. This translates into over 600 additional data streams flowing to the archive (including state of health information); most of them will be searchable through the Oceans 2.0 website interface. Unfortunately, the connection to the Main Endeavour Field was lost later, however over a month of continuous data were captured. Failures of some equipment at other sites also occurred, to be expected in an observatory that has not been developed previously and being installed in hostile and deep environments: specifically, the vertical profiler at Barkley (after a successful 250m profile), the HD camera at Endeavour, and the auxiliary seismic instruments at ODP 1027. These problems appear solvable, and do not detract from the successful ongoing data flow from a range of complex instruments at Endeavour and a sophisticated suite on the new crawler (Wally II). Armed with the experience acquired during the September 2010 cruise, preparations are underway to reconnect the Main Endeavour Field on NC's

next two cruises in 2011, when the installed instruments will be inspected and new equipment added, expanding the potential of the observatory even further.



These successful installations are allowing progress with the initial experiments planned through a series of workshops and international proposal competitions. At inshore Folger Passage, Barkley Sound (17-100m), understanding controls on biological productivity help evaluate the effects that marine processes have on invertebrates, fish and marine mammals. Experiments around Barkley Canyon (400-1000m) allow quantification of changes in biological and chemical activity associated with nutrient and cross-shelf sediment transport around the shelf/slope break and through the canyon to the deep sea. There and north along the mid-continental slope (ODP 889 site at 1250m), instruments on exposed and shallowly buried gas hydrates allow monitoring of changes in their distribution, structure, and venting, particularly related to earthquakes, slope failures and regional plate motions. New circulation obviation retrofit kits (CORKs) were installed this past summer by the Integrated Ocean Drilling Program (IODP) near ODP 889 and will be connected to the NC network in summer 2011; another near mid-plate ODP 1027 (2660m) was repaired. These monitor real-time changes in crustal temperature and pressure, particularly as they relate to events such as earthquakes, hydrothermal convection or regional plate strain. At Endeavour Ridge (2200m), complex interactions among volcanic, tectonic, hydrothermal and biological processes are being quantified at the western edge of the Juan de Fuca plate. Across the network, high-resolution seismic information elucidates tectonic processes such as earthquakes, and a tsunami system allows determination of open ocean tsunami amplitude, propagation direction, and speed. The infrastructure has further capacity to allow experiments to expand from this initial suite.

In parallel, software and hardware systems have been developed for acquiring, archiving, and delivering the continuous real-time data through the Internet to the world (about 60TB/yr when all instruments are installed). Data flow is open and free. A web environment (Oceans 2.0) to combine this data access with analysis and visualization, collaborative tools, interoperability, and instrument control is being released progressively. A network of scientists and technicians are contributing to the process in every phase, and data users already number in the thousands from 100 countries. The need for a cyber-infrastructure to support NC's underwater assets is therefore critical. The Data Management and Archiving System (DMAS) serves as an interface between users and the cable observatory to:

- collect, index and archive all data produced by the various instruments on the underwater network
- provide data to users through search and retrieval functions, covering any arbitrary time period, in a 3-D volume of the ocean
- provide the ability for Principal Investigators of experiments to control and manipulate individual instruments (e.g. to change the data acquisition parameters)
- enable the management of underwater resources (power and network bandwidth)
- allow scientists to collaborate in their exploitation of both the underwater assets and of the archived data.

Started in 2004, the DMAS is being developed close to the stakeholders, in-house, using the Agile development methodology to deliver frequent, incremental versions of the functionality. This approach was first applied to VENUS (click) with data flowing since 2006, and subsequently to NC to establish the system specifications, understand the issues, develop the software, and train operations staff on observatory control and monitoring. DMAS is recording data from over 250 individual science sensors (e.g., temperature, pressure, oxygen saturation) as well as from 1250 engineering sensors (mostly reports from the junction boxes). The total amount of scientific scalar measurements received on a daily basis amounts to about 10 million. The number is clearly much larger still for the engineering values, as about 100 million of them are received, parsed, converted and calibrated every day.

With the installation of the backbone cable system, instruments, shore station facilities, and the development of a sophisticated DMAS, NEPTUNE Canada has transitioned from the installation into the operational phase, with a staff expanded to 40 members. The project is destined to transform the ocean sciences and to provide a wealth of new research opportunities and socio-economic benefits. Along with several other countries planning cabled observatories over the next decade, the result will be a progressive wiring of the oceans. The observatory is designed to be expandable in its footprint, in the number of nodes and instruments, and provides a magnificent facility for testing prototypes of new technologies monitored and demonstrated in real time (facilitated by ONCCEE (click). Funding opportunities for further expansion may be possible in the near future with the recent announcement of a new CFI funding competition in 2011-12; details will be explored at a NC workshop planned for April. NC (click) extends an invitation for new scientific, government and industrial participation in experiments, instrumentation, data services, education and outreach.

