Monitoring the Dynamics of Gas Hydrate Deposits and Hydrothermal Discharge using the NEPTUNE Undersea Observatory Network

S. Kim Juniper
Ocean Networks Canada
University of Victoria
Email: kjuniper@uvic.com

ABSTRACT

Ocean observatory technologies permit uninterrupted, real-time observation of dynamic seafloor environments such as gas hydrate deposits and hydrothermal vent fields that are of both scientific and economic interest. Such observations enable new discoveries of linkages between physical, chemical and biological processes and could permit continuous monitoring of environmental variables during mining operations. Ocean Networks Canada operates the NEPTUNE and VENUS cabled observatories in the Northeast Pacific Ocean. The offshore NEPTUNE observatory supports instruments at two gas hydrate sites on the continental margin off Vancouver Island, and in the hydrothermal vent fields of the Endeavour segment of the Juan de Fuca Ridge.

The primary focus of the gas hydrate field observations is to understand the dynamics of the growth and stability of outcropping and sub-seafloor hydrate deposits. Outcropping hydrates at 840 m depth in Barkley Canyon have been monitored for the past 3 years with a mobile instrument platform known as Wally, which is operated over the Internet by a research group in Germany. This tracked vehicle carries standard oceanographic sensors, acoustic current metres, cameras and methane sensors. Data indicate a relationship between degassing of hydrates and tidal currents. In 2012-2013 two high-resolution sonar towers were added to the hydrate field to provide precision tracking of Wally and to monitor volume changes in the outcropping hydrate mounds. A large subsurface hydrate deposit occurs at the Clayoquot Slope site, where bottom depth is 1260 metres. Monitoring instrumentation is currently being established at this location. Gas bubble release from this deposit is being monitored by a sector scanning sonar mounted on a

seafloor tripod. New instrumentation is being developed for sub-seafloor monitoring in boreholes. In May 2013 the scientific drillship JOIDES Resolution installed a SCIMPI (Simple Cabled Instrument for measuring Parameters In-situ) sensor string in a shallow borehole at this site. Data (temperature, pressure, resistivity) from this autonomous deployment were recovered by ROV in September 2013 and a new data logger was installed. Several deeper, cased and sealed boreholes, previously established by International Ocean Drilling Program, will be instrumented with tilt metres and temperature sensors in 2014 or 2015.

Instrumentation at the Endeavour hydrothermal fields (2200-2400 m depth) will be expanded over the next 3 years. Current instrumentation is concentrated in the Main Endeavour hydrothermal vent field, along with a wider array of seismometers and water column moorings. Within the vent field, the Ifremer Tempo-mini camera and chemical analyzer monitor low temperature vents and their associated fauna on a single point on a large sulphide edifice. Aggregate hydrothermal discharge from this same edifice is monitored by the Cabled Observatory Vent Imaging Sonar (COVIS), which acoustically images vent plumes. COVIS creates acoustic images of the plumes that buoyantly rise from high-temperature black smoker vents and lower temperature diffuse flow discharging from the surrounding seafloor. These images can be used to determine flow rate and volume flux of the plumes and the area of diffuse flow. Also on this same edifice a Benthic and Resistivity Sensor (BARS) instrument measures temperature and resistivity of high temperature vent effluent, a short-period seismometer and Remote-Access water Sampler (RAS) for sampling the seawater above the vent. A newly funded project will essentially triple the instrumentation on the Endeavour Segment, adding replicate instruments in the Mothra and High Rise hydrothermal fields. Installation of new instruments will begin in the summer of 2015.