OKEANOS EXPLORER ROV DIVE SUMMARY

Site Name	South Slope of the Von Damm vent site		
ROV Lead	Dave Lovalvo		
General Area Descriptor	100 km SSW of Grand Cayman Island		
ROV Dive Name	Cruise Season	Leg	Dive Number
	EX1104	-	DIVE06
Equipment Deployed	ROV:	Little Hercules	
	Camera Platfom:	Seirios	
ROV Measurements	☒ CTD	☒ Depth	☒ Altitude
	☒ Scanning Sonar	☒ USBL Position	☒ Heading
	☒ Pitch	☒ Roll	☒ HD Camera
	☒ Low Res Cam 1	☒ Low Res Cam 2	
Equipment Malfunctions	Stbd vertical thruster malfunction during descent		

ROV Dive Summary (From processed ROV data)

Dive Summary: EX1104_DIVE06

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In Water at:	2011-08-09T13:25:41.087000 18°, 22.490' N ; 081°, 47.906' W
Out Water at:	2011-08-09T23:15:10.044000 18°, 22.431' N ; 081°, 47.974' W
Off Bottom at:	2011-08-09T21:24:51.112000 18°, 22.607' N ; 081°, 48.018' W
On Bottom at:	2011-08-09T14:58:48.958000 18°, 22.397' N ; 081°, 47.848' W
Dive duration:	9:49:28
Bottom Time:	6:26:2
Max. depth:	2421.9 m

Special Notes	The purpose of this dive was both a science/exploration dive, as well as a live telepresence broadcast to shore for a joint VIP/media event with the Nautilus.
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Purpose of the Dive

The plan for Dive 06 is to traverse from SSE of Von Damm toward the base of the mound, to conduct a VIP event including broadcasting from the seafloor at the central Von Damm spire and then to continue exploration onward to the West of that vent site as time allows.

Specifically:-

10:30-12:30 (approx) we will dive at the launch point which coincides with a locale at which the HYBIS camera system recorded images of worm tubes in Spring 2010, approximately 400m SSE of the central Von Damm spire (Connelly et al., in review). We will then proceed north of there along the spur that extends SE away from the central southern limit of the Von Damm mound and where both high backscatter signals and Eh anomalies in the overlying water column were detected from the AUTOSUB 6000m vehicle during the same cruise (RRS James Cook 44).
12:30-14:00 VIP event preparation and broadcast, central Von Damm spire
14:00-16:00 continue exploration to West of Von Damm field.

Description of the Dive:

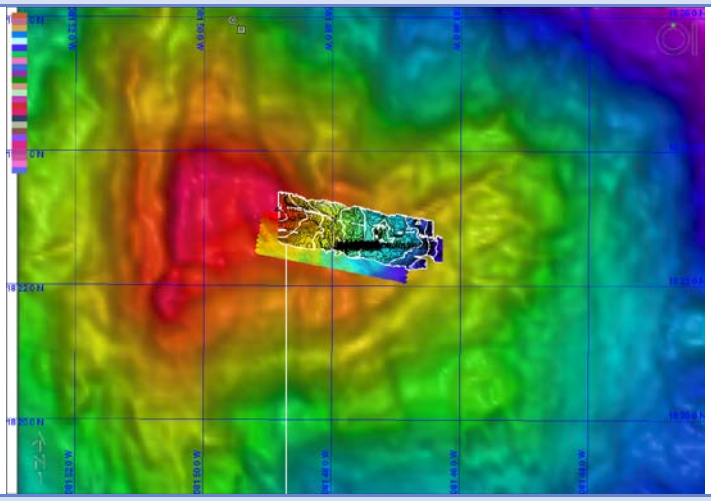
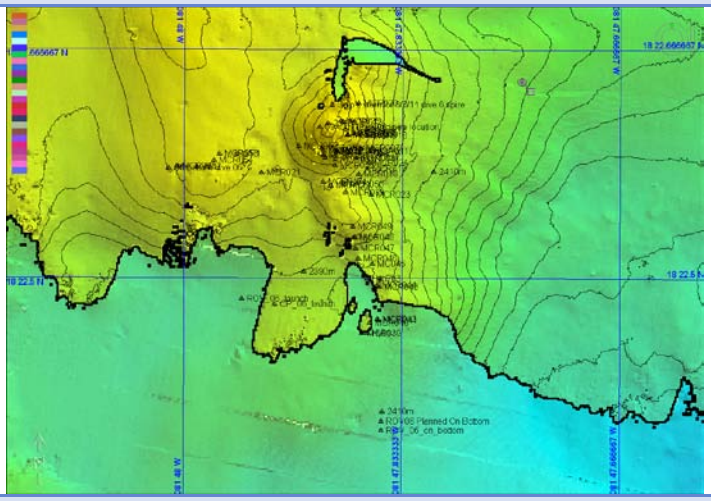
EX 1104 Dive 6, 9th August 2011: Geology, hydrothermal fluids and biology

