VENUS

Victoria Experimental Network Under the Sea

Saanich Inlet

Strait of Georgia

UVic University of Victoria

Fall 2006 Newsletter

The hydrophone array was recovered during the November 2006 CCGS Vector maintenance cruise. Strait of Georgia platform is in the background.

Project Overview

VENUS is a research facility that is supporting coastal oceanography and providing data for long term studies in British Columbia waters. The VENUS network of instruments is dedicated to observing oceanographic processes in our marine environment. The VENUS Data Archive will support data mining and communication among users. Measurements, images, and sound are being delivered to scientists, managers, the public, and a data archive via seafloor fibre-optic cables laid from two separate landfall sites. These cables will deliver power for instruments, lights, and robots, transmit commands from project scientists, as well as deliver information back on the state of our oceans.

The VENUS Project includes two interactive laboratories, one currently installed and operational in Saanich Inlet and a second in the Strait of Georgia to be installed later in 2007.

Saanich Inlet Operations

By Adrian Round

December marks 11 months of operations or over 7,500 hrs of data collection for the Saanich Inlet Array. The data archive now has over 80 million scalar data points and thousands of hours of complex acoustic data. VENUS is fulfilling its primary mandate of providing a real-time, interactive ocean observatory for researchers in Canada and abroad.

For the most part, the instruments deployed on VENUS have performed well. While VENUS has not been immune to connector failures, cable floods or instrument failures, the overall number of failures has been small. The response of the primary infrastructure to the instrument failures has been closely analysed and has helped refine the design of the Strait of Georgia array.

Bio-fouling has not proven to be as significant an issue as was originally thought.

The shore station equipment, fibre optic cable and node have proven to be very robust and reliable. The SIIMs (Science Instrument Interface Module) have, however, suffered from premature failures of the DC-DC converter modules. While these failures have now been attributed to manufacturing defects in the converters, the SIIM power has been redesigned to improve its overall performance and reliability. These redesigns will be included in the Strait of Georgia design and later replace the existing Saanich Inlet SIIM.

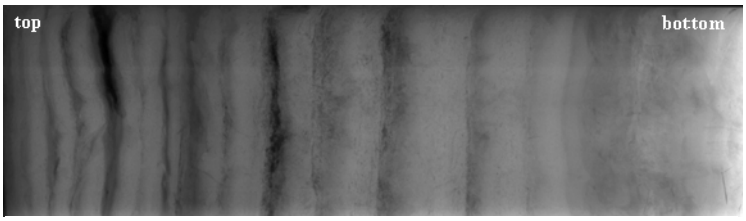
The varied instrument platforms and different support ship platforms have challenged the team during the two scheduled maintenance cruises. By capturing the lessons learned from each cruise, at-sea operations have grown increasingly more efficient. The VENUS and ROPOS Teams have steadily refined the recovery, maintenance, and re-deployment of the VENUS instrument packages, in many cases reducing the time to conduct an evolution by over 50%.

The VENUS team is now focused on the installation of the Strait of Georgia Array and transitioning the team into steady-state operations. The next year will likely bring new challenges as we move into deeper water and a much higher current regime, but I have no doubt that we have an excellent team in place to deal with them.

VENUS Fraser Delta

By Gwyn Lintern, Phil Hill, and Kim Conway

Progress has been made on the two components that make up VENUS Fraser Delta: The Sediment Dynamics Laboratory (SDL) and the Seismic Liquefaction In-situ Piezometer (SLIP) array. Power and communications will reach the SDL through a 5 km fibre optic cable connected to the eastern VENUS Node in the Strait of Georgia. The SLIP array will then connect directly to the SDL.



Radiograph of 10 cm column of sediment collected using a boxcore in the highly active canyon area indicates a sequence of depositional events over a single run-off season.

An agreement to manage the Fraser Delta project was signed between VENUS and Natural Resources Canada (NRCan) in April 2006. In anticipation of this, NRCan had begun earlier that year by acquiring piezometer equipment and information from the Department of Engineering Science at Oxford University. Several scientific cruises have been conducted by NRCan to examine the proposed instrument locations. These have been done in conjunction with researchers from the University of Washington and Western Washington University. One of these cruises was used to determine local sedimentation rates around the river mouth, critical to the deployment of instruments. This work represented a pilot collaboration with marine geologists from the University of Washington's School of Oceanography, who have an interest in collaborating on VENUS science in the vicinity of the Sand Heads Disposal Site. Initial results suggest that sedimentation rates from close to the river mouth are at least 10 cm per year and in places probably greater. For instance, the radiograph shown bottom left, shows repetitive layers in the seabed with graded bedding (upward fining). The depth of Be-7 in this core was greater than 10 cm, indicating that this sequence of depositional cycles was probably generated during a single freshet (run-off from Spring snow melt).

(Above) Lintern and Murphy, NRCan, deploy the Oxford piezometer to test the method both in soft delta front sediment and in stiff river mouth sediment. (Right) Deployment of the Free Fall Cone Penetrometer allowed rapid assessment of the geotechnical properties of the area.

