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Fieldwork

USGS Atlantic Margin Expedition Combines Submarine-Landslide Studies with Law of the Sea Mapping

By Deborah Hutchinson and Nathan Miller

Science and technical crew aboard the research vessel (R/V) Marcus G. Langseth*, standing beneath buoys that help float the airgun arrays used as sound sources for multichannel seismic-reflection surveying. Back row, left to right,* ***Alan Thompson*** *(Lamont-Doherty Earth Observatory [LDEO]),* ***Klayton Curtis*** *(LDEO),* ***David Martinson*** *(LDEO),* ***Brian Meyer*** *(National Oceanic and Atmospheric Administration's National Geophysical Data Center),* ***Matt Arsenault*** *(USGS),* ***Mike Martello*** *(LDEO),* ***Wayne Baldwin*** *(USGS). Front row, left to right,* ***Angela Slagle*** *(LDEO),* ***David Foster*** *(USGS),* ***Brian Van Pay*** *(U.S. Department of State),* ***Deborah Hutchinson*** *(USGS),* ***Carlos Gutierrez*** *(LDEO),* ***Eric Moore*** *(USGS),* ***Tommy O'Brien*** *(USGS),* ***Will Fortin*** *(University of Wyoming),* ***Nathan Miller*** *(USGS). Missing from photo are* ***Bobby Kropowski*** *(LDEO),* ***Chad Rich*** *(LDEO), and* ***Josh Kasinger*** *(LDEO). Photograph by* ***Chad Rich****.*

What do big submarine landslides capable of triggering tsunamis have in common with U.S. sovereignty over resources on and beneath the seafloor? Answer: the 2014 Atlantic margin expedition aboard the research vessel (R/V) *Marcus G. Langseth*. This research cruise, which began in Brooklyn, New York, on August 20 and ended in Norfolk, Virginia, on September 13, combined objectives of the USGS Law of the Sea project to map sediment thickness for identifying the outer limits of the U.S. Extended Continental Shelf with objectives of the USGS Atlantic hazards project to study submarine landslides capable of generating dangerous tsunamis.

Under international law as reflected in the Law of the Sea (<**http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm**>), every coastal country automatically has a Continental Shelf out 200 nautical miles from its shore, where it may exercise sovereign rights over resources on and beneath the seabed. (This definition is different from the geographic definition of "continental shelf" as the relatively flat, submerged edge of a continent.) In some cases, a country can have a Continental Shelf beyond 200 nautical miles, or an "Extended Continental Shelf." The Law of the Sea allows a country to use calculations based on the shape of the seafloor and (or) the thickness of sub-seafloor sediment to determine the edge of its Extended Continental Shelf.

Both objectives of the *Langseth* expedition—submarine-landslide studies and delineation of Extended Continental Shelf—required the use of seismic (sound) energy to map the seafloor and image layers of sediment beneath the seafloor at high resolution, as well as to measure the velocity of sound through sub-seafloor sediment in order to correctly calculate its thickness. Likewise, both objectives required exploration of the same region: the Atlantic continental margin, which encompasses the continental shelf, slope, and rise—that is, all the seafloor from the shoreline to the deep ocean basin. The landslide-hazards objectives were met by collecting data along ship's tracks perpendicular to the margin while transiting to and from tracks along the deep margin where data were collected to help delineate the Extended Continental Shelf.

Delineating the edge of the U.S. Extended Continental Shelf is the focus of the U.S. Extended Continental Shelf (ECS) Interagency Task Force, which has been working since 2007 to identify all parts of the U.S. margins beyond 200 nautical miles where the nation can potentially exert its sovereign rights over seabed resources such as deep-water corals or mineral crusts and nodules, and sub-seabed

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Sound Waves

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Fieldwork, continued

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resources such as oil and gas. (Read about this group and its work in "Department of State Recognizes U.S. Extended Continental Shelf Project Team with Superior Honor Awards," *Sound Waves*, May/June 2013, <**http://soundwaves.usgs.gov/2013/06/awards.html**>.) Only after the Extended Continental Shelf is delineated can it be evaluated and designated for conservation, management, resource exploitation, or other purposes. Unless the Extended Continental Shelf is delineated as part of the Continental Shelf of the United States, it could be explored and exploited outside of the U.S. regulatory system.

The ultimate determination of the outer limits of the Extended Continental Shelf on the U.S. Atlantic margin will depend in part on the data collected during the survey last August–September, as well as a second survey planned for 2015. The first survey acquired reconnaissance data along tracks parallel to the margin in order to assess variability in sediment thickness and depth to the igneous rocks that lie below the sediments. The second, follow-up expedition is planned to use knowledge of sediment-thickness variability to position tracks that allow the full extent of the Extended Continental Shelf to be identified.

The submarine-landslide mapping is part of assessing geologic hazards that could generate tsunamis along the Atlantic seaboard. (See "Submarine Landslides as Potential Triggers of Tsunamis That Could Strike the U.S. East Coast," *Sound Waves*, August 2009, <**http://soundwaves.usgs.gov/2009/08/fieldwork.html**>.) Since the 2004 Indian Ocean tsunami and the 2010 Tohoku tsunami in Japan, the U.S. Nuclear Regulatory Commission has contracted with the USGS to evaluate the potential tsunami threat to nuclear power plants along U.S. margins. Tsunamis could threaten other infrastructure as well, such as coastal cities, industrial centers, and port facilities, and so additional agencies have requested USGS input and assessments for their tsunami-preparedness planning. These agencies include Federal Emergency Management Agency (FEMA) offices in several coastal states and the City of Boston Office of Emergency Management.

Tsunamis on passive margins that are far from active tectonic-plate boundaries, such as the Atlantic seaboard, pose a challenge to regulators because these events are rare (they have low probability) but potentially devastating (they pose high risk). Three lines of evidence demonstrate that the Atlantic margin is not immune to potential tsunami hazards: (a) the 1929 Grand Banks tsunami, generated by a submarine landslide triggered by a magnitude 7.2 earthquake, killed 28 people along the sparsely populated Newfoundland coast; (b) scientists have measured and modeled abnormally high fluid pressure in sediment on the New Jersey margin, which can cause slope failure; and (c) seafloor mapping has revealed evidence of enormous submarine landslides, such as the Cape Fear slide off North Carolina.

As part of its research into submarine landslides, the USGS has used a multipronged approach, employing, for example, analytic and numerical models, geomorphic (related to the shape of the feature) analysis, regional assessments using existing data, geotechnical (related to physical properties of materials) analysis, and laboratory studies. Until now, no single landslide on the Atlantic margin had been mapped and imaged in the subsurface from the location of its origin high on the continental slope, where the headwall, or rupture surface, occurs, to its run-out position on the lower continental rise or abyssal plain. Seismic-reflection images provide important information about subsurface structures that determine where and why landslides occur. The lack of such information prevents further modeling of the processes associated with these landslides and evaluating the potential tsunami-generating risks they have posed or could pose along the Atlantic margin. The 2014 *Langseth* survey offered the opportunity to study the internal structures of two major landslide regions on the U.S. margin: the Southeast New England landslide complex offshore New Jersey and the Cape Fear submarine landslide offshore North Carolina.

In total, the expedition collected more than 2,700 kilometers of multichannel

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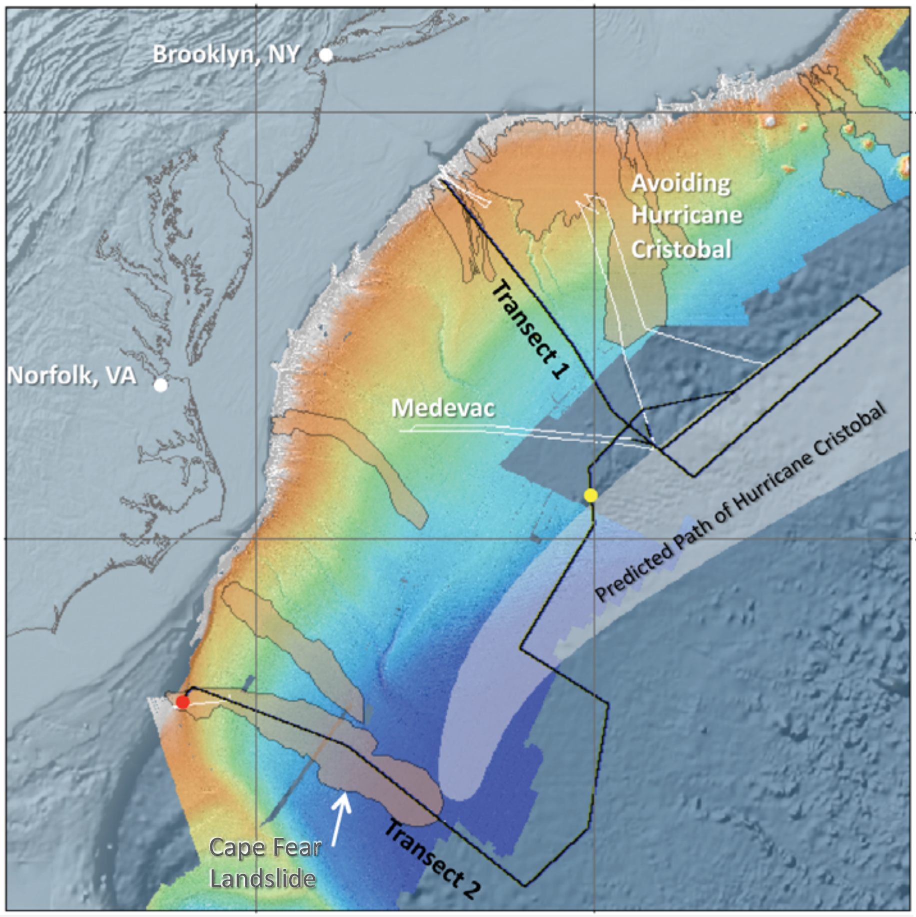

Map showing R/V Langseth *tracks where seismic (sound-based) data were acquired (black). Transects 1 and 2 were acquired for landslide hazards objectives. The other seismic lines were acquired for Extended Continental Shelf objectives. White tracks were taken to avoid Hurricane Cristobal's path (light shading) and to facilitate a medical evacuation (medevac). Major east coast submarine landslides are shown in light brown. Bathymetry is colored from shallow (tan/gray) to deep (dark blue). Yellow dot shows the location of contourite image (page 4); red dot, the location of landslide image (page 4).*

seismic-reflection data that will be used to create images of rock layers below the seafloor, more than 4,000 kilometers of multibeam bathymetry (seafloor depth) and backscatter data (amplitude of reflections from the seafloor) that will be used to map seafloor features and composition, and chirp data that provide high-resolution images of shallow sediments. The expedition collected additional data from deployment of 34 sonobuoys that will provide information about speed of sound through the deeper crust and improve images of structures at greater depths, as well as 101 expendable bathy thermographs, or XBTs, which provide information about speed of sound through water, required for calculation of water depths. The total data volume was about 1.5 terabytes. All of the multichannel seismic-reflection data were processed at sea with preliminary geometric corrections to get initial images of the subsurface. The multibeam bathymetry and backscatter data were edited and gridded, and the high-resolution chirp data were gathered into lines coinciding with the multichannel seismic-reflection profiles. This at-sea work facilitated on-the-fly decisions about minor adjustments to tracks during the cruise and subsequent decisions about post-cruise processing and interpretation.

R/V *Langseth* is a 234-foot-long vessel owned by the National Science Foundation (NSF), operated by Lamont-Doherty Earth Observatory (LDEO), and specially designed for both 2D and 3D multichannel seismic-reflection data acquisition. *Langseth* was acquired by NSF in 2008 and was used in USGS Extended Continental Shelf studies in 2011 in the Bering Sea and the Gulf of Alaska (for example, see <**http://soundwaves.usgs.gov/2011/08/fieldwork2.html**>). The multichannel streamer is a solid-state, 8-kilometer-long streamer that is towed behind the vessel (yes, that's 8 kilometers, or 5 miles, long). *Langseth* also tows an airgun array that provides the sound source for seismic-reflection operations.