NC gratefully acknowledges the financial support provided for the installation and initial operations phases primarily from the Canada Foundation for Innovation and the British Columbia Knowledge Development Fund. The Natural Sciences and Engineering Council of Canada, CFI and the BC Ministry of Advanced Education,

together with support for specific aspects from CANARIE and the University of Victoria, have provided funding towards the operating phase. In-kind support and other grant awards have come from many other partners and contractors. The University of Victoria at all levels has been and remains committed to the project in a myriad of ways and for which the project team and its partners are deeply appreciative.

OBIS Canada

Submitted by Nadine Templeman, North Atlantic Fisheries Centre, St. John's NL

The OBIS (Ocean Biogeographic Information System; click) project was established by the Census of Marine Life (CoML; click) in 1997 to help facilitate global sharing of data within the scientific community. As a strategic alliance of people and organizations sharing a vision to make marine biogeographic data from all over the world freely available over the World Wide Web, OBIS is tailored towards global awareness of our oceans and global contribution to knowledge about our oceans. Any organization, consortium, project or individual may contribute to OBIS. Notably, in 2009, OBIS was adopted by the Intergovernmental Commission of UNESCO as an activity under its International Oceanographic Data and Information Exchange (IODE; click).

OBIS provides: i) an avenue for nations to meet their obligations to the Convention on Biological Diversity (CBD; click) through reporting on the biodiversity in their exclusive economic zones; ii) a permanent repository for spatially referenced data on all forms of marine life; and iii) a site where a realm of users can find biodiversity information about all species throughout the world's oceans.

Records in OBIS continue to increase over time, currently standing at 27.7 million (Fig. 1; click). Users can search marine species datasets from all of the world's oceans, identifying biodiversity hotspots and large scale ecological patterns, analyzing dispersions of species over time and space, and plotting species' locations across temperature, salinity, and depth.

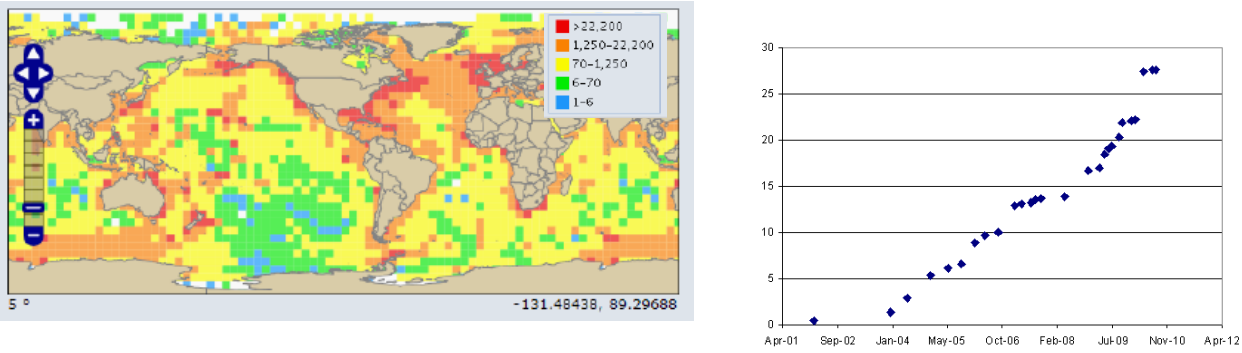


Figure 1. Number of Records available spatially in OBIS; and increase in number (x10^6) of records available in OBIS over time.

Regional OBIS Nodes (RONs) are organizations that have committed to continued support of OBIS through regional/national resources, including serving data online and developing a data-provider and end-user community. Some RONs may also provide tools, other language versions, and/or mirror sites for the OBIS portal. The OBIS Canada RON (click) was developed to facilitate the accessibility of Canadian biological collections through

the internet – it is now a major contributor to OBIS and one of its most active members. OBIS Canada is a national activity under Fisheries and Oceans Canada's National Science Data Management Committee.

OBIS Canada, whose theme is 'Three Oceans of Biodiversity', aims to enhance the quality of Canadian biological data and metadata, including promotion of standardized species names and taxonomic hierarchies. Further information on OBIS Canada and its various collections can be found on OBIS Canada's web page, hosted by the Centre for Marine Biodiversity (click), or by contacting them (click).