Other cruises have tested the suitability of placing the sediment dynamics lab in an area close to the river mouth, and placing Piezometers on the Fraser Delta slope. Along with 3.5 kHz sub-bottom profiling, work has included piston coring, suspended sediment monitoring, ROPOS submersible ground survey, and deployment of a new tool, the Free Fall Cone Penetrometer (FFCPT) for rapid assessment of geotechnical conditions. Deployments of the Oxford piezometer have been successful in both the soft delta slope sediment, and in the stiffer sediment near the river mouth.

Priority instruments for the sediment dynamics laboratory are currently being delivered. These will be deployed on a platform similar to the ones already in use by VENUS,

scheduled to be built by March 2007. Instrumentation for the Fraser Delta installation was largely funded through the original VENUS grant to the University of Victoria from the Canada Foundation for Innovation (CFI) and the British Columbia Knowledge Development Fund (BCKDF).

The design, build and test of Piezometers have been delayed by decreased availability of qualified bidders, and due to increased costs (largely due to increase in activity by the oil and gas sector). As a result, the number of Piezometers may be reduced. One of these will remain in the highly active delta canyon, and another will be used as part of a comprehensive examination of disposal activities in the Sand Heads designated disposal area. The latter work has been funded by Environment Canada's Disposal at Sea Program. (http://www.pyr.ec.gc.ca/disposal_at_sea/index_e.htm)

Ship and ROPOS time has been scheduled for September and October 2007, for deployment of the Fraser Delta packages, and for maintenance of VENUS Strait of Georgia infrastructure and instrumentation. Interest in this work has continued to grow and now involves possible scientific collaboration with the University of Oxford, University of British Columbia, University of Colorado, University of Washington, Western Washington University, and Environment Canada. More information is available by contacting:
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The Fraser Delta. Important infrastructure is located on low lying and relatively loosely consolidated sediment. This has led to a high interest in slope stability and possible tsunami-generating slides. (VENUS note: This image shows the location and scope of the VENUS Delta Dynamics Laboratory. Strait of Georgia cable location has not been included in NRCan's map.)

Tales from the Tomb: Marine Skeletal Carbonate Preservation

by Mairi Best
Assistant Professor, Earth and Planetary Sciences, McGill University

The most abundant shells and skeletons of marine animals are made of calcium carbonate. When and if these skeletons are buried, they form a large part of the fossil record and are the main way carbon is removed from the surface global carbon cycle into the earth's crust. Understanding the "when and if" is therefore key to knowing how to read the biological history of climate change on earth and how to estimate changes such as marine acidification in the carbon cycle. My lab has pursued research into marine skeletal carbonate preservation (part of a field called "taphonomy" or the "study of the grave") across latitudes and environments to understand what controls net preservation and potential bias. VENUS now provides the opportunity to document occasional events that affect the net preservation of skeletons. For example, using the VENUS camera we observed that squat lobsters and crabs handle dead shells frequently (a phenomenon dubbed "mistaken predation") resulting in scrapes and breakage. During Saanich Inlet's seasonal hypoxia events we can observe what impact these chemical changes have on the crab population and therefore on shell preservation. From these and other processes, between August to November 2006, experimentally deployed mussel shells lost ~4.5% of their weight; mostly the mother of pearl that normally lines their inside. Previous experiments indicate this shell loss won't proceed linearly, however it is a significant amount in a short period of time, raising the possibility that shells in this setting may have a poor chance at final preservation.

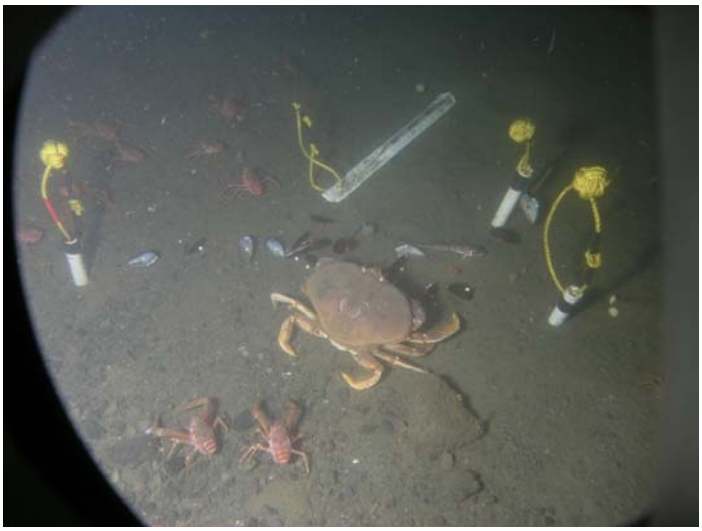
This research assesses processes, agents and rates of modification during shell preservation. This greatly increases our confidence in turning to these records for both short and long-term environmental baselines and in comparing shell accumulations through time as a proxy for tracking climate change or evolutionary patterns. As the burial patterns of skeletal carbonate become better understood at a global scale, it will then be possible to assemble a burial model of carbonate and assess where the major carbonate sinks are, thereby clarifying a poorly understood part of the carbon cycle.

Interior before

Interior after

Exterior before

Exterior after


Looking through the VENUS camera in Saanich Inlet: crab mangling the shells.

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