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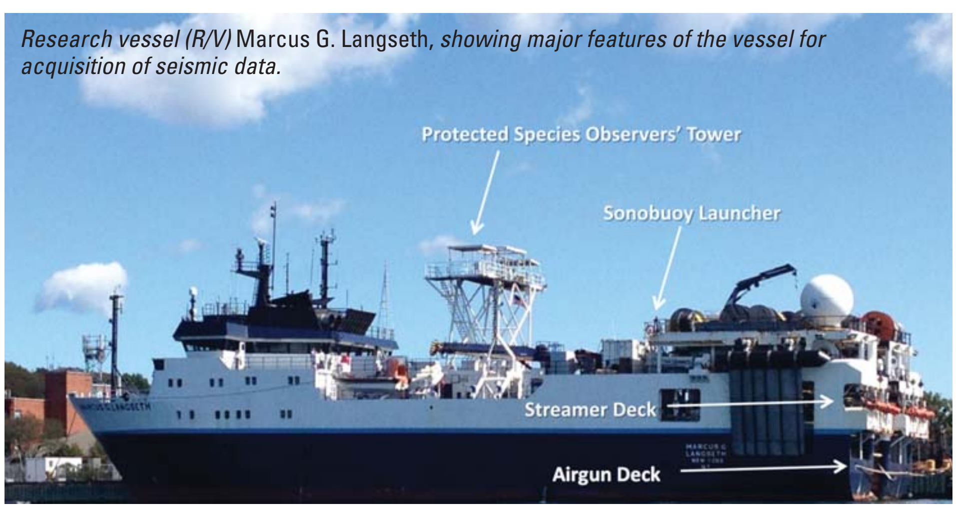

Research vessel (R/V) Marcus G. Langseth, *showing major features of the vessel for acquisition of seismic data.*

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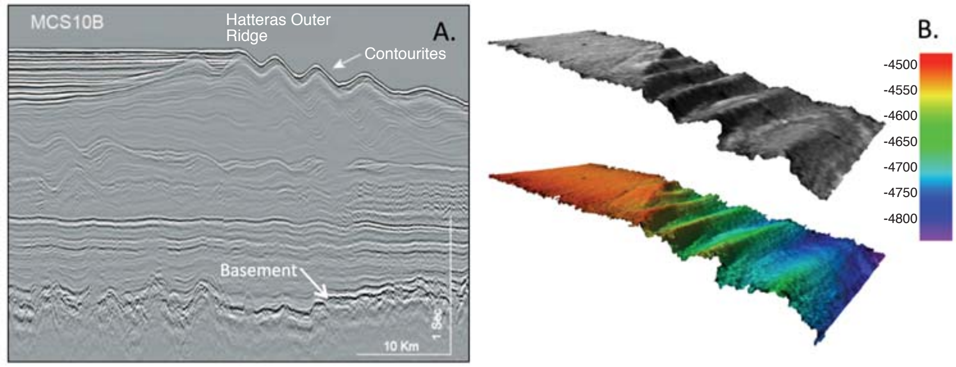
The cruise was an outstanding success. The Extended Continental Shelf objectives of mapping sediment thickness were fully achieved on all lines acquired for that purpose (see map, page 3). Several other sedimentary features were spectacularly imaged, including contourite deposits formed by deep, southward-flowing currents (see cross section at right). Major unconformities, or surfaces where sediment layers have been truncated by erosion; seamounts; variations in basement roughness and relief; faults; possible fluid-flow features; and other anomalies that disturb the sedimentary layering are evident in the data at scales that range from the resolution of the multichannel seismic-reflection data (10s of meters to kilometers) to much higher resolution in the chirp and multibeam data (meters to 10s of meters). The seismic lines crossed two boreholes drilled by the Deep Sea Drilling Program in 1970 and 1983, enabling identification and dating of stratigraphy imaged by the seismic data.



Hatteras Outer Ridge and associated contourites (sediment deposits formed by deep currents below the influence of waves). A, *Multichannel seismic-reflection profile showing that the deposits composing the Hatteras Outer Ridge contain older buried contourites. Below the contourites are still older flat-lying deposits; basement (igneous rock) is the deepest visible and bright black-white reflection. Younger deposits are burying and spilling over the crest of Hatteras Outer Ridge. The crest of Hatteras Outer Ridge is a local maximum of sediment thickness.* B, *Three-dimensional scene from the multibeam data along profile shown in part* A, *illustrating the crest of the Hatteras Outer Ridge with dramatic rhythmic, continuous topography having wavelengths of 4 to 6 kilometers and amplitudes between 60 and 100 meters. Top panel shows backscatter data (strength of reflected sound, which indicates seafloor composition and roughness) draped on bathymetry, and bottom panel shows shaded-relief bathymetry. Location shown by yellow near center of study area map (page 3).*

Hazards objectives were also achieved. A full transect of the Cape Fear submarine landslide was collected in the southern part of the study area, and these data show multiple deformation events, faults, slide surfaces, and disturbed stratigraphy. The landslide is continuous for more than 375 kilometers from its multiple headwalls near 2,500-meter water depth to its toe in 5,400-meter water depth. Remarkably, failed blocks that are several kilometers long have been imaged near the headwall (see images below). One block is clearly shown in the multichannel seismic-reflection data, in the chirp image, and along the multibeam-bathymetry track. This is the first time that a landslide on the U.S. Atlantic margin has been mapped with multiple imaging techniques along its entire length, providing a rich dataset for studying the multiple failures evident in the data. To the north, offshore New Jersey, the same data types were collected across smaller landslides of the Southeast New England landslide complex. The transects acquired to study both submarine landslide regions show salt diapirs, basement beneath much of the sedimentary section, and clearly delineated stratigraphy that will enable these data to be tied to known Atlantic margin chronologies.

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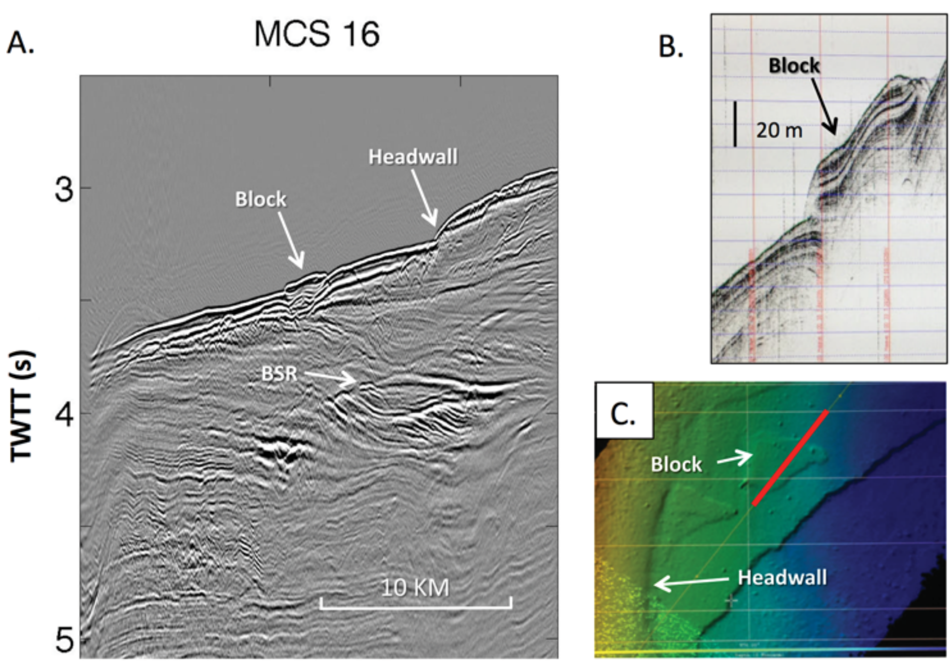

Images across top of Cape Fear submarine landslide. A, *Multichannel seismic-reflection line showing a failed block and headwall. MCS, multichannel seismic; TWTT, two-way travel time (time for sound signal to travel to seafloor and back); s, seconds; BSR, bottom-simulating reflector.* B, *High-resolution chirp profile (at-sea screen capture) showing the same failed block sitting on the seafloor.* C, *Multibeam-bathymetry image (at-sea screen capture) showing the location of the chirp profile (red line), the failed block, and the headwall shown in part* A. *A second, triangular-shaped block is visible on the seafloor in the multibeam image (beneath the word "block"), and a second headwall is visible crossing beneath the "H" of "Headwall" and trending from lower left to upper right of the image. Location shown by red dot in lower left of study-area map (page 3).*

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While the cruise ended as a complete success, it did not begin that way. The starting date was delayed by a week because of mechanical issues with the ship and permitting delays. After only 3½ days of profiling, the scientists were forced to haul gear and run back toward land to avoid Hurricane Cristobal (see map on page 3). While the hurricane may have been "safely out to sea" for onshore weathermen, her path could not have more perfectly crossed the expedition's field area. The scientists lost 2½ days avoiding Cristobal and had just resumed collecting data for 3 hours when the captain informed them that they needed to break work for a medical emergency. That took another 2 days of down time, though the researchers got to witness some impressive maneuvering by the Coast Guard helicopter during the medical evacuation. They wondered when the next shoe would drop, but for the rest of the expedition they were treated to flat seas, calm winds, and near-perfect conditions for data acquisition. These were also ideal conditions for the Protected Species Observers to observe wildlife, yet only a single detection of unidentified dolphins occurred during seismic-data collection, and seismic operations were interrupted for 12 minutes. Although the total kilometers of data were slightly less than planned, LDEO allowed the scientists two extra days to make up for the medical emergency. The hard work of reprocessing, analyzing, interpreting, and publishing the results is the next big challenge! ☸

Interdisciplinary Exploration of Seamounts in the Anegada Passage, Northeast Caribbean

By Jason Chaytor and Amanda Demopoulos

Seamounts in the Anegada Passage, northeast Caribbean, were the focus of a September 2014 research expedition to characterize their geology, geomorphology, and ecology, including deep-sea coral habitats and associated communities. The September cruise was a follow-up to the first-ever remotely operated vehicle (ROV) exploration of the Anegada Passage that took place in October 2013 (<**http://soundwaves.usgs.gov/2014/06/**>). A team of U.S. Geological Survey (USGS) scientists (**Amanda Demopoulos**, **Jennifer McClain-Counts**, **Jill Bourque**, **Brian Andrews**, **Shannon Hoy**, and **Jason Chaytor**) and collaborators from Temple University (**Erik Cordes** and **Alex Barkman**) returned to the region from September 3–13, 2014, to collect a wide range of detailed data about this little-explored submarine world.

The interdisciplinary expedition, led by co-chief scientists **Amanda Demopoulos** (USGS Southeast Ecological Science Center) and **Jason Chaytor** (USGS Woods Hole Coastal and Marine Science Center) on the Ocean Exploration Trust's exploration vessel (E/V) *Nautilus* (<**http://www.oceanexplorationtrust.org/#!ev-nautilus/cj4u**>), examined several unexplored seamounts. These undersea mountains punctuate the seafloor within the Anegada Passage (see map, next page), providing an extensive record of the regional geologic, biologic, and oceanographic processes. Seamounts are topographically and oceanographically complex, with environmental characteristics (such as substrate types, carbon flux, and current patterns) that differ greatly, both within and among seamounts. Variable environmental conditions may influence faunal community structure among seamounts; yet, to our knowledge, no studies to date have examined these factors across multiple spatial scales of a seamount chain.

Three of the five targeted seamounts—Dog, Noroît, and Conrad seamounts—were investigated using two ROVs that operate in tandem, *Hercules* and *Argus* (<**http://oceanexplorer.noaa.gov/technology/subs/hercules/hercules.html**>). In addition, high-resolution multibeam bathymetry (seafloor depth) data were collected throughout the cruise to shed light on the recent geologic (for example, sediment transport) and tectonic (for example, fault rupture) development of the seamounts and the surrounding transition zone between the Greater Antilles and Lesser Antilles. More than 170 rock, sediment, invertebrate, and water samples were collected during the seven dives of the cruise; these will be analyzed by project partners mentioned above and additional USGS and academic collaborators: **Nancy Prouty**, **Cheryl Morrison**, and **Andrea Quattrini** of the USGS; **Martha Nizinski** of the National Oceanic and Atmospheric Administration (NOAA); **Scott France** of the University of Louisiana at Lafayette; and **Tim Shank** of the Woods Hole Oceanographic Institution (WHOI).

