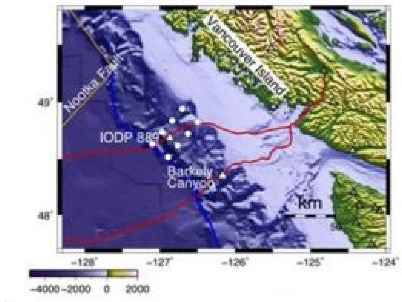
First Real-Time Seafloor Earthquake Observatory



An interdisciplinary project led by Woods Hole Oceanographic Institution (WHOI) geologist Jeff McGuire, an expert in global earthquake seismology and geodesy, and John Collins, director of WHOI's Ocean Bottom Seismometer Lab, will build and install the first seafloor geodesy observatory above the expected rupture zone of the next great Cascadia earthquake. The project is being facilitated by a grant of USD1 million from the W. M. Keck Foundation.

One of the most dangerous faults in North America is the Pacific Northwest's Cascadia fault, an offshore, subduction zone fault capable of producing a magnitude 9 earthquake that would damage Portland, Tacoma, Seattle, and Victoria, British Columbia, and generate a large tsunami. There are currently no instruments installed offshore, directly above the fault, for measuring the strain that is currently building up along the fault.

The Cascadia subduction zone is a very long sloping fault that stretches from mid-Vancouver Island to Northern California. It separates the Juan de Fuca and North American plates. For many years, according to conventional wisdom, the Cascadia subduction zone slipped without earthquakes. In the last thirty years, geologists have uncovered sedimentary records as well as historical records in Japan showing that the fault repeatedly had these huge earthquakes with big tsunamis.

Cascadia's last big event occurred in 1700 and was likely very similar to the March 2011 Japanese earthquake - a magnitude 9 quake and tsunami that travelled across the Pacific. This similarity is foreboding for earthquake scientists, as a key scientific lesson of the Japanese earthquake has been that the standard datasets collected onshore are completely inadequate for characterising the upcoming ruptures on an offshore subduction zone thrust fault.

WHOI president and director Susan Avery expects that the real-time data flowing from the fault on the seafloor will advance the understanding of earthquakes and can help city planners and emergency response managers.

One key limitation in the seismic hazard estimation for subduction zones is the use of geodetic data recorded onshore, primarily GPS data, to determine the extent to which offshore faults are locked and building up strain for the next big earthquake. GPS can detect surface motion to unprecedented precision, a fraction of a millimetre per year, but land-based GPS is too far away from offshore faults to be sensitive enough to that motion.

McGuire and Collins will install tiltmeters at a location approximately 4 kilometres above the Cascadia subduction zone thrust interface. Tiltmeters are standard instruments on land used at most volcano observatories. They also can record slow movements, what seismometers can't do.

The tiltmeters will be located within a 300 metre-deep borehole, a study site established by the Integrated Ocean Drilling Program, and will take advantage of an existing seafloor cable infrastructure, NEPTUNE Canada, enabling immediate access to the data collected by the instrument. The instrument array should be installed and returning data by summer 2013.

If such a data stream had been available in real time from the Japanese subduction zone in the days preceding the 11th March 2011 quake, the scientific community might have known that the potential for a large earthquake was very high because the fault was already slipping slowly.

McGuire says the co-location of the instruments in the IODP borehole, where scientists study the fluid pressure in the Earth, will also enable the scientists to collaborate across disciplines in new ways.

He said part of the reason to install a tiltmeter in a borehole is because of interesting signals collected in boreholes in the past.