

of kilometer-scale isolated and amalgamated scours. The scours are generated by large-volume submarine gravity flows [e.g., Talling *et al.*, 2007], which can erode large amounts of seafloor sediment and pose a significant geohazard to seafloor infrastructure. Current knowledge of deepwater scours is biased toward larger features, as smaller scours are typically beyond the resolution of standard mapping tools [Wynn *et al.*, 2002]. In contrast, studies of scours in the rock record tend to be biased toward smaller examples, due to limitations in the extent of rock outcrops. Very few rock outcrops, e.g., cliff or quarry sections, extend over distances that would allow for clear imaging of large, kilometer-scale scours. High-resolution AUV-based multibeam surveys may help to link the observations in outcrops with those from the seabed.

The surveys were performed using a Kongsberg Simrad EM 2000 multibeam system at about 100 meters above the seafloor, with a typical 24-hour mission covering an area of approximately 25 square kilometers. Data processing was carried out with the CARIBES software suite from the French Research Institute for Exploitation of the Sea (Ifremer). The final grid has a vertical resolution of approximately 15 centimeters and a pixel size of 2 meters. Maps were

imported immediately into a geographic information system (GIS), and they were available for the planning of new coring sites within 2 hours of the AUV reaching the sea surface.

The example in Figure 1 shows an area in the lower reaches of the Agadir Canyon, at a water depth of approximately 4200 meters. Large scours had been imaged previously in this region using deep-towed 30-kilohertz side-scan sonar (Figure 1c; see also Wynn *et al.*, [2002]). However, the new high-resolution images (Figure 1d) clarify the process of the scours' formation, which is through lateral amalgamation of smaller, isolated, spoon-shaped scours. Ongoing analyses of accurately positioned piston cores from within and outside the scours will provide further insight into the nature and timing of the scour formation.

With technological breakthroughs now focused on endurance and cost-effectiveness, deepwater AUVs will become more accessible for science, especially for high-resolution mapping. The new Autosub6000 data presented here provide an example of how AUV technology will advance the understanding of geological and biological processes operating in the deepest reaches of the ocean.

### Acknowledgments

The authors wish to thank the captain, crew, and scientific party of the JC027 cruise for their contribution to the first scientific missions of Autosub6000.

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- VEERLE A. I. HUVENNE, STEPHEN D. MCPHAIL, RUSSELL B. WYNN, MAATEN FURLONG, and PETER STEVENSON, National Oceanography Centre, Southampton, UK; E-mail: vaih@noc.soton.ac.uk

## NEWS

### Plume 1400 Meters High Discovered at the Seafloor off the Northern California Margin

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On 17 May 2009, the Kongsberg EM302 multibeam echo sounder on board the U.S. National Oceanic and Atmospheric Administration's (NOAA) *Okeanos Explorer* was collecting bathymetry and water column acoustic data offshore of northern California when it suddenly imaged a previously undiscovered 1400-meter-high plume (Figure 1) rising from the seafloor at 40°32.13'N, 124°47.01'W. The ship was mapping in water depths of approximately 1830 meters and heading east up the northern California continental margin 20 kilometers north of the Gorda escarpment. The continental shelf in this area is known to have subsurface and water column thermogenic and methane gas, although no plumes from this area previously have been reported from deeper than the continental shelf.

The plume, which rises vertically 1000 meters before being deflected to the north, was recorded for approximately 5 minutes before it disappeared from the data. The recording was made at night, so the ship's bridge watch was not able to see any surface manifestations of the plume at that time. The plume is composed of

individual streams of acoustic reflectors, best seen in a video assembled from the water column data ([http://ccom.unh.edu/NOAA\\_oceanexploration](http://ccom.unh.edu/NOAA_oceanexploration)). The digital terrain model created from the multibeam bathymetry shows that the plume rises from the base of a large, previously unknown, amphitheater-like failure.

The plume was mapped again by the multibeam echo sounder on board the *Okeanos Explorer* on 3 June 2009 during daylight. The ship's bridge watch was alerted by scientists to look for bubbles, discolored water, and other signs of irregularities

on the sea surface, but the watch did not report anything unusual. The ship stayed over the plume for 2.5 hours and lowered a conductivity-temperature-depth instrument equipped with water bottles and a redox sensor. Preliminary shipboard analysis of the data found no temperature anomaly and no unusual redox values. The thermosalinograph showed no indications of any surface events during that time.

Given this information, it is believed that this plume is not a hydrothermal vent and is not associated with the Mendocino transform fault. It appears from the characteristics of the feature that it is a plume of methane gas bubbles coated with a methane hydrate.

—JAMES V. GARDNER, Center for Coastal and Ocean Mapping, University of New Hampshire (UNH), Durham; E-mail: jim.gardner@unh.edu; MASHKOOR MALIK, Office of Ocean Exploration, U.S. National Oceanic and Atmospheric Administration (NOAA), UNH, Durham; and SHARON WALKER, Pacific Marine Environmental Laboratory, NOAA, Seattle, Wash.

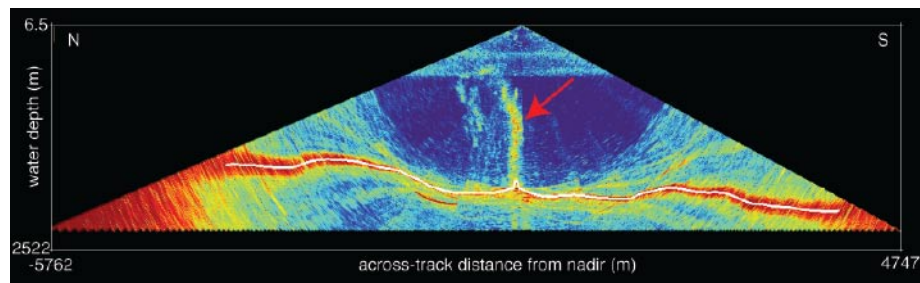


Fig. 1. Screen grab of the multibeam echo sounder water column display showing the plume (red arrow). The horizontal axis is across-track distance, and the vertical axis is water depth. The somewhat horizontal white line embedded in the red band is the seafloor acoustic return. The plume disappears from the water column at roughly 400 meter water depth.