Visual observations made during each dive revealed information on the distribution and abundance of deep-sea corals, fishes, and associated invertebrates, plus the fine-scale geomorphic, lithologic, and stratigraphic nature of these bathymetrically complex features. Future analysis of video footage and samples obtained during the dives will be used to examine the degree to which these organisms depend on specific habitat features, and will allow for the characterization of the faunal communities associated with seamounts, including corals, squat lobsters, and macrofauna that live in the sediment. In addition, comparisons of faunal-habitat associations on seamounts in the Anegada Passage with associations in other regions will advance the understanding of habitat specialization in the deep sea and the role seamounts play in providing habitat for deep-sea fauna.

The cruise was streamed live via the Internet 24 hours a day. Scientists on the ship interacted daily with school groups and visitors at museums and aquariums (U.S. and international), discussing their discoveries in real time and highlighting the excitement, difficulty, and

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importance of working in the deep sea. Additionally, Chaytor and Demopoulos were interviewed during the cruise by the National Aquarium in Baltimore, Maryland, to kick off the aquarium's Star Spangled Spectacular event; view the interview at <**https://plus.google.com/events/cp63cah49dcfb8l2iskkfg1n0i0**>.

We would like to thank the entire crew of the *Nautilus* and the 31 members of the science party, all of whom made the cruise a success. This research was funded through a competitive award from NOAA's Office of Exploration and Research 2013 Federal Funding Opportunity, with additional support from the USGS.

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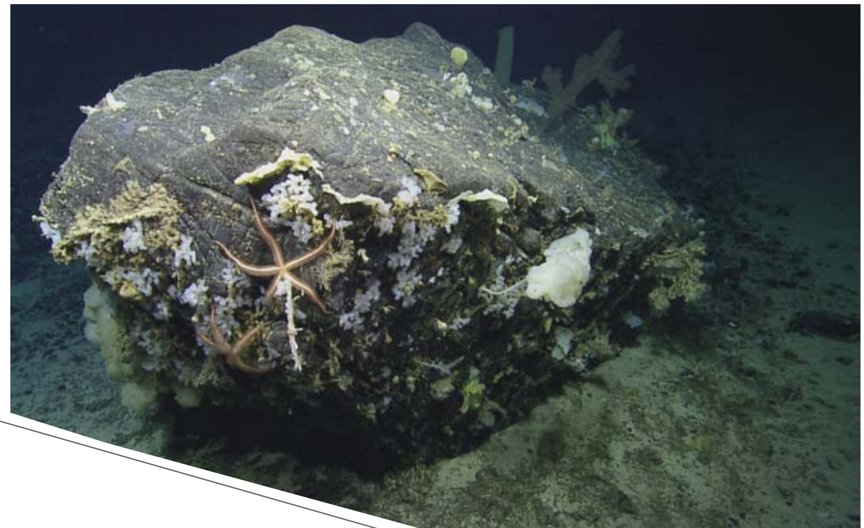
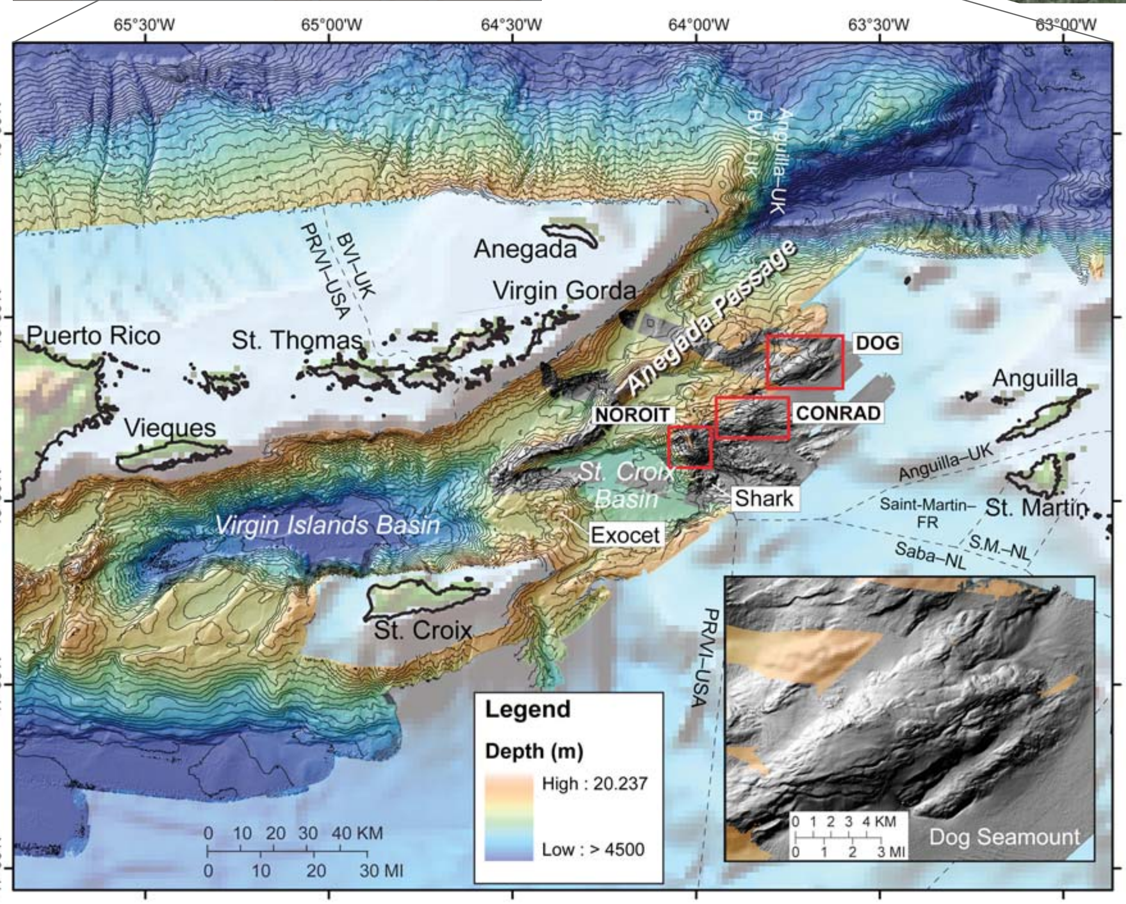
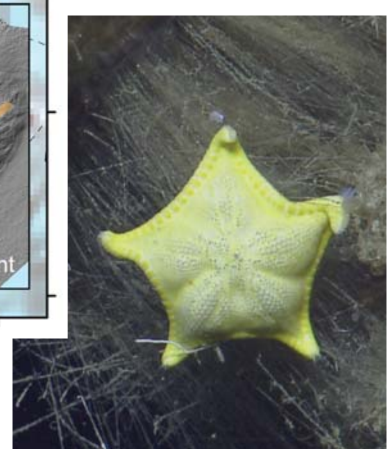


Brisingid sea stars, sponges (white and dull yellow), and corals (branching yellow and orange, right side of block) are using this debris block (coated with dark iron-manganese hydroxide) as a home. This block was located within a prominent debris field at the base of the western slope of Dog Seamount. Photograph taken by ROV Hercules. *Image courtesy of Ocean Exploration Trust—Seamounts of Anegada Passage.*



*Map of the northeast Caribbean, showing the extent of previously collected (colored) and new (gray) bathymetric data and location of the seamounts targeted as part of the project. Red boxes highlight locations visited by the dual-body (*Hercules *and* Argus*) remotely operated vehicle (ROV) system during the September cruise. Close-up view of Dog Seamount, as revealed by the new bathymetric data, is shown in the inset.*

Yellow sea star perched on the long spicules of a sponge, Dog Seamount. Photograph taken by ROV Hercules. *Image courtesy of Ocean Exploration Trust—Seamounts of Anegada Passage.*



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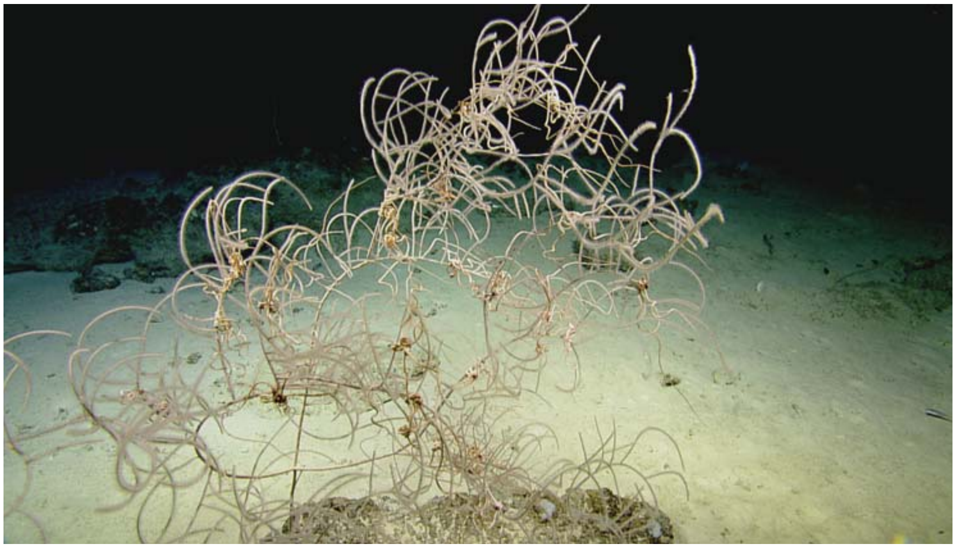
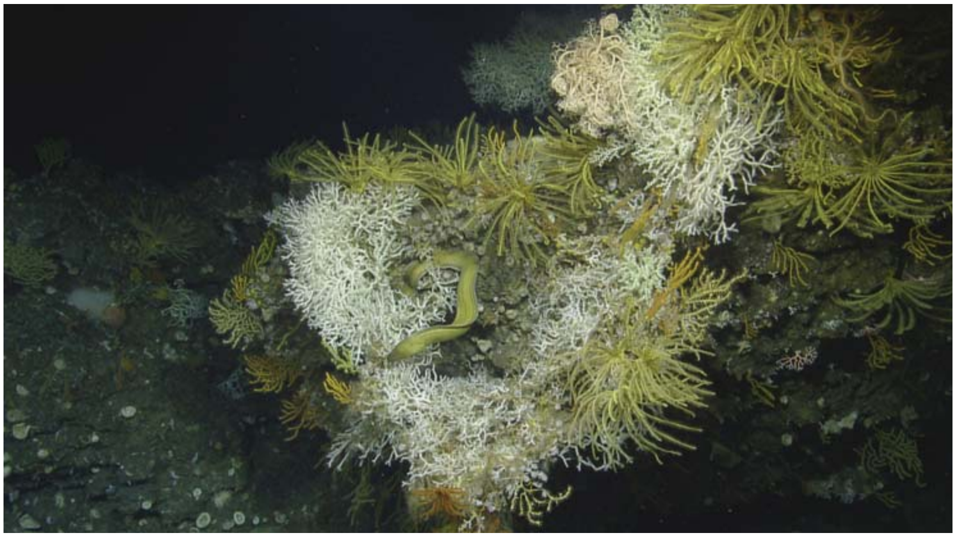
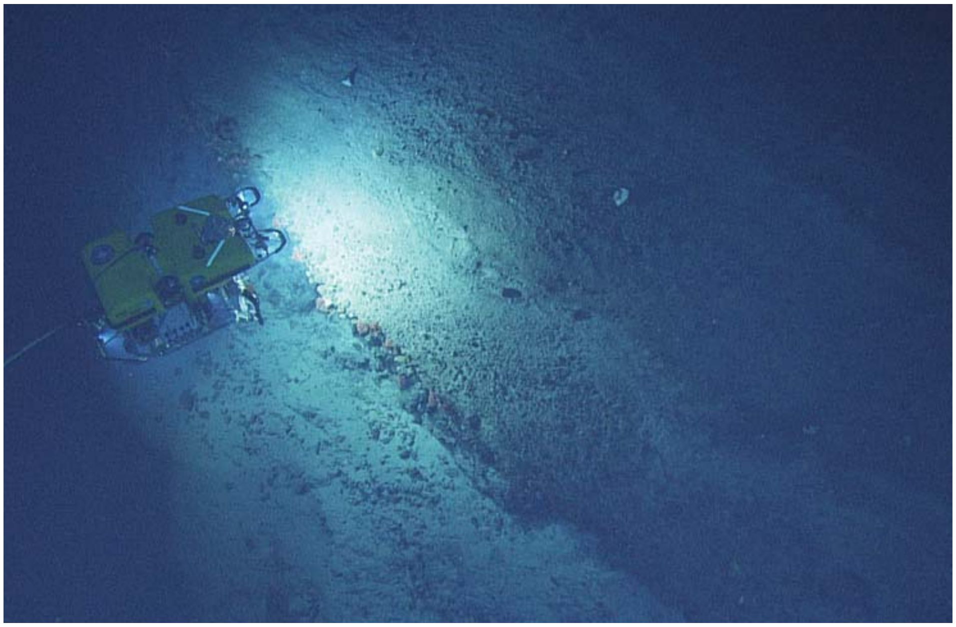