Northern Observational Technology

Industry Canada has awarded $7.1 million to C-CORE, located in St. John's, NL, to commercialize the emerging technologies that are used to monitor conditions in Canada's North. The award will create a new Centre of Excellence for Commercialization and Research, to be called LOOKNorth (Leading Operational Observations and Knowledge for the North). Through its engagement of resource industries, researchers, service providers, local communities and government organizations, LOOKNorth will define industry needs by sector, develop business cases for new technologies that address those needs, and generate opportunities for small and medium-sized enterprises to secure a niche market for these monitoring technologies. In bringing together expertise from Canada and abroad, LOOKNorth will position Canada as an international leader in monitoring technologies for northern environments.

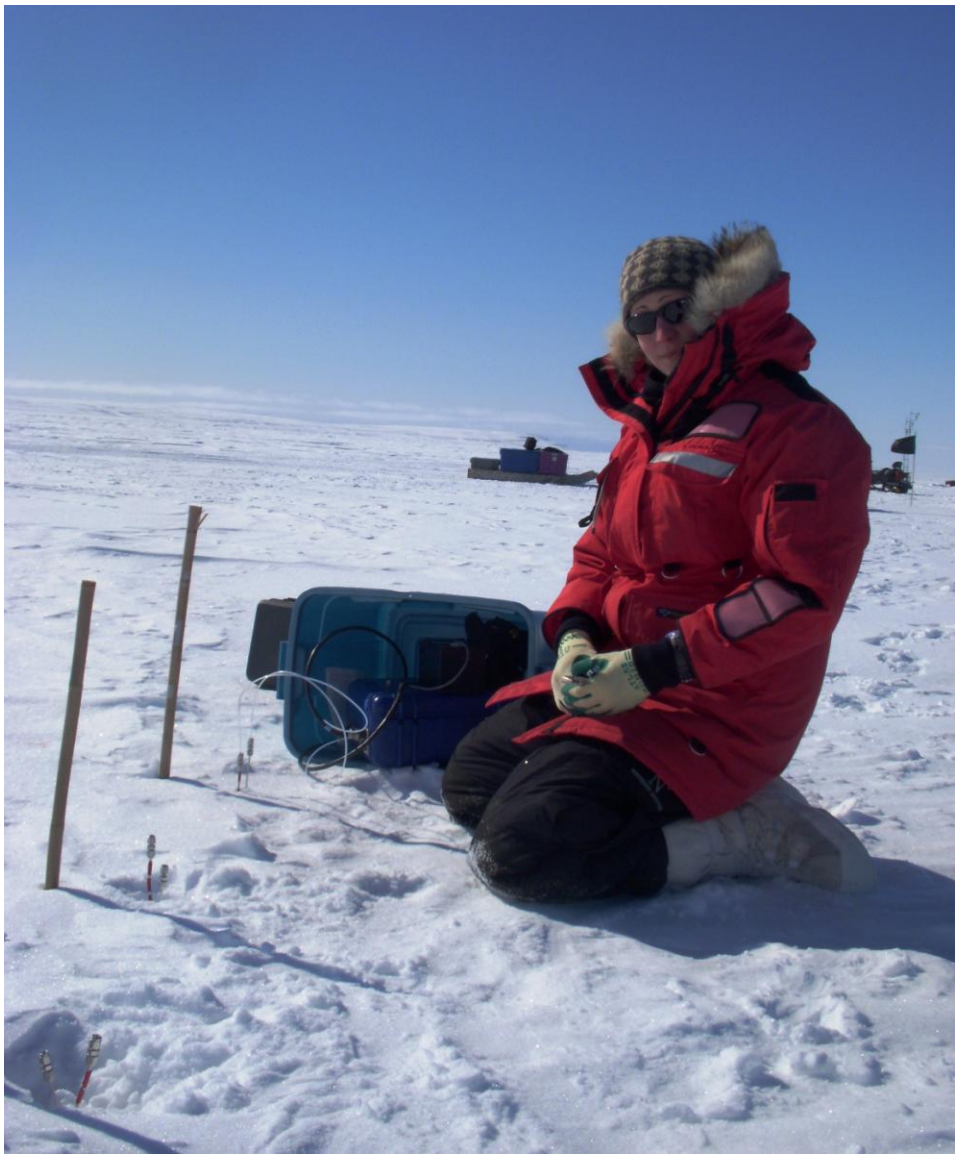
PERSONNEL

Kristina Brown

Kristina Brown holds the two-year CNC-SCOR Scholarship Supplement in Ocean Sciences for 2009 and 2010

Even at midnight, the brightness of the polar sun distorts the brain's sense of time and it is easy to understand the ecological impact of its reemergence after a long, dark winter. It's spring time in Resolute Bay, a small community on the southern tip of Cornwallis Island, smack in the center of the Canadian Arctic Archipelago, Nunavut. Our field camp is situated on a slab of 145 cm thick landfast sea ice that currently fills a small bay west of the hamlet, and we have been travelling here daily by skidoo to monitor the changes occurring in the ice pack, atmosphere, and underlying water column as the spring thaw commences.