Little Herc was deployed and landed on biogenic carbonate-draped sediment ~400m to the SSE of the Von Damm spire near a row of small mounds where Eh hits and tubeworms had been identified previously by the James Cook 44 Hybis 10 track (HDG 025°, ROV depth 2412m). To align with the JC44 track, Little Herc moved off bottom to a depth of 2409m, heading NNW and proceeded over pockmarked sediment. Sparse typical abyssal-plain fauna for this area was observed including the holothurian, *Benthodytes typica*, the shrimp *Sergestes* sp. and macrourid fish. There were some sparse rocks in this area, which had a few gorgonian corals, some actinarians with possible pennatulids present in sediment. After 20 minutes, the ROV encountered a granular textured outcrop of possible peridotite with Mn coating and hint of foliation. This outcrop showed a distinct vertical fracture cleavage, perhaps the best image of a fault in the ridge to Von Damn. A short time later, Little Herc encounted outcrops that were rubbly, with knobbly textures suggestive of differential weathering between pyroxene and olivine. However, the next outcrops consisted of rounded cobbles and larger clasts, consistent with basalt rubble. Continuing to follow this spur up toward the Von Damn dome we soon encountered extensive diffuse flow within the apparent basalt/talus outcrops hosting a greater abundance of tubeworms than we had previously observed anywhere eles on the central Von Damm cone in a single field of view (MCR039). There were also many areas of dense mussel shells (possibly *Bathymodiolus* sp.) partially covered in sediment, some of which exceeded 20cm in length. Also present were occasional galatheid squat lobsters (possibly *Munidopsis* sp.) on rocks and many aggregations of live tubeworms. Visual counts of these worms exceeded, at the very least, 20 living specimens. Many species of the fauna seen at the Von Damm site also appeared to be present here, including *Rimicaris* sp. and *Alvinocaris* sp. in low numbers, and white gastropods. One polynoid scaleworm was noted, as well as two unidentified siphons or tubes of an unknown species in crevices between rocks. Microbes were noted in these areas of diffuse flow. At MCR043 a particular highlight was noted with the co-existence of diffuse flow hosting microbial mats, chemosynthetic shrimp and chemosynthetic tubeworms. To our knowledge, and confirmed by many international colleagues following the progress of the dive on-line, this was the first identification worldwide of chemosynthetic shrimp and worms inhabiting the same vent-site. Continuing NNW, Little Herc passed over more tubeworms to a third site of robust shimmering diffuse flow venting through cracks in rocky outcrops with almost 0% sediment cover but with white gray microbial filaments coating the rocks and more abundant concentrations of particles suspended in the water column (MCR044). At this waypoint, we detected a small patch of shrimp among some visible diffuse flow in a ~2m high block. There were other waypoints with more or less the same description as MCR044 (both species of shrimp in low numbers, *Rimicaris* sp. and *Alvinocaris* sp., sparse galatheid squat lobsters, white gastropods, areas of dense dead mussel shells, sparse brisingid seastars and zoarcid eelpout fish). Basalt cobbles and rubble then gave way to slabby rocks indicative covered by an expanse of shrimp, all equally-spaced ~ 10cm from one another. The day's fifth diffuse vent fluids were exiting through ~5cm cracks in a 2m tall 1.5m wide rock edifice (MCR045). MCR045 revealed a small population of shrimp near some diffuse flow, yet it was peculiar and possibly significant that the shrimp seemed to be regularly spaced over the rock surface rather than closely flanking the the diffuse flow. Moments later we found the first