◀*Several unknown species of corals were documented on these seamount dives. Here is a large unknown species of black coral (Antipatharian) with multiple brittle stars (Ophiuroids) coiled around its branches. Photograph taken by ROV* Hercules. *Image courtesy of Ocean Exploration Trust—Seamounts of Anegada Passage.*



◀*Diverse fauna were observed occupying a rock at the summit of Dog Seamount, including a sharktooth moray eel (*Gymnothorax maderensis*), several species of corals (scleractinians and octocorals; branching white, pink, and orange colonies), yellow and orange crinoids, and a basket star (light pink, right of top-center). Photograph taken by ROV* Hercules. *Image courtesy of Ocean Exploration Trust—Seamounts of Anegada Passage.*



◀*Remotely operated vehicle (ROV)* Hercules *inspecting rock outcrops and attached fauna along the eastern flank of Conrad Seamount. Photograph taken by ROV* Argus. *Image courtesy of Ocean Exploration Trust—Seamounts of Anegada Passage.* ☸

Mapping Coastal Changes Along Northern Monterey Bay, California, to Aid Planning for Future Storms

By Amy West and Helen Gibbons

When U.S. Geological Survey (USGS) scientist **Curt Storlazzi** was standing near Moran Lake Beach east of Santa Cruz, California, in January 1998, he witnessed waves from an epic storm wash onto the roadway and straight into a bus, hitting it hard enough to push it into the oncoming lane. Luckily no one was hurt, but the village of Capitola a few miles away suffered severe damage from waves and wave-driven logs bursting through the ocean-facing windows of restaurants and businesses. Normally, a wide beach protects Capitola's Esplanade from the ocean waves. But in that El Niño year, much of the beach had already been eroded by winter storms when the February tempest hit.

Big storms are inevitable on the central California coast, and climate change and rising sea level are expected to intensify them, particularly in El Niño years, when atmospheric conditions bring heavy rains. For safety's sake, and to protect resources such as businesses, beaches, and harbors that bring a coastal community like Santa Cruz much of its revenue, there's a great need to understand how big storms can shape and affect the coast.

To address this need, a team of USGS scientists led by research geologists **Patrick Barnard** and **Jonathan Warrick** are running repeated surveys of beaches and the nearby ocean bottom to compile three-dimensional maps of how beaches in northern Monterey Bay change over time. The first survey was conducted October 20–24, 2014, from Mitchell's Cove in Santa Cruz to Moss Landing, where the head of Monterey Canyon comes close to shore. Staff from

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*▲**Alex Snyder** carries Global Positioning System (GPS) equipment in a backpack to survey the beach near the mouth of the Pajaro River, about 5 kilometers (3 miles) northwest of Moss Landing. Backpack transects typically ran from the inland edge of the beach as far out into the surf zone as safety permitted. USGS photograph by **Andrew Stevens**.*

*◀**Peter Harkins** uses a GPS unit mounted on an all-terrain vehicle (ATV) to survey beach elevations parallel to the shore near the mouth of the Pajaro River. Note **Alex Snyder** in the background doing a GPS transect on foot. USGS photograph by **Andrew Stevens**.*

*▶**Tim Elfers** using an echosounder and GPS receiver mounted on a personal watercraft to survey the seafloor just off the beach near the Santa Cruz Beach Boardwalk. Most of the personal watercraft transects ran perpendicular to the shore, with the transect's shoreward end as close to the beach as possible to tie into the beach surveys. USGS photograph by **Andrew Stevens**.*

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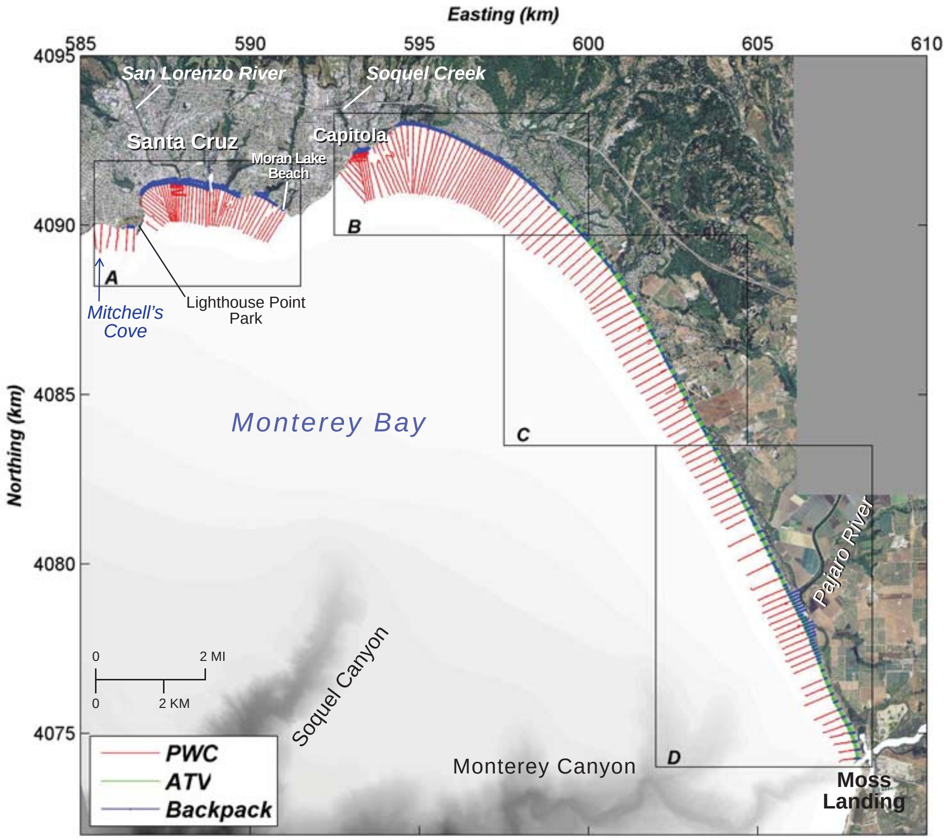

Map showing transects along which USGS staff surveyed the northern Monterey Bay, California, coastline in October 2014 with instruments mounted on personal watercraft (PWC, red lines), all-terrain vehicles (ATV, green lines), and backpacks (blue lines). Scale is approximate. USGS image courtesy of **Andrew Stevens**.

the USGS Pacific Coastal and Marine Science Center in Santa Cruz used high-precision Global Positioning System (GPS) receivers carried on foot and mounted on all-terrain vehicles (ATVs) to measure beach and swash-zone elevations (topography), and GPS receivers and 200-kilohertz echosounders mounted on personal watercraft to measure underwater elevations (bathymetry).

Scientists carrying GPS receivers in backpacks walked transects perpendicular to the shore, from the inland edge of the beach—for example, the base of the sea cliff—as far into the water as they could safely go. The personal watercraft drivers also surveyed transects perpendicular to the shore; most of these were extensions of the onshore transects, running from as close to the beach as possible to approximately 2 kilometers offshore. The ATV drivers surveyed beach transects parallel to the shore. Over the 5 days of the October survey, 15 mappers and support personnel collected a total of 513 kilometers of trackline data along the coast: 219 kilometers of personal-

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Tim Elfers at the shoreward end of a personal watercraft transect near Moss Landing. The screen mounted on the side of the watercraft allows the driver to monitor survey data in real time. **Peter Harkins** stands by with a wetsuit and radio in case the watercraft driver needs assistance. USGS photograph by **Andrew Stevens**.

*USGS geographer **Josh Logan** prepares to measure beach elevations with a lidar (light detection and ranging) scanner near Capitola on December 10, 2014, in anticipation of a large storm forecast for the next day. To view a "virtual flyover" video Logan created with lidar data collected near the San Lorenzo River mouth in Santa Cruz, visit <**http://walrus.wr.usgs.gov/climate-change/scruz.html**>. USGS photograph by **Amy West**.*

(Mapping Changes continued from page 9)

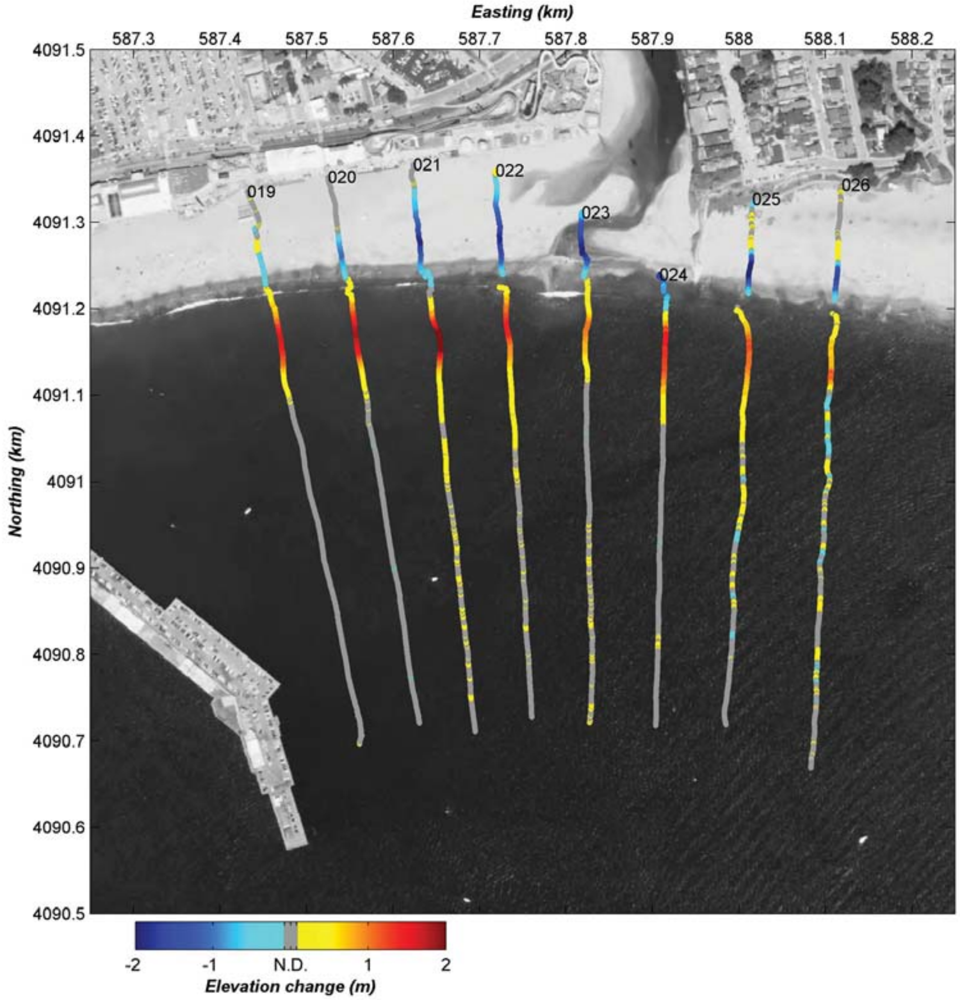
watercraft data, 210 kilometers of ATV data, and 84 kilometers of backpack data (see map, page 3).

The October survey proved its worth just 2 months later, when a large storm, dubbed the "Super Soaker," brought heavy rain and big waves to the Santa Cruz area on December 11, 2014. To capture the effects of this storm, the scientists conducted small-scale surveys near the mouth of the San Lorenzo River in Santa Cruz and the mouth of Soquel Creek in Capitola—two areas known to undergo large changes in response to storms. For these surveys, a terrestrial lidar scanner was added to the mix of instruments. Lidar (light detection and ranging) uses laser light to measure distances and produce highly accurate three-dimensional maps and images of terrain. (To learn more about lidar, and to view a lidar "flight" over the beach near the San Lorenzo River mouth, visit <**http://walrus.wr.usgs.gov/climate-change/scruz.html**>.)