We've had a string of calm weather nights, where the blustery wind and blowing snow flurries of mid-day have had a chance to die down, renewing the ability to see past arms length. Under these clear sky conditions the landscape opens up, and one is instantly hit with the overwhelming feeling of smallness in this vast, white desert. Despite the background hum of the diesel generator, which keeps our core program elements - the eddy covariance and meteorological towers – recording 24/7, the image before me is peaceful, serene. A small automated infrared sensor is sitting beside me, carefully measuring the CO_2 content of the *in situ* collectors we have deployed throughout the ice pack. As I disconnect and reconnect to each sampler, I have a new 10 minute window to sit and admire the beautiful snowscape around me.



Kristina measuring the CO_2 concentration within "peepers", in situ semi-permeable gas samplers which have been frozen into the sea ice at the Allen Bay field site. (Photo: Cole Moszynski, June 2010)

Until fairly recently, sea ice had been presumed to act primarily as a cap on the ocean, reducing gas transfer at the ice-water interface simply by providing a barrier to this exchange. However, recent work investigating CO_2 dynamics in ice covered regions has begun to illustrate a much more complex story. Field studies in Canada's Arctic have suggested that sea ice actively mediates CO_2 movement between the ocean and the atmosphere, through complex biogeochemical dynamics involving the interaction between gaseous, aqueous, and solid forms of carbon at different stages of the sea ice life cycle.

As sea water freezes, salts are pushed out of the forming ice crystals and accumulate in a saline solution termed brine. While much of this brine is imparted back to the surface mixed layer, a portion of it is also retained within channels in the freezing ice pack, further concentrating as more and more water is removed through freezing. Such high concentrations of the ocean's major ions can result in the inorganic precipitation of minerals such as mirabilite, hydrohalite, and, most interestingly, calcium carbonate. The precipitation of calcium carbonate not only acts to remove major ions from brine, but it also results in the addition of aqueous CO_2 to solution (Ca^{2+} +

$2HCO_3^- = CaCO_3 + CO_2 + H_2O$), increasing the partial pressure of gaseous CO_2 (pCO_2) in brine channels. These channels then act as conduits for CO_2 diffusion through the ice pack, either to the atmosphere above or to the underlying water below. It has been proposed that this mechanism of inorganic $CaCO_3$ precipitation could serve as a source of CO_2 to the atmosphere and underlying water column in winter, as sea ice forms and grows, and potentially act as a sink of CO_2 in spring, when sea ice has the opportunity to melt, and $CaCO_3$ dissolves. However, the net impact of these processes to act as sources or sinks of atmospheric CO_2 over the seasonal sea ice life cycle is still not adequately characterized.

Through the use of a "tool kit" of naturally occurring geochemical tracers, my PhD research is attempting to investigate the pathways of carbon cycling as sea ice forms, grows, and ultimately, melts. In addition to direct measurements of dissolved inorganic carbon, alkalinity, and pCO_2, I will attempt to utilize stable carbon isotopes as a natural tracer to tease apart the contributions of biotic and abiotic players that can act as both sources and sinks of CO_2 in this multi-component system.

The most challenging aspect of this research is that we are still at the very beginning of understanding the mechanisms involved in sea ice carbon cycles, especially from an abiotic perspective. While it was predicted from empirical models decades ago that carbonate mineral precipitation occurs as sea ice forms, actual examples of precipitates have only recently been isolated from the field, leading to a new series of questions concerning the role of inorganic mineral precipitation in this system. Through the combination of pCO_2 measurements within the sea ice (via *in situ* pCO_2 collectors and discrete samples of sea ice cores and brine), in the surface water below (through niskin bottle samplers), and in the atmosphere above (using eddy covariance CO_2 flux measurements), we are hoping to better characterize the pathways of CO_2 movement within the ice pack, and further understand its response to periods of intense change, for instance during the spring melt. Ultimately, it is hoped that this information will lend insight toward understanding the link between the cryosphere and atmospheric CO_2 concentrations, allowing us to more accurately predict how this system will respond to changing sea ice conditions in a warming polar climate.

