


OKEANOS EXPLORER ROV DIVE SUMMARY

Site Name	Europa		
ROV Lead	Dave Lovalvo		
General Area Descriptor	100 km SSW of Grand Cayman Island		
ROV Dive Name	Cruise Season	Leg	Dive Number
	EX1104	-	DIVE09
Equipment Deployed	ROV:	Little Hercules	
	Camera Platform:	Seirios	
ROV Measurements	<input checked="" type="checkbox"/> CTD	<input checked="" type="checkbox"/> Depth	<input checked="" type="checkbox"/> Altitude
	<input checked="" type="checkbox"/> Scanning Sonar	<input checked="" type="checkbox"/> USBL Position	<input checked="" type="checkbox"/> Heading
	<input checked="" type="checkbox"/> Pitch	<input checked="" type="checkbox"/> Roll	<input checked="" type="checkbox"/> HD Camera
	<input checked="" type="checkbox"/> Low Res Cam 1	<input checked="" type="checkbox"/> Low Res Cam 2	
Equipment Malfunctions	Seirios Stbd Inner HMI Lamp burned out.		
ROV Dive Summary (From processed ROV data)	Dive Summary: EX1104_DIVE09		
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	In Water at:	2011-08-12T13:44:35.017000 18°, 22.072' N ; 081°, 51.149' W	
	Out Water at:	2011-08-12T23:04:03.925000 18°, 21.565' N ; 081°, 50.122' W	
	Off Bottom at:	2011-08-12T21:40:09.413000 18°, 21.849' N ; 081°, 50.319' W	
	On Bottom at:	2011-08-12T15:10:19.370000 18°, 22.076' N ; 081°, 50.838' W	
	Dive duration:	9:19:28	
	Bottom Time:	6:29:50	
	Max. depth:	2298.0 m	
Special Notes	Click here to enter text.		
Scientists Involved <i>(please provide name / location / affiliation / email)</i>	<p>Chris German (Science team lead), EX, WHOI, cgerman@whoi.edu Paul Tyler, EX, Uni. Southampton, pat8@noc.soton.ac.uk Cameron McIntyre, EX, WHOI, cmcintyre@whoi.edu Diva Amon, URI, Uni. Southampton, dja605@noc.soton.ac.uk Bobbie John, URI, Uni. Wyoming, BJohn@uwyo.edu Jameson Clarke, URI, Duke, jamesonclarke@gmail.com Mike Cheadle, URI, Uni. Wyoming, cheadle@uwyo.edu Jill McDermott, URI, WHOI, jmcdermott@whoi.edu Sarah Bennett, Home, NASA JPL, Sarah.A.Bennett@jpl.nasa.gov Cindy Van Dover, Home, Duke, clv3@duke.edu Julie Meyer, URI, MBL, jmeyer@mbl.edu Julie Huber, WHOI or Internet1, MBL, jhuber@mbl.edu</p>		

Purpose of the Dive

The aim of the dive was to locate the source of pervasive CH₄ and Eh anomalies detected in the water column at this site, near the SW limit of Mt Dent's summit, a prioritized area of note from independent analysis of multi-beam bathymetry and backscatter data collected during EX1104. The bathymetry suggested local peaks on a ~ 2km by 2km slump block. We expected the western edge of the block to be bounded by a N-S trending, high angle normal fault.

Description of the Dive:

Little Herc was launched at a site on the southwest corner of the top of Mt Dent. The ROV landed on a flat terrace underlain by thick biogenic carbonate. Locally the carbonate had patches and/or grooves filled with gravelly sediment (~5mm size grain size), including shells and dark particles - black and red-brown (volcanic spherules and/or basaltic clasts?). The first rock encountered was likely a boulder of pillow basalt (MCR-089). A possible pillow tube was also observed on the margin of the slab. A major boulder field (MCR091) was characterized by irregular boulders with both smooth/rounded surfaces and very angular surfaces. The dive continued through what appeared as pillow basalt and possible basalt sheet flows, covered in most areas by thick biogenic carbonate deposits. We observed a large gully/fissure striking @236° (parallel to the slope) cutting likely pillow basalts covered with sponges and thick biogenic sediment (MCR093). Later, a basalt scarp, covered with sponges was found forming the side of a ~5m wide spur, striking 124° approximately perpendicular to the main hillside (MCR095). The basalts may be a combination of pillows and sheet flows, covered by thick biogenic carbonate sediments. A similar sub-parallel spur was found striking 110° immediately to the south. At MCR096, Little Herc encountered a 041° striking ridge, with a parallel 1m wide fissure upslope through basalt below a sub-horizontal biogenic carbonate covered terrace. Another ~1m wide, 071° trending, fissure/crack through volcanic rocks (basalt) was found (MCR097). Little Herc then reached a 200m wide biogenic carbonate covered terrace at the top of the slope at E02 (MCR098). After traversing this terrace NNE-SSW (E02 to E03 waypoints), Little Herc continued SE up slope towards the highest point on the dive (waypoint E04). Between E03 and E04, Little Herc traversed distinctive sediment-covered outcrops of foliated rocks, different to those seen earlier in the dive, layered on the 5cm scale, that may be ropey sheet flows or 'foliated' fault breccias. This outcrop continued further S toward E04 and it was interesting to note that the nose of each layer/slab was somewhat rounded, rather than angular. The layering gently dips to the W, in places subparallel to the slope.

By MCR103, lithified biogenic carbonate appeared to lie below and inter-bedded with the layered/foliated rock. This locality was carefully imaged for future examination. It is possible that lava flowed over the sediment, thereby providing evidence that basalts were erupted onto the detachment fault surface after it had been exposed on the sea floor. Alternatively, the sediment may not lie below the thin sheet flows, but instead be banked up against a weathered fault scarp juxtaposing it against the lava. The final, but less likely possibility, is that the layered rocks are fault rocks from the detachment fault surface. The biogenic carbonate has ~5cm layering that appears more lithified than other carbonate found elsewhere, so it may be metamorphosed by overflowing lava. However, there is no clear evidence of a thin alteration rind against the sediment either symmetrically or asymmetrically disposed along contact.

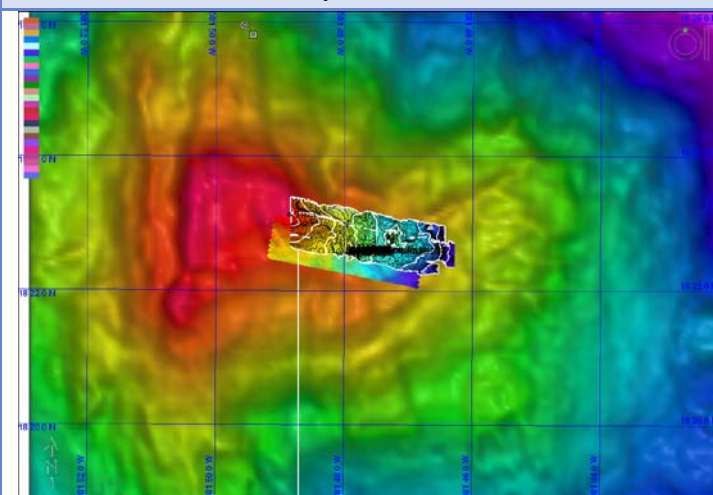
Near the summit at waypoint E04, NE trending structures consistent with extensional faulting were observed. We know this area has both NS and ~EW trending, so variations in fault orientation are not surprising. The surface between E04-E05 was covered by thick, pock-marked and tracked biogenic carbonate sediment. Little Herc continued along this surface to waypoint E06 (MCR105) through thick, pock marked and tracked biogenic carbonate sediment. At E06, Little Herc traversed through the water column due east to waypoint E09 and reached the seafloor near E09 (2160m) at the top of a small conical hill to the E of the main hill (at E04). Again the top of the hill consisted of a thick covering of biogenic carbonate. Little Herc briefly traversed to the north and no outcrops were found before Little Herc left the seafloor.