Because lidar had not been part of the October survey, USGS personnel collected pre-storm lidar data on December 10, the day before the storm was forecast to hit. On December 18, a week after the storm, they surveyed the two river-mouth areas with the lidar scanner plus all the instruments they had used in the October survey.

The December survey results are currently being compared with the October survey data. Among the preliminary findings is evidence that the storm eroded sediment from the beach near the San Lorenzo River mouth and deposited sediment offshore (see change map in upper right). Overall, the volume of sediment near the river mouth increased; the researchers hypothesize that the additional sediment was delivered to the area by the river, possibly augmented by along-shore movement of sediment from the west.

Another full-scale survey, from Santa Cruz to Moss Landing, will take place in March 2015, and regular surveys will be run in the fall and spring of subsequent years to capture seasonal fluctuations and extreme events, such as flooding from



Map showing how the elevation of the sediment surface near the mouth of the San Lorenzo River (intersected by transect 023) changed between the October 2014 survey and the survey run December 18, 2014, after a large storm hit the area. In general, sediment was removed from the beach (indicated by blue shades) and deposited offshore (red and yellow shades). Structure at lower left is the Santa Cruz Wharf. USGS image courtesy of ***Andrew Stevens****.*

the San Lorenzo River. USGS scientists will also create beach maps from video captured during aircraft flyovers, and they will attach time-lapse cameras and tide and wave gauges to local piers for a multidimensional understanding of coastal processes.

Collecting these data over many years will ultimately provide a detailed picture of how sand moves along the northern Monterey Bay coast, and how the position of the coastline changes in response to changes in sand input and waves. Studying vulnerable and dynamic zones such as the San Lorenzo River mouth and the Soquel Creek mouth before winter storms hit will enable scientists to measure how the beaches change, and will aid the understanding of how big storm events, such as those occurring during El Niño years, shape and erode the coast. The survey results can be incorporated into future scenarios of sea-level rise and climate change, contributing directly to Monterey Bay communities working on how and what to protect along their coastlines.

For more information about this project, please visit <**http://walrus.wr.usgs.gov/climate-change/scruz.html**>. ☸

USGS Joins the Mid-Atlantic Coastal Resilience Institute—A Partnership for Integrated Climate Research to Help Local and Regional Leaders

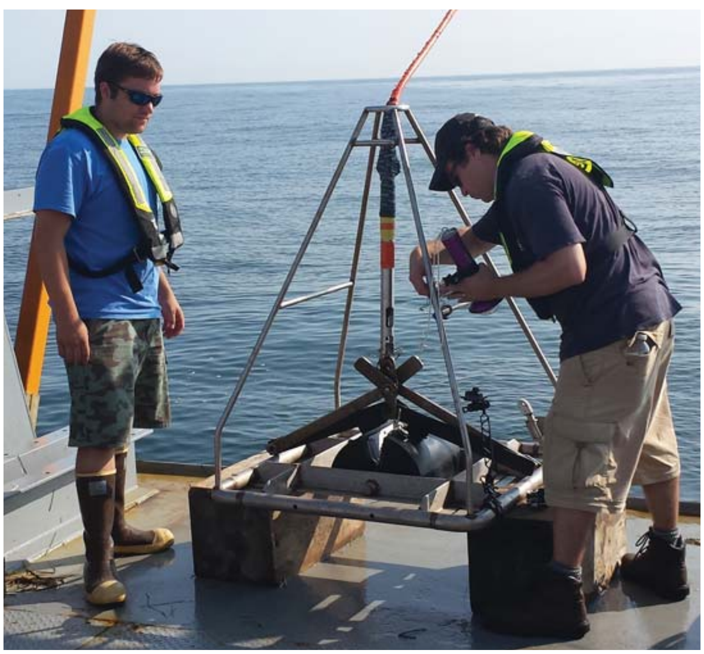
By Laura Brothers

On August 28, 2014, the U.S. Geological Survey (USGS) participated in the inaugural meeting of the Mid-Atlantic Coastal Resilience Institute (MACRI, <**http://www.nasa.gov/content/macri/**>) at NASA's Wallops Flight Facility in Wallops Island, Virginia. MACRI is a partnership of institutions that conduct climate-related research in the Mid-Atlantic coastal zone. Other members of MACRI include NASA's Goddard Space Flight Center, the U.S. Fish and Wildlife Service, Chincoteague Bay Field Station of the Marine Science Consortium, the Virginia Institute of Marine Science (College of William and Mary), the Virginia Coast Reserve Long Term Ecological Research Network (University of Virginia), the Nature Conservancy, the University of Delaware, and the University of Maryland.

The purpose of MACRI is to optimize research resources and to help local and regional leaders make scientifically informed decisions regarding coastal communities and habitat resilience. Such a partnership complements the USGS's response to Hurricane Sandy. Currently the USGS Coastal and Marine Geology Program (<**http://marine.usgs.gov/**>) has three projects underway in the Delmarva (Delaware, Maryland, Virginia) region that will help us better understand coastal change.

At the August workshop, participants discussed MACRI's mission, presented current regional research, and formed working groups. Research geologist **Laura Brothers**, from the USGS Woods Hole Coastal and Marine Science Center, gave a brief presentation on USGS Coastal and Marine Geology Program research in the region, including the projects "Barrier Island and Estuarine Wetland Physical Change Assessment" (<**http://coastal.er.usgs.gov/sandy-wetland-assessment/**>), "Estuarine Physical Response to Storms" (<**http://woodshole.er.usgs.gov/project-pages/estuarine-physical-response/**>), and "Linking the Delmarva Peninsula's Geologic Framework to Coastal Vulnerability" (<**http://woodshole.er.usgs.gov/project-pages/delmarva/**>).

MACRI provides a network for distributing scientific results directly to the local and regional stakeholders and researchers. Already the partnership has enhanced USGS field logistics and data-mining efforts. The official agreement among the agencies was signed into effect on June 9, 2014, at NASA's Wallops Flight Facility in Wallops Island, Virginia.



__Alex Nichols__ (left) and __Seth Ackerman__ prepare a Van Veen sediment grab sampler for deployment during a 2014 geophysical and sampling cruise conducted offshore of the Delmarva (Delaware, Maryland, Virginia) Peninsula (<__http://soundwaves.usgs.gov/2014/10/spotlight2.html__>). The seafloor samples they collected will be used to characterize the seafloor geology of the inner continental shelf and for comparison with samples collected during other coastal studies in the area. USGS photograph by __Laura Brothers__.

USGS oceanographer __Pat Dickhudt__ preparing instruments for deployment in Chincoteague Bay, Maryland/Virginia, as a component of the Estuarine Physical Response to Storms project (<__http://woodshole.er.usgs.gov/project-pages/estuarine-physical-response/__>). USGS photograph by __Sandra Brosnahan__.

New Researcher Studies Coastal Sediment Changes Using 3D Modeling

By John Warner

◂*Maria Liste*

Maria Liste has joined the U.S. Geological Survey (USGS) Woods Hole Coastal and Marine Science Center in Woods Hole, Massachusetts. Liste will work collaboratively to apply a fully three-dimensional coupled modeling system to investigate how forces created at the seabed by currents and waves mobilize and transport sediment across the coastal region and inner continental shelf offshore of Fire Island, New York. The inner continental shelf at this location is characterized by a series of large shoreface-connected sand ridges. Recent geophysical investigations have identified mobility of these ridge features, and locations of sediment deposition on the inner continental shelf. Liste will conduct targeted numerical experiments to study the hydrodynamic forcings and processes that transport sediment in this region. Results will help scientists to understand the larger coastal response to storms, including the response to Hurricane Sandy in 2012.

Originally from Spain, Liste studied oceanography and earned her Ph.D. at the University of Cantabria in Santander, Spain. Her thesis research focused on ocean circulation patterns on the Spanish coastline to assess the probability that an oil spill would impact a certain area of the coast. Other previous experience includes working at University of Leuven (KU Leuven) in Belgium, where she studied river-plume dispersion in response to flash-flood events and improved models in fluid dynamics codes to better simulate deformation and flow of cohesive sediments.

Research

Interested in Naming Undersea Features?

By Susan Russell-Robinson

As oceangoing research vessels gather high-resolution elevation data of the seafloor, many opportunities arise to identify new features and to name them. The approval of names falls to the U.S. Board on Geographic Names, a Federal body created in 1890 and established in its present form by Public Law in 1947 to maintain uniform geographic name usage throughout the Federal Government. The Board comprises representatives of Federal agencies concerned with geographic information, population, ecology, and management of public lands. Sharing its responsibilities with the Secretary of the Interior, the Board promulgates official geographic feature names with locative attributes (character, extent, and position) as well as principles, policies, and procedures governing the use of domestic names, foreign names, Antarctic names, and undersea feature names. (See <**http://geonames.usgs.gov/**>.)

Advisory Committee on Undersea Features

The U.S. Board on Geographic Names' Advisory Committee on Undersea Features (ACUF, <**http://earth-info.nga.mil/gns/html/acuf.html**>) is the body that provides guidelines about the processes for proposing names for undersea features, both large and small. ACUF accepts submissions at any time, researches submissions to verify uniqueness and appropriateness of proposed names, and meets at least quarterly to discuss and vote on name proposals before submitting name nominations to the full U.S. Board on Geographic Names for a decision. Decisions of the Board are accepted as binding by all departments and agencies of the Federal Government.

ACUF has changed its submission policy in the past two years to allow the naming of minor features. This change reflects the ability to use high-resolution imaging techniques to characterize the seafloor and has resulted in the submission of many hundreds of names in the Gulf of Mexico. ACUF anticipates many long lists of names submissions.

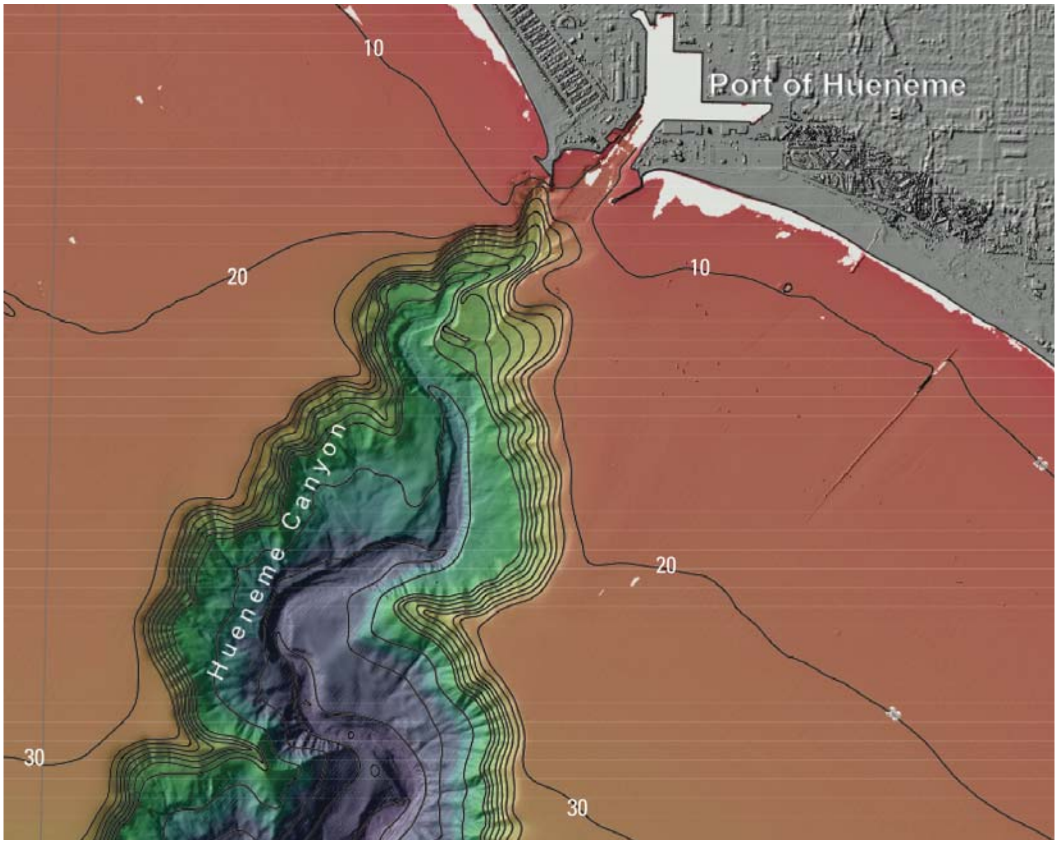
As the USGS member of ACUF, I'd like to walk you through some of the most common questions asked by people submitting names in hopes of encouraging you to submit new names and to help those of us who review name submissions.