Geoff Holland

Geoff Holland was presented with a special medal on the occasion of the Intergovernmental Oceanographic Commission's 50th Anniversary. Associated with the IOC continuously since 1970, he was its Chairman from 1994 to 1999.

Geoff Holland with Wendy Watson-Wright, Executive Director of the IOC. (IOC photo)

Geoff started his career as a specialist in hydrodynamics and aerodynamics in England. After moving to Canada, he spent 32 years with Fisheries and Oceans Canada, where he became Director General, Ocean Sciences and Services. A passionate

believer in the value of scientific cooperation, he has also been Chairman of the London Convention on disposal at sea, the International Maritime Organization, and the Arctic Ocean Sciences Board.

MEETINGS

ESSAS Open Science Meeting, Seattle, 22-26 May

The IMBER Regional Programme, Ecosystem Studies of Sub-Arctic Seas (ESSAS) will hold an Open Science Meeting from 22-26 May in Seattle, Washington. Its theme is: "Comparative studies of climate effects on polar and sub-polar ocean systems: progress in observation and prediction" (click). Marine scientists, economists and social scientists interested in high latitude marine systems and their response to climate change are urged to register and submit abstracts for oral and poster presentations.

The deadline for early registration, abstract submission and application for financial support for early career scientists is **January 15, 2011**.

JOBS & TRAINING

SCOR Visiting Scholars Program

SCOR began a program in 2009 to enlist the services of ocean scientists from the SCOR community, from both developed countries and developing countries, both recently retired and active, to teach short courses and to provide more extended on-site education and mentorship at developing country institutions. Some countries and/or individual institutions have requirements for their scientists to retire at a given age, sometimes as early as 60 years of age. Many retired ocean scientists are still interested in teaching and mentoring, and are supported by pensions after their retirement, so do not need salary support. Some active scientists can also use some of their already-supported work time to serve in a developing country.

Hosting visiting scientists, whether retired or active, can have many benefits to host institutions, such as inspiring, motivating, and informing students and faculty, and leading to future collaborations between the visiting scientist and the host institution.

The idea of this program is to regularly send ocean scientists interested in short-term visits to developing countries. The program is a partnership, with the host institution providing local accommodation and SCOR finding resources to pay for airfares and other local expenses, as necessary. The participating scientists donate their time. The participating scientists might be onsite for as little as two weeks to as long as visa requirements would allow. The Partnership for Observation of the Global Oceans (POGO) implemented a program focused on ocean observations and modeling (click). The SCOR program is complementary with the POGO program.

Applicants may already have selected a host institution or SCOR will help identify hosts. Previous scholar placements have worked both ways. Please contact Ed Urban for further information (click).

Looking for work? Try the CMOS site (click)

GENERAL

It's Nomination Time

The annual nomination process for CMOS prizes and awards has started (click; pdf file). Nominations of interest to the Canadian ocean science community include:

- The President's prize, for a paper or book of special merit
- The J.P. Tully Medal, for significant contributions to Canadian oceanography
- The François J. Saucier Prize, for an outstanding contribution to the application of oceanography
- The Roger Daley Postdoctoral Publication Award, for an exceptional publication

If you haven't nominated someone before, consider making this the year you do.

Volcanic Ash Fuels Pacific Phytoplankton Bloom

In August 2008, ash from the explosive eruption of Kasatochi Volcano in the Aleutian Islands not only snarled air travel in the region, it also fuelled a plankton bloom of unprecedented scale in the North Pacific. Oceanographers had the opportunity to directly observe this event when a Fisheries and Oceans Canada research cruise was in the area at the time of the bloom. In a recent paper in Geophysical Research Letters (click), a team of researchers, including Roberta Hamme and Laurence Coogan from the University of Victoria, Bill Crawford from Fisheries and Oceans Canada, and graduate students Karina Giesbrecht and Damian Grundle, reported that ash from the eruption provided iron to the ocean that plankton needed to grow. Approximately 20% of the world's oceans, including the Alaska Gyre, are deficient in iron. A large increase in ocean colour was observed by satellite and confirmed by ship-based measurements over a wide area of the eastern North Pacific. It was the first directly observed, basin scale high productivity event caused by volcanic ash.

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Previous newsletters may be found on the CNC/SCOR web site.
Les bulletins antérieurs se retrouvent sur le site web du CNC/SCOR.

Newsletter #55 will be distributed on January 27, 2011. Please send contributions to Bob Wilson, wilson@telus.net
Bulletin #55 sera distribué le 27 janvier 2011. Veuillez faire parvenir vos contributions à Bob Wilson, wilson@telus.net

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