Scientific Rationale for AUV *Sentry* in Guaymas Basin

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We are proposing to employ the AUV *Sentry*, build and operated by the Woods Hole Oceanographic Institution, for a mapping and photomosaic survey of the Southern Guaymas Trench and its adjacent regions during our upcoming Guaymas cruise with *RV Atlantis* and *HOV Alvin* (scheduled for Sept 6 to 22, 2016). *Sentry* is operated during the night so that it does not interfere with Alvin dives during the day; bunk space for *Sentry* personnel can be accommodated. Sentry brings the following capabilities to the cruise:

1. Mapping: *Sentry* can produce high-resolution bathymetry at a rate of ~1km^2/hr. In addition (and concurrently) it can collect sidescan sonar backscatter which is useful for identifying hard bottom (e.g., carbonate) among the sediment and subbottom chirp that can penetrate 10s of m in this type of sediment.

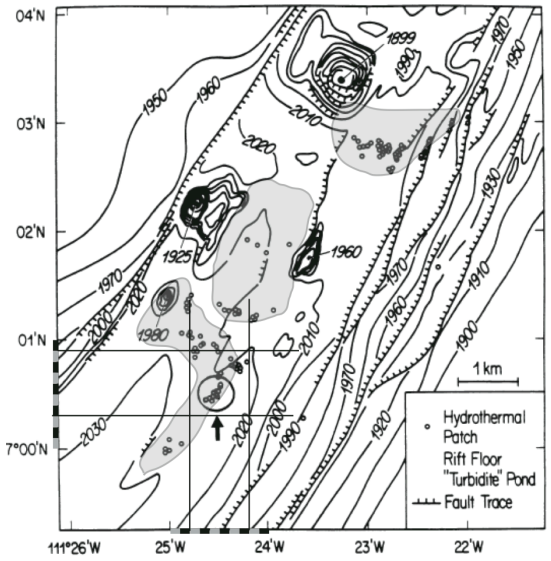
2. Photomosaics/surveys: *Sentry* can collect down-looking seafloor photographs from 1-3 m altitude. The 12 MP images can be used to identify the distribution of bacterial mats and the abundance and type of macrofauna present. *Sentry* can photograph ~100m^2/hr in this mode. Options 1 and 2 are mutually exclusive.

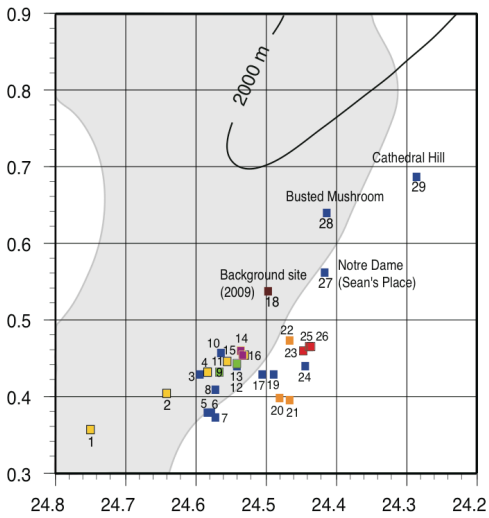
3. *Sentry* can collect water column chemistry measurements during all of these surveys including conductivity, temperature, redox potential, dissolved O_2 and turbidity.

All three capabilities will add scientific value to the planned Guaymas Expedition. So far, Alvin dives and sampling campaigns have returned to a relatively small area, less than a km^2, of the southern Guaymas Trench again and again (see maps on the next page); the informally named hydrothermal features of Guaymas Basin (Rebecca's Roost, Cathedral Hill, Busted Mushroom, and others) are all located in this area. All *Alvin* dives during Guaymas expeditions AT15-40 and AT15-56 in December 2008 and November/ December 2009 also returned consistently to this sampling area. Even here, no published seafloor topographical map or photomosaic of the complex hydrothermal features is available that could guide sampling efforts; every expedition has to a large extent blaze its own trail, aim for recognizing the major landmarks and then "rediscover" the surrounding seafloor detail – a waste of Alvin dive time. Outside of this area, numerous hydrothermal features were found in early surveys during the 1980ies, but they remain unvisited and unsampled since they are not localized spot-on.

A comprehensive *Sentry* seafloor photomosaic would focus sampling efforts within and outside of the traditional sampling area. By overlaying a seafloor photomosaic of hydrothermal hot spots and microbial mat areas with a shallow seismic *Sentry* survey of the underlying subseafloor, it should be possible to connect the surface expression of hydrothermal circulation at Guaymas Basin with its sources, such as shallow buried basalt sills (see next page for detail). By quantifying the hydrothermally active seafloor (*Sentry*), diffusive hydrothermal flow (Dr. Rick Paterson, CCSU), and biomass/faunal assemblages (Dr. Xavier Caraveo-Patiño, CIBNOR), areal flux and productivity estimates of the Guaymas Basin hydrothermal areas are within reach. Deepwater chemistry of Guaymas Basin can be examined finely resolved on an unprecedented scale. Last but not least, the exploratory capabilities of *Sentry* could open up new sampling sites of geological, geochemical and biological interest, within the spreading center and also off-axis (Lizarralde et al. 2011. Nature Geoscience 4:50-54).

Mapping surface/subsurface connections. Locations of hydrothermal features are based on local XY grid data, the gridding system used by the National Deep Submergence Facility (NSDF), as recorded on the Alvin framegrabber system (documentation at http://4dgeo.whoi.edu/alvin) for the time point and location of each observation. Local XY is a grid system (in meters) that is referenced to a local Latitude/Longitude origin. The conversion between Latitude/Longitude and Local XY use a simple flat-earth projection with East=X and North=Y. It is used for relatively small areas (a few kilometers) where the distortion introduced by the projection is minimal (http://www.marine-geo.org/references /descriptions/LocalXY.php). Latitude/ longitude positions of key locations were converted from XY grid data using the online NSDF coordinate conversion utility (http://www.whoi.edu/marine/ndsf/utility /NDSFutility.html). Using this system, the hydrothermal features visited in 2008/2009 are mapped on a xy grid within an area of a few hundred meters. The overlay of these sites on a chart of the southern Guaymas trench (left; based on Bazylinski et al. 1989. AEM 55:2832-2836) and on the approximate position of the basalt sills in the Southern Guaymas trench (based on J.M. Peter and W.C. Shanks III 1992. GCA 56: 2025-2040) shows the extremely limited extent of the surveyed area (the square with the circle pointed out by a small arrow) where pictorial and metadata records of hydrothermal features (chimneys, hot spot sediments, hydrothermal mounds, microbial mats, etc.) based on direct *Alvin* observation and sampling are available. The chart on the right shows this area enlarged, with hydrothermal sites that were visited and sampled in 2008/2009 coded in different colors and numbers (compiled by Barbara MacGregor, UNC-Chapel Hill).





If this superimposition of our observations on older charts from different sources is correct, the hydrothermal features documented and sampled in 2008/2009 are clustering near the edge of a basaltic sill; hydrothermal circulation at the sill's edge could determine the concentration of hydrothermal features in a specific area. A comprehensive seafloor photomosaic by *Sentry* could document and locate seafloor hydrothermal features far more efficiently and across significantly larger areas, including - for example - ridge flank regions adjacent to the southern trench. Connecting seafloor mosaics with subsurface seismic surveys would provide original information on hydrothermal circulation patterns in the complex Guaymas subsurface.