What Can Be Named?

The ACUF accepts names for both major and now minor features. The first choice of a specific term, where feasible, should be one associated with a geographic feature (previously approved examples include Aleutian Ridge, Aleutian Trench, Peru-Chile Trench, Barrow Canyon). The specific term should be combined with a generic term selected from ACUF's list of 78 "feature designation names," which

(Naming Undersea Features continued on page 13)

(Naming Undersea Features continued from page 12)



◀*Hueneme Canyon was named for the nearby Port Hueneme (the city's harbor, Port of Hueneme, is labeled here), about 90 kilometers (55 miles) west-northwest of Los Angeles, California. Detected in 1855 during Coast Survey sounding operations, Hueneme Canyon is possibly the first seafloor canyon to be discovered. This view is an excerpt from sheet 1 of USGS Scientific Investigations Map 3225, <**http://pubs.usgs.gov/sim/3225/**>. Contours in meters.*

ranges from "apron" to "valleys" and includes definitions to guide usage. You can submit a feature name with a generic term that is not on the list, but know that ACUF members will use resources such as the American Geosciences Institute's (AGI) *Glossary of Geology* and *Dictionary of Geologic Terms* to verify that the proposed geographic feature name fits accepted definitions.

Specific names may be used to commemorate ships or other vehicles, expeditions, or scientific institutions involved in the discovery of the feature, or to honor the memory of famous people.

In cases where prior names were approved by the U.S Board on Geographic Names or appear in a body of scientific papers or charts, ACUF supports continued use of the major feature name.

Can You Name a Feature after a Living Person?

Yes, you can, but you need to document how the person fits the following criteria: "If names of living persons are used, surnames are preferable, and they should be limited to those who have *made an outstanding or fundamental contribution to ocean sciences*."

Inappropriate names include those of individuals occupying high offices who have not contributed directly and significantly to the knowledge of the oceans or undersea topography.

How Do You Make a Formal Submission?

You need to fill out a form specific to proposing undersea features. The more detailed your description the better, including coordinates, description of the feature, any prior map or chart references, reason for choice of name, discovery facts, any other supporting materials, and information about the submitter.

This is where your background work really helps ACUF members. If you are proposing a number of names in an area that has been mapped with high-resolution methods for the first time, try to relate the names you select to nearby major features with previously approved names. This means that a new name might be East or West "X Ridge" (where "X Ridge" is the previously approved name of a major feature), or new proposals might form a cluster of related, historically meaningful names such as Crockett Valley, Bowie Knob, and Travis Fan, all associated with the previously named Alamo Plateau.

If your proposed name recognizes a formal entity, such as an organization or federally recognized tribe, be sure to use the official name.

Where Do You Find the Submission Forms?

The form, as well as the standardization policy document that provides principles for naming features and a list of feature designation names, can be found at <**http://earth-info.nga.mil/gns/html/underseafeatures.html**>.

Questions?

You can contact me at **srussell@usgs.gov** or the ACUF Secretary at **underseafeatures@nga.mil**. ☸

USGS Ocean Data Ambassador Announces New Website for Marine Planning and Resource Management

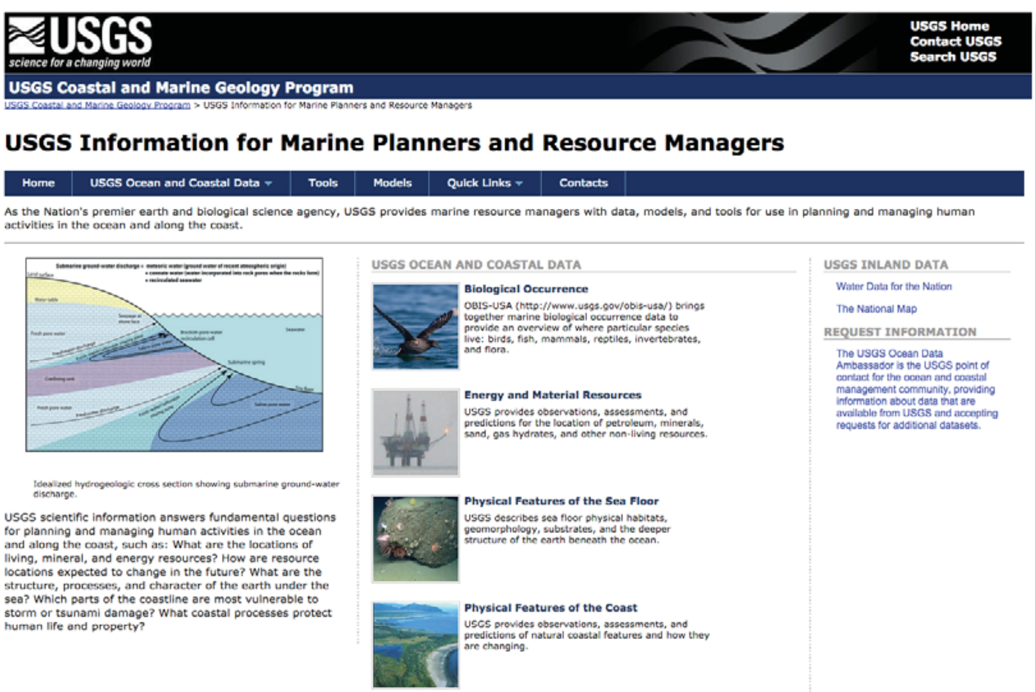
By Fran Lightsom

U.S. Geological Survey (USGS) scientific information addresses fundamental questions for planning and managing human activities in the ocean and along the coast, such as: What are the locations of living, mineral, and energy resources? How are resource locations expected to change in the future? What are the structure, processes, and character of the earth under the sea? Which parts of the coastline are most vulnerable to storms, tsunamis, or sea-level rise? What coastal processes protect human life and property? Assisting marine planners and resource managers in finding USGS data that answer such questions is the role of the USGS Ocean Data Ambassador, **Fran Lightsom** of the USGS Woods Hole Coastal and Marine Science Center in Woods Hole, Massachusetts. One of the services she provides is a new website, "USGS Information for Marine Planners and Resources Managers" (<**http://marine.usgs.gov/marineresourceinfo/**>).

The Ocean Data Ambassador will serve as the USGS point of contact for the U.S. ocean and coastal management community, with a focus on networking with regional ocean partnerships, regional planning bodies, and state and local agencies. In addition to providing information about data that are available from USGS, Lightsom will accept requests for additional datasets and work with USGS data managers to develop data products and services that meet the requirements of this important set of customers.

Lightsom is one of a network of agency ocean data ambassadors recognized by the Data and Information Working Group of the National Ocean Council. This network assists regional alliances and planning bodies in locating federal data for marine planning and other elements of the National Ocean Policy. (To learn more about the National Ocean Council and National Ocean Policy, see <**http://www.whitehouse.gov/administration/eop/oceans**>.) The ocean data ambassadors are also working to improve the utility of the data.gov ocean community (<**http://www.data.gov/ocean/**>) to provide these data in the future, but regional alliances and planning bodies need information now, so Lightsom developed the new USGS website for immediate use.

The website provides access to information from across the USGS, organized by using a set of data categories that describe the information needs for marine spatial planning. With this system of organization, marine planners can quickly identify which of their requirements can be met by the USGS. The website also includes links to USGS models and other tools that might be useful to this audience. In the future, Lightsom plans to rely on the USGS Science Data Catalog (**http://data.usgs.gov/**) to provide a comprehensive and automatically updated view of appropriate USGS data; but for now, data services and other resources are identified and linked to the website individually. Lightsom (**flightsom@usgs.gov**) would appreciate hearing from USGS colleagues who know of additional resources that could be added to the website. ☸



*The new website, "USGS Information for Marine Planners and Resources Managers," <**http://marine.usgs.gov/marineresourceinfo/**>, assists marine planners and resource managers in finding USGS information. New information will be added to the website as it is identified. In the future, the website will make use of the USGS Science Data Catalog (**http://data.usgs.gov/**) to provide consistent and comprehensive listings of USGS data that meet the needs of these customers.*

Shells from Deep Arctic Ocean Sediment Reveal a New Clam Species, Hint at Methane-Based Seafloor Ecosystem

By Paul Valentich-Scott (Santa Barbara Museum of Natural History), Tom Lorenson (USGS), and Helen Gibbons (USGS)

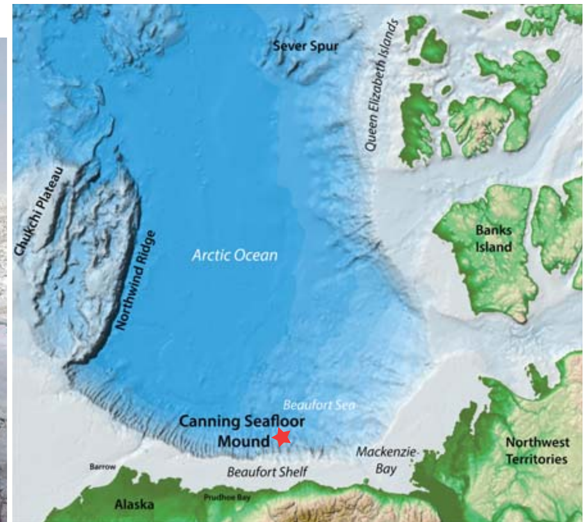
A new type of bivalve mollusk (clams, mussels, oysters, and their kin) has been discovered more than 2.5 kilometers (1.5 miles) below the ocean surface off the coast of northern Alaska. Shells of the new clam were found in sediment cores that penetrated as much as 4.5 meters (15 feet) below the seafloor surface. (No living specimens were observed.) Methane gas recovered from the same cores suggests that the clams may have been part of a methane-based ecosystem. The recovered shells' ages are estimated to range from a maximum of 1.8 million years old to near present, but scientists cannot discount the possibility that the new clam might still be alive today. The animal represents a new genus and species, and its discovery was reported in December 2014 in the open-access scientific journal *ZooKeys* (<**http://dx.doi.org/10.3897/zookeys.462.6790**>).

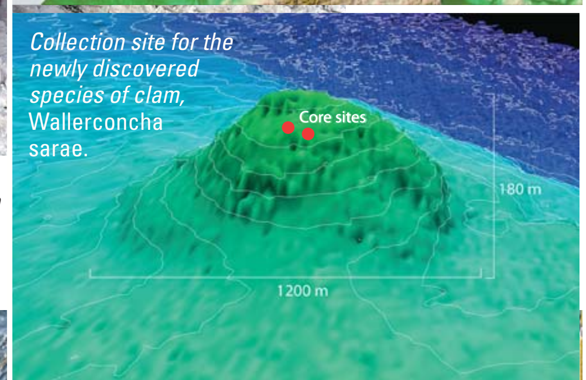
The path to discovery is seldom simple or easy, and this one is no exception. It resulted from the collaboration over several years of four scientists: geologists **Brian D. Edwards**, **Thomas D. Lorenson**, and **Charles L. Powell, II**, of the U.S. Geological Survey (USGS), and bivalve mollusk specialist **Paul Valentich-Scott** of the Santa Barbara Museum of Natural History (California).

In the summer of 2010, **Brian Edwards** (now a USGS emeritus scientist) was the chief scientist on a joint U.S.-Canadian icebreaker expedition aboard the U.S. Coast Guard Cutter *Healy* (<**http://soundwaves.usgs.gov/2010/08/**>). The primary purpose of the expedition was to map the Arctic seafloor and the sediments beneath to help delineate the outer limit of the U.S. Extended Continental Shelf, where the nation can potentially exercise sovereignty over seafloor and subseafloor resources in accordance with the international Law of the Sea (<**http://continentalshelf.gov/missions/10arctic/welcome.html**>).