Today's traverse confirmed that the SW corner of the summit of Mt. Dent consists of faulted pillow basalts and sheet flows, covered by thick sequences of biogenic carbonate, much like those explored during dive 08.

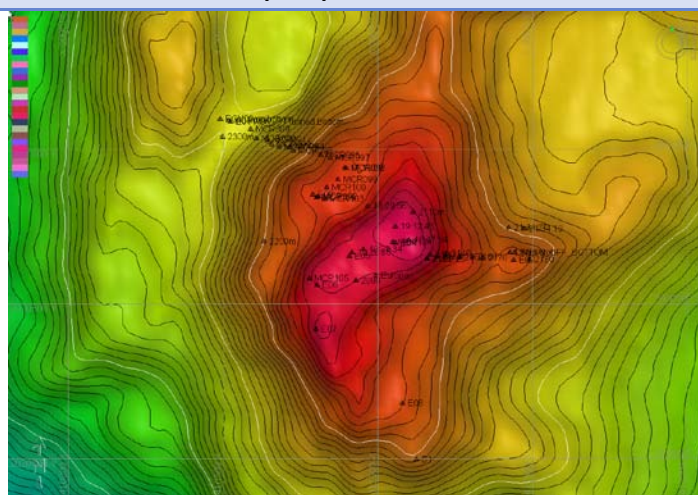
The fauna observed during the dive was typical of sedimentary and hard rock substrata in the deep sea. On sediment the holothurian ?

Benthodytes was the most common megainvertebrate. Also observed were the single-celled large protozoan xenophyophores that have a cell up to 10cm diameter. Occasional pagurids and galatheids were observed as well as two colonies of an, as yet unidentified, seapen, a cerianthid anemone and a burrowing anemone cf. *Peachia* sp. Lying on the sediment surface were a piece of thick bamboo and a piece of wood that may contain the wood boring bivalve *Xylophaga* but no siphons were seen. Isopods and galatheids were present on the wood. Where rock was exposed the surface was richly coated in suspension feeding species that almost obscured the rock surface. The fauna included sponges, large gorgonian colonies (both whip and fan), tubicolous polychaetes and serpulids. MCR098 was particularly rich. Also observed was the pale green stoloniferous octocoral similar to that seen at the end of Dive 07, but this time with no obvious hydrothermal fluid flow apparent. Nearby was a colony of white/grey alcyonians cf. *Xenia*. Throughout the dive we saw occasional fish including macrourids and possibly an eel, similar to *Synaphobranchus*.

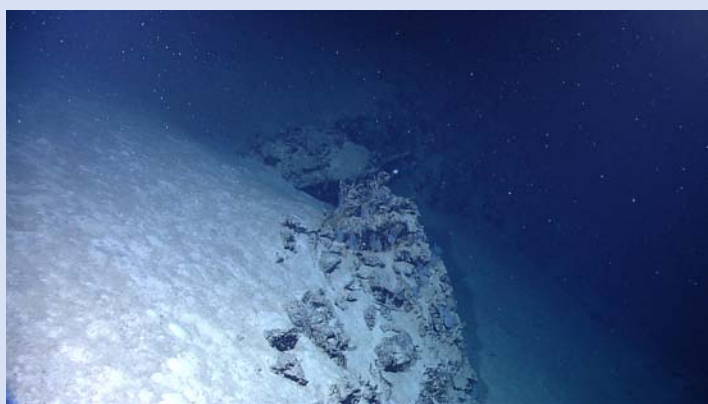
Overall Map of ROV Dive Area



Close-up Map of Main Dive Site



Representative Photos of the Dive



Rocks outcropping on a steep slope during the dive



Apparently layered rock with a sediment slope below

Please direct inquiries to:

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