focused, higher T (estimated to be < 150°C based on the absence of anhydrite precipitation) clear fluids, jetting from two small (~30cm high, 10 cm wide) white beehive-shaped chimney structures, about 2m apart. The chimneys sit on a conical basalt rubble mound. Continuing north, Little Herc soon encountered a second focused high-T vent of the day (again, estimated to be < 150°C) jetting clear fluids from the "old man tree" weathered sulfide structure, about 1.5m tall with a smaller and a larger limb, connected at the base of the structure by a single conduit 'trunk' (MCR046). MCR046 was a site of focused flow where both species of shrimp were present in low numbers, *Rimicaris* sp. and *Alvinocaris* sp., sparse galatheid squat lobsters (possibly *Munidopsis* sp.), white gastropods, areas of dense mussel shells (possibly *Bathymodiolus* sp.), sparse brisingid seastars and zoarcid eelpout fish were present. MCR048 revealed very healthy tubeworms exceeding 1-2 metres in length. We then flew over knobbly rubble that comprised ≤1m boulders with lighter coloration toward their undersides, apparently due to extensive hydrothermal alteration. Sedimentation increased to 80% at a break in slope between the central Von Damm cone and the SSE trending spur. Turning due north toward the summit of the Von Damm cone, Little Herc then encountered a sixth area of low-T diffuse flow, white stained rubble with active diffuse flow percolating through a crack in cemented sediment (MCR 051). At this same MCR051 location, we also countered evidence of microbial film among some tubeworms – the first sighting of tubeworms so far upslope on the Von Damm cone *or* on the South flank of the cone - at a site that also hosted diffuse flow and associated (?) *Rimicaris* shrimp.

Toward the mid-point of the dive we arrived at the Von Damm main spire where time was taken for a live broadcast to shore and NOAA HQ in Silver Spring, MD, together with the Nautilus expedition diving on archaeological sites in the Black Sea. All of the species as noted on previous days were observed - both species of shrimp in huge numbers, *Rimicaris* sp. and *Alvinocaris* sp., white gastropods and zoarcid eelpout fish.

After approximately 1 hour our exploration was continued, descending to the South West limit of our prior "Square Spiral" survey passing a sedimented area with many individuals of *Benthodytes typica* before arriving at the 'coral garden' (MCR021) location. Here the rocks encountered were noticeably more "slabby" than the angular clasts found covering the Von Damm cone, perhaps indicating the presence of gabbro at this locale. Diffuse flow was confirmed supporting a collection of gorgonian octocorals, sponges, brisingid seastars, anemones and a few galatheid squat lobsters at this site. Many of the gorgonians were in very poor condition - dead and broken, although healthy gorgonians were also noted. There were aggregations of dead mussel shells between the rocks at this site and proceeding west, guided by AUTOSUB 6000 (UK) sonar data, we encountered a further outcrop of large (>6m) slabby rocks. These could be parts of the detachment fault surface, likely gabbro. This last area also hosted ery lightly shimmering flow percolating through lightly sedimented rubble (MCR054). At this last site, again, there appeared to be healthy populations of gorgonians corals, sponges, holothurians and a single specimen of the tripod fish *Bathypterois* sp. The dive overall provided a very successful test of a method using bright AUV-based sonar targets to lead us to interesting outcrops and discovering many patches of active fluid flow and associated fauna.

Overall Map of ROV Dive Area	**Close-up Map of Main Dive Site**
	
	Bathymetry courtesy of D.P.Connelly et al.

Representative Photos of the Dive

	
Small gastropods (snails) in hydrothermal fluid. Each one is about 8mm in diameter.	Concentrations of shrimp and a single zoarcid fish on the southern side of the Von Damm central Spire.

Please direct inquiries to:	NOAA Office of Ocean Exploration & Research 1315 East-West Highway (SSMC3 10th Floor) Silver Spring, MD 20910 (301) 734-1014