(New Clam continued on page 16)

U.S. Coast Guard Cutter (USCGC) Healy *in the Arctic Ocean. Photograph courtesy of the U.S. Coast Guard.*





Collection site for the newly discovered species of clam, Wallerconcha sarae.

Gravity corer being deployed from the USCGC Healy. *USGS/ECS Project photograph by* ***Helen Gibbons****.*

(New Clam continued from page 15)

Edwards took deep sediment core samples to further understand the geology of the region (<**http://continentalshelf.gov/missions/10arctic/logs/aug11/aug11.html**>). The bivalve shells were discovered in sediment cores collected near the summit of an unusual seafloor mound, informally named the Canning Seafloor Mound, about 150 kilometers (90 miles) off Alaska's north coast (see map on page 15). The 130-meter (430 foot)-high mound was previously identified by USGS geophysicist **Pat Hart** while reviewing seismic-reflection data collected by the USGS in the 1970s. This site was targeted for coring because it lies above the crest of an anticline (an upward-bowing of the sediment layers) that brings older sediments closer to the seafloor. The clams were an unexpected bonus, as was a chunk of gas hydrate (an ice-like form of methane gas combined with water) found in one of the cores—the first methane hydrate sample reported from the deep Arctic Ocean basin. Additionally, residual gas recovered from the core liner contained a high percentage of methane.

After returning to his USGS laboratory in Menlo Park, California, Edwards worked with geochemist **Tom Lorenson** and other USGS scientists to open, examine, and sample the cores. They found numerous clam shells whose positions corresponded to depths ranging from 31 centimeters (1 foot) to nearly 4.5 meters (15 feet) below the seafloor surface. Many specimens were intact, with both top and bottom valves (shells) in place, indicating they had lived there instead of being carried there. The numerous shells, an odor of hydrogen sulfide, and the evidence of methane gas all suggest that the clams were part of a cold-seep ecosystem, in which the base of the food chain consists of bacteria that produce energy not from sunlight (photosynthesis) but from chemicals (chemosynthesis), such as hydrogen sulfide and methane seeping up and out of the seafloor. Like other cold-seep bivalves, the clams likely were nourished by chemosynthesizing bacteria living in their tissues.

Lorenson said: "We suspect the clams were part of a methane-oxidizing ecosystem occupying the mound, which is probably leaking a lot of methane from deeper sources." He and USGS biogeochemist **John Pohlman** collected methane, authigenic carbonate (carbonate minerals precipitated in place, commonly associated with cold-seep communities), and pore water from the cores to explore this hypothesis; their analyses are still underway. (Learn more about the cores and how they were processed at <**http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-12-23**>.)

*USGS scientists **Brian Edwards** (left) and **Andy Stevenson** collecting samples from the gravity corer. USGS/ECS Project photograph by **Helen Gibbons**.*

*USGS scientists **Tom Lorenson** (left) and **John Pohlman** begin sample collection from a core section. Photograph by **Bill Schmoker**, Polar TREC Arctic Research Consortium.*

The shells recovered from the cores were taken to USGS paleontologist **Chuck Powell** for identification. Powell was able to ascertain the higher level classification of the clam shells (Family Thyasiridae), but he was unable to determine the genus or species. Powell contacted **Paul Valentich-Scott**, a clam specialist from the Santa Barbara Museum of Natural History in California (<**http://sbnature.org/**>).

Upon examining these ancient shell specimens, Valentich-Scott was fairly certain that they were new to science. The hunt to validate the potential new species was on. Valentich-Scott contacted a number of thyasirid bivalve specialists around the world and all gave it a thumbs-up as a new species. Further, several scientists felt it also might be a new genus (the level above species).

"It is always exciting when you are the first person to be looking at a new creature," declared Valentich-Scott. "While I have been fortunate to discover and describe many new species in my career, it is always exhilarating at the outset."

Then the painstaking work began. Valentich-Scott contacted museums around the globe and requested to borrow specimens that were potentially related to the new species. Though he found many species that shared some characteristics, none matched the new Arctic specimens.

The four scientists have been writing up their findings for the past two years, and in December 2014, the work was published in the international science journal *Zookeys* (<**http://dx.doi.org/10.3897/zookeys.462.6790**>).

The new clam, *Wallerconcha sarae*, is named after two individuals. The genus is named in honor of **Thomas R. Waller**, a prominent paleontologist at the Smithsonian Institution (<**http://paleobiology.si.edu/staff/individuals/waller.html**>). The suffix "concha" meaning shell, was added to create the

(New Clam continued on page 17)

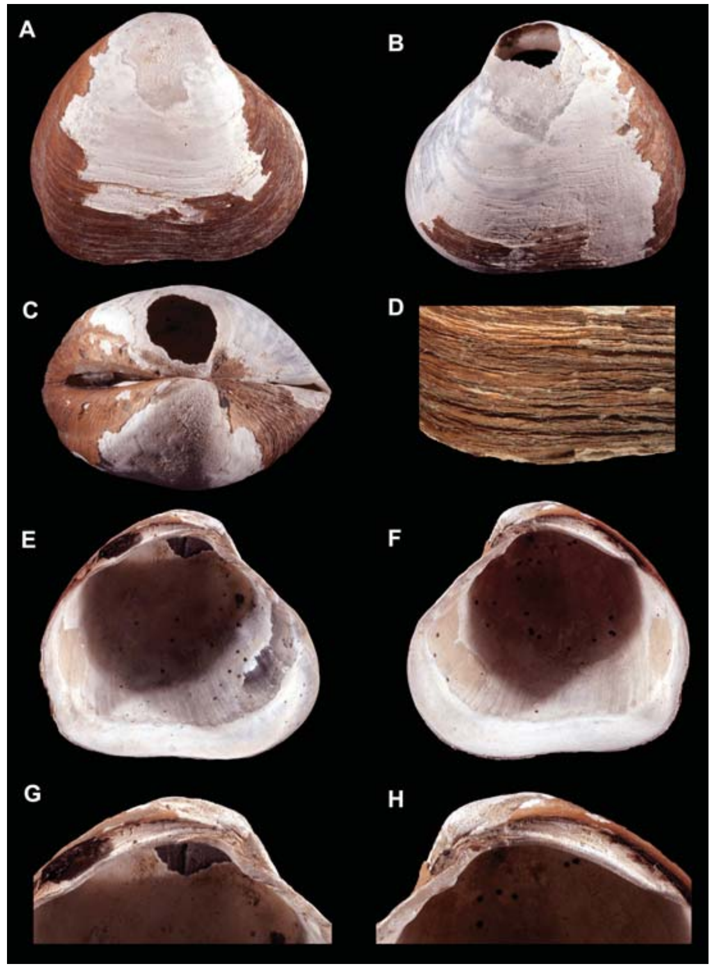
(New Clam continued from page 16)

name *Wallerconcha*. The new species is named after **Sara Powell**, the daughter of co-author Chuck Powell. Powell was quick to mention, “I want to name new species after all of my children.”

Although many of the specimens collected were clearly ancient, the scientists cannot discount the possibility that *Wallerconcha sarae* is alive today. Lorenson summarized it this way: “The likely collection of living specimens of this species awaits expeditions to come.” Who knows what other new creatures might be found in those expeditions?

The full citation for the new paper is:

Valentich-Scott P., Powell, II, C.L., Lorenson, T.D., and Edwards, B.R., 2014, A new genus and species of Thyasiridae (Mollusca, Bivalvia) from deep-water, Beaufort Sea, northern Alaska: ZooKeys, v. 462, p. 11–26 [**http://dx.doi.org/10.3897/zookeys.462.6790**]. ❅



A new species of bivalve mollusk was recently described and named Wallerconcha sarae. *Photograph by* ***Paul Valentich-Scott****, Santa Barbara Museum of Natural History.*

Outreach

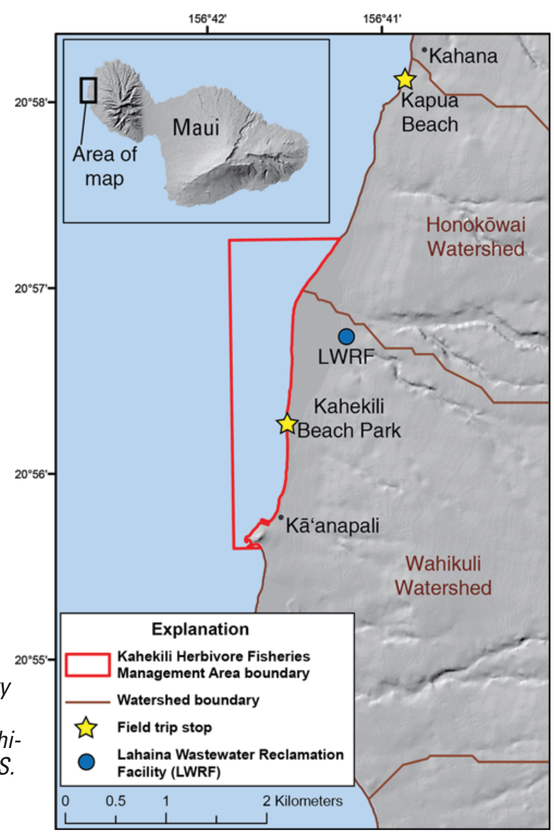
USGS Leads Field Trip for Attendees at U.S. Coral Reef Task Force Meeting

By Susan Cochran

During the fall 2014 meeting of the United States Coral Reef Task Force (USCRTF), held in Kāʻanapali, Maui, Hawaiʻi, **Curt Storlazzi** of the U.S. Geological Survey (USGS) Pacific Coastal and Marine Science Center (Santa Cruz, California) led a field trip along the west Maui coast to address the science behind the “Past, Present, and Hopefully Future of Maui’s Coral Reefs.”

The goal of the field trip was to provide participants with an overview of more than 15 years of integrated scientific investigations by federal, state, academic, and non-governmental organization (NGO) scientists to identify land-based sources of pollution from the Wahikuli and Honokōwai watersheds—primarily eroded sediment, nutrients from agricultural fertilizers, and nutrients and contaminants from discharged wastewater—and document the resulting impact on the adjacent fringing coral reefs. These watersheds have been designated as a USCRTF priority study site, underscoring their importance in the “ridge to reef” concept of marine ecosystem health.

(Coral Reefs continued on page 18)



West coast of Maui, showing the locations of the two stops (stars) on the field trip held September 12, 2014; the boundary of the State of Hawaiʻi Kahekili Herbivore Fisheries Management Area; and the Wahikuli and Honokōwai watersheds of the U.S. Coral Reef Task Force (USCRTF) priority study area.

(Coral Reefs continued from page 17)

The nearly 50 field-trip participants represented a broad range of organizations, including the U.S. Department of the Interior, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Aeronautics and Space Administration (NASA), State of Hawai‘i Division of Aquatic Resources, Hawaiian Islands Humpback Whale National Marine Sanctuary, Scripps Institution of Oceanography, University of Hawai‘i, and National Coral Reef Institute, along with interested members of the public. At both stops on the field trip, participants were briefed on the scientific issues and history of research at the site, including geologic and oceanographic controls of sediment, nutrient, and contaminant influx to the coral reefs, as well as how recent management efforts have begun to mitigate the impacts of these land-based pollutants. Discussions were followed by a snorkeling tour of the nearshore reefs.

The field trip started on Kapua Beach, located in Kahana at the very northern edge of the Honokōwai watershed, where Storlazzi described the legacy of 150 years of pineapple cultivation and other causes of upland erosion, and explained how sediment delivered to the coast has resulted in a shift from clear water and a healthy coral reef system to a nearshore environment with cloudy water and a veneer of mud on the reef and surrounding seafloor. He discussed how previous research by University of Hawai‘i ecologists motivated the USGS Pacific Coral Reef Project, in the 2000s, to focus its investigations on circulation and sediment dynamics in this area. Those USGS studies resulted in numerous scientific journal articles and USGS reports that advanced our understanding of how sediment moves through fringing coral reefs and provided data for scientists and managers. (For an overview of these studies, see <**http://coralreefs.wr.usgs.gov/maui.html**>.) While snorkeling, the field trip participants could see the abundance of algae, a muddy seafloor with little live coral, and few reef fish.

▲*U.S. Geological Survey (USGS) researcher, **Curt Storlazzi** (bottom left), discusses how 150 years of pineapple cultivation has affected the nearshore environment around Kahana, Maui, Hawai'i.*

▲***Mark Eakin** (National Oceanic and Atmospheric Administration Coral Reef Watch program coordinator) checks out the degraded coral reef off Kapua Beach, which is covered with land-derived mud and algae.*

At the second stop at Kahekili Beach Park, located along the central coast of the Wahikuli watershed, Storlazzi and **Darla White** (State of Hawai‘i, Division of Aquatic Resources) discussed the history of research into the impact of nearby wastewater injection wells on the coral reefs. These studies began in the late 1990s with inconclusive EPA investigations on algal overgrowth of the reefs, followed by successful studies by the University of Hawai‘i linking the algal overgrowth to nutrients in the wastewater. The USGS Pacific Islands Water Science Center followed with an observational study and numerical modeling that showed how the plume from the Lahaina Wastewater Reclamation Facility flows underground to the coast; this prompted the USGS Pacific Coral Reef Project’s high-resolution seafloor mapping and studies of physical and geochemical processes to understand the rates, volumes, and ultimate fate of constituents being discharged through the reef. Lastly, Storlazzi and White discussed

(Coral Reefs continued on page 19)

◀*Left to right: field trip participants **Karen Koltes** (Department of the Interior, Office Of Insular Affairs, Coral Reef Policy), **Tova Callender** (USCRTF West Maui watershed coordinator), and **Lori Faeth** (Department of the Interior, Acting Assistant Secretary for Policy and International Affairs).*

(Coral Reefs continued from page 18)

the recent success of the State of Hawai‘i Kahekili Herbivore Fisheries Management Area (established in 2009), which has improved the health of the coral reef by increasing the number of herbivores (plant eaters) that consume the algae growing on the corals because of the introduction of wastewater nutrients. During the underwater tour, participants were able to view nearshore submarine vents issuing nutrient- and contaminant-laden groundwater and nitrogen bubbles from the onshore injection wells, as well as erosion of the reef rock around these vents. A short swim northward, away from the vents, allowed the snorkelers to view a healthy coral reef, with an abundance of live coral, many reef fish, and little algae.

After seeing the effects of erosion and sedimentation—the “Past”—and wastewater discharge—the “Present”—the participants ended the day with this vision of the “Hopeful Future.”

Feedback from field-trip participants was positive and discussions were lively. Much of the talk centered on what the next steps should be to ensure the future of west Maui’s coral reefs. Many asked, “What should we do?” What was clear to all was the volume and breadth of the science that helps guide restoration efforts in this USCRTF Priority Study Area, and that the USGS continues to play a leading role in providing the basic and applied science on land-based pollution necessary to achieve these goals.

For further information see:

Cochran, S.A., Gibbs, A.E., and White, D.J., 2014, Benthic habitat map of the U.S. Coral Reef Task Force Watershed Partnership Initiative Kā‘anapali priority study area and the State of Hawai‘i Kahekili Herbivore Fisheries Management Area, west-central Maui, Hawai‘i: U.S. Geological Survey Open-File Report 2014–1129 (**http://dx.doi.org/10.3133/ofr20141129**). ?

Storlazzi, C.D., and Field, M.E., 2008, Winds, waves, tides, and the resulting flow patterns and fluxes of water, sediment, and coral larvae off West Maui, Hawaii: U.S. Geological Survey Open-File Report 2008–1215 (**http://pubs.usgs.gov/of/2008/1215/**).

Swarzenski, P.W., Storlazzi, C.D., and others, 2012, Nearshore morphology, benthic structure, hydrodynamics, and coastal groundwater discharge near Kahekili Beach Park, Maui, Hawaii: U.S. Geological Survey Open-File Report 2012–1166 (**http://pubs.usgs.gov/of/2012/1166/**).

USGS instrument (curved tube) off Kahekili samples submarine groundwater discharge from the seafloor for geochemical analysis. The blurry, shimmering columns in the water are areas where the fresher groundwater is mixing with the more saline seawater.

*▸**Tova Callender** (USCRTF West Maui watershed coordinator) swims above the healthy coral reef off Honokōwai, which has greater than 50 percent live coral and a low percentage of algae and sediment cover.*

*▴**Juan Torres-Pèrez** (NASA Ames Research Center; USCRTF Education and Outreach Working Group) gives the field trip a big thumbs-up.*

USGS Staff Participate in Grand Community Clean-Up—A Kickoff Event for the BLUE Ocean Film Festival and Conservation Summit in St. Petersburg, Florida

By Kathryn Smith

Personnel from the U.S. Geological Survey (USGS) St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida, participated in the Clam Bayou Trash Bash, a local volunteer trash clean-up effort conducted as part of the Grand Community Clean-Up, a kickoff event for the BLUE Ocean Film Festival and Conservation Summit (<**http://www.blueoceanfilmfestival.org/**>).

The BLUE Ocean Film Festival and Conservation Summit, an internationally recognized event celebrating ocean conservation and filmmaking, was held for the first time in St. Petersburg, Florida, from November 3–9, 2014. In previous years, BLUE has been hosted in alternate years in Monaco and Monterey, California. This year, BLUE selected St. Petersburg, Florida, because of the region's reputation for ocean-science research, its vibrant arts community, and its deep connection with the issues and challenges facing the world's oceans.

The Clam Bayou Trash Bash was organized by the University of South Florida (USF) College of Marine Sciences (<**http://www.marine.usf.edu/**>) and the nonprofits Chart411 (<**http://www.chart411.com/**>) and Keep Pinellas Beautiful (<**http://www.mykpb.org/**>). The event included volunteers from the USGS, USF student groups, Scubanauts, Admiral Farragut Academy, and additional agencies within the marine science community, such as the Florida Wildlife Conservation Commission and the National Oceanic and Atmospheric Administration. The volunteers removed more than 3,300 pounds of trash from Clam Bayou Nature Preserve, a 10-acre kayak and trail park that drains into Boca Ciega Bay and eventually the Gulf of Mexico. The removed trash included plastic bags, bottles, drinking straws, fishing line, and even a shopping cart and an armchair.

USGS participants included **Andrew Brownell**, **Christopher Moore**, **Amanda Sosnowski**, **Hilary Stockdon**, and **Kathryn Smith**, plus family and friends.☸

Clam Bayou Nature Preserve. Photograph from Southwest Florida Water Management District's Water Matters Magazine*, November–December 2012, <***https://www.swfwmd.state.fl.us/documents/publications/watermatters/nov-dec2012/1.html***>.*

USGS staff members ***Amanda Sosnowski*** *(left) and* ***Chris Moore*** *use a canoe to access trash and debris near the Clam Bayou Nature Preserve outfall.*

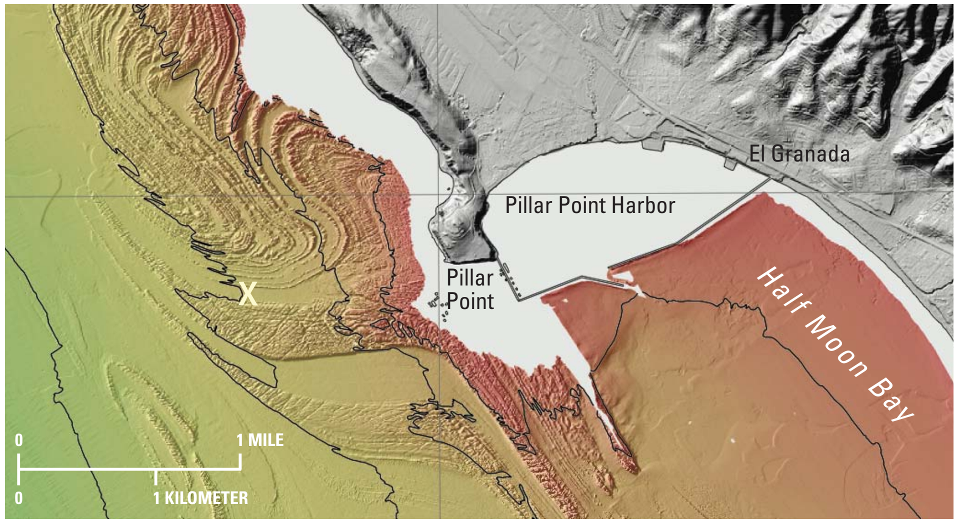
USGS research oceanographer ***Hilary Stockdon*** *and her son,* ***Ian****, pick up trash near the shoreline of a pond that collects stormwater before it enters Clam Bayou.*

Workshops on the California Seafloor and Coastal Mapping Program

By Sam Johnson

In October 2014, the U.S. Geological Survey (USGS), the California Ocean Protection Council (OPC), and the National Oceanic and Atmospheric Administration (NOAA) co-hosted two workshops on the California Seafloor and Coastal Mapping Program (CSCMP) at the USGS Pacific Coastal and Marine Science Center in Santa Cruz, California. Both workshops had the same agenda and title—"California Seafloor and Coastal Mapping Program Workshop"—but were attended by different groups of participants: one group on October 22 and a second group on October 23. These workshops gave the large CSCMP team an opportunity to update participants on all that they have accomplished and to receive input that will help them plan future efforts. CSCMP scientists are currently publishing a comprehensive geologic and habitat base-map series for all of California's State waters (from the shore out 3 nautical miles), and they are seeking feedback on how the program should go forward to best fit diverse scientific and stakeholder needs.

Each daylong workshop was attended by 45 to 50 participants, with representation from 32 different entities, including nine state agencies, eight federal agencies, five academic or research institutions, three regional associations, three nongovernmental organizations, and seven private-sector companies. The breadth of interests and expertise led to some enthusiastic and stimulating discussions. Here are some of the more salient points:



*Excerpt from sheet 1 of USGS Open-File Report 2014–1214 produced by the California Seafloor and Coastal Mapping Program. This view shows color shaded-relief bathymetry (seafloor depth) offshore of Half Moon Bay, California, approximately 30 kilometers (20 miles) south of San Francisco. Bathymetric data reveal the shape of the seafloor, including rough terrain (possibly rock outcrops), smooth terrain (possibly sediment deposits), canyons, and man-made features. Note the "white zones" that were too difficult for the mapping vessel to traverse, owing to rocky shoals off Pillar Point, docks and boats in Pillar Point Harbor, and shallow water beside the shore. (Learn about techniques for mapping such areas in "Mapping Coastal Changes Along Northern Monterey Bay, California," this issue, <**http://soundwaves.usgs.gov/2014/12/fieldwork3**>.) "X" marks approximate location of screenshot from seafloor video, below left.*

*Screenshot from underwater video used to interpret sonar data and develop habitat maps. Green laser dots are 15 centimeters (6 inches) apart. Learn more at <**http://dx.doi.org/10.5066/F7J1015K**>.*

- Participants expressed interest in new data collection and products for both the nearshore "white zones" (areas beside the shore that are particularly difficult to map and therefore remain white on present maps) and offshore federal waters (from 3 to 200 nautical miles offshore).
- Efforts must continue to provide maps and data in suitable formats, including web-accessible formats for data.
- Decision makers at all levels must be educated on how to access and use CSCMP map and data products. Decision-support tools should be developed to assist them, and science communication and translation should be a high priority.
- Mapping products and data have a very large range of applications and are essential for establishing baselines and monitoring change.
- Exploring and developing new partnerships for all CSCMP endeavors—such as data acquisition, map and data development and delivery, information management, education and outreach—should remain a priority.

CSCMP staff members are eager to continue the conversation and facilitate communication within the broad science and stakeholder community. They received valuable feedback from workshop attendees and hope to hear from those who were unable to attend. To learn more about the California Seafloor and Coastal Mapping Program, visit the project website at <**http://walrus.wr.usgs.gov/mapping/csmp/**>. To view the October workshop agenda and (or) leave feedback, visit the workshop webpage at <**http://walrus.wr.usgs.gov/mapping/csmp/workshop.html**>.

The workshop organizing committee thanks you for your interest:

Guy Cochrane (USGS)
Tim Doherty (NOAA)
Nadine Golden (USGS)
Sam Johnson (USGS)
Daniel Santillano (OPC)
Amy Vierra (OPC) ☸

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