

Jason Dive J2-210, August 4-5, 2006 (GMT)

09:03 Off Deck

10:23 On Bottom: 3° 43.60'S, 151° 40.34'E, 1656 mbsl

23:50 Off Bottom: 3° 43.72'S, 151° 40.32'E, 1708 mbsl

01:10 On Deck

Aim:

The target of the dive is the Snowcap hydrothermal site, an area of mostly diffuse venting within the Pacmanus field in about 1650 m water depth. It is planned to sample two solid / fluid sample pairs, one at a site of active venting of high-T fluids and one diffuse fluid venting from an area outside a chimney field. Further, the extent and characteristics of hydrothermal activity in the area will be examined and documented. Part of that operation will be the description of the location of ODP Leg 193 drill holes 1188A and 1188F, both of which are marked by re-entry cones. It will be particularly interesting to learn whether or not the drill holes produce fluids. Upon surveying, samples of sulfides as well as fresh and altered rocks characteristic of the area should be collected. If time allows for further exploration; of the area around Snowcap, a small active(?) field at around x2500, y2350, z1720 can be visited and checked out for solid and future fluid sampling.

Co-ords for the landing site:

- **Lat/long:** -3°43.677' S, 151°40.240'E, 1630 m
- **UTM:** 352376, 9587832 (WGS84 Zone 56S)

Summary

Eh values dropped from 210 mV to 120 mV at a depth of 1600 mbsl and then come up to 175 mV on bottom. The area around the landing site is heavily sedimented terrain. Heading 270 to find the high-T chimneys at Snowcap, we came up a sedimented slope with occasional lava outcrops and heavy red and white staining. There is a hyaloclastite field near the top of the slope and a 3-4 m diameter crater that is the apparent source of the clasts (x2235, y2432, z1638, vvan#24698-24703). The feature is more than 40 m away from an ODP Hole, so very unlikely to be drilling-related. After crossing an area of continuous sediment cover with common whitish staining, a lava outcrop completely covered with white mat(?) was encountered (x2138, y2435, z1635, vvan#24718). Crossing more areas of mat development and a colony of corkscrew-shaped worm casings(?) at x2175, y2463, z1627 (vvan#24733), we reach the chimney field at x2150, y2429, z1639; vvan# 24740). Chimney field consists of two large multi-spired complexes that show patchy diffuse and semi-focused venting about half way up the structure 6-7 m tall structures. Smaller solitary spires in the area are all inactive. The field sits near the termination of a NE trending ridge and is about 15 m SW-NE and 7 m NW-SE. Some chimneys grow out of fissures in hard rock basement (x2151, y2439, z1636; vvan# 24800). Overall hydrothermal activity is minor.

Looking for the source of weak Eh anomalies detected by ABE at around x2100, y 2500 we head 015 along the NW border of the Snowcap dome. The area immediately north of the chimney field shows common diffuse venting and thick mats with occasional corkscrew worm colonies, snails, crabs, and rare mussel beds (e.g., x2167, y2471, z1632; vvan# 24850). There is no further hydrothermal activity in the area around the northern and shallowest part of Snowcap. At x2180, y2513, we change heading to 270 to explore

area of suspected hydrothermal activity (ABE Eh data). We find moderately sedimented volcanic terrains, mostly flat with occasional knolls that have scattered crabs. A 15-minute survey reveals no further hydrothermal indications in the area. Heading back to chimney field over sedimented rubble and pillowed lava flows to take fluid sample at chimney area. We approach the chimney field heading 136 and come across small beds of live snails beds and a large patch littered with dead snails (x2143, y2441, z1645; vvan# 24957). Set up to take fluid sample from a spot of semi-focused venting draped with an alvinella colony midway up a large chimney complex (x2143, y2430, z1643; vvan# 25007). T-probe measurements gives 107°C. IGT bottles 5 and 8 are fired. Bottle 8 records Tmax of 117°C; bottle 5 records up to 151°C, but nozzle jumps out of vent jet, during taking that sample. A majors bottle was also fired on this station. A spire of the complex is sampled that has no obvious fluid venting, but is colonized by shrimp (x2148, y2424, z1642; vvan# 25134). We place Marker 6 and head north to check out outcrops in the periphery of the chimney field. Set up to sample a light gray rock with possible sulfur veining (x2154, y2422, z1642; vvan# 25202). Take fresh sample (J2-210-2-R1) from slope debris at x2150, y2421, z1642; vvan# 25280).

Next we begin to traverse up the Snowcap dome to ODP Hole 1188A target (x2214 y2403 vvan# 25371). See plenty of galathea crabs and white stained gravel hyaloclastite. Come across a small 30 cm high white chimney, shimmering water, some larger extinct chimneys, white coating on seafloor. Continue over flat slightly domed gravelly seafloor covered with white material. A depression filled with gastropods and weak shimmering water, some mussels. Arrived at the ODP drill cone after spotting it in the sonar and heading north a little ways. We fly over the drill cone but no change in Eh and it looks too deep to take a temperature. This hole reached some 300+ meters into basement and was hot at the bottom of the hole when drilled, but no obvious venting now or in the past. Seems to be blocked by sediment fill. We retrace our track and head back a little way to the south and land to take a temperature of the top of the white stained dome. Sticking the probe into the ground the entire way (probe is 39 cm long to the hilt) got a temperature of 10.6°C after about 4 minutes (vvan# 25426). Surface temp. was ambient at 2.4°C. That translates into a ~20°C/m temperature gradient, ie 300°C at 15 m depth. A second measurement got 9.7°C. We tried a scoop of the gravel but failed so moved forward (south) a couple of meters and took a successful scoop of the gravel and white surface staining (3-R1 x2209 y2398 z1635). Tried a push core but the gravel/sand material has no cohesion and simply slurped out. We abandon this attempt. We moved off to the east to begin heading down the southern one of two lobes that extend out from the Snowcap dome to the east. Before leaving the dome however we came across a second drill hole, this time with no cone (z2243 y2423 vvan# 25593). Immediately after the hole we see a bucket lid #6 (x2248 y2418 vvan# 25608), which is apparently a CSIRO camera tow marker. Driving off the dome we cross heavily sedimented terrain or at least the flanks of the eastern member of the twin hyaloclastite cones that seems to comprise the Snowcap feature. We cross over a steep slope at 15:54 and turn onto course 110 to head to the Satanic South region which has a strong Eh hit in the ABE map. We cross heavily sedimented terrain which buries slabby/blocky lava forms. Eh begins to drop and we see biota density pick up with broken shells first then galathea and snails in cracks. Smoke appears in Medea, seafloor has extensive white and oxide staining, some shimmering water but weak. Increasing density of biota and now mussels (vvan #25719)

and then we spot a small area black smokers a few meters across and a few meters high (vvan# 25742). The tops appear extinct or sealed off but black smoke is emanating from small white chimneys near the base with the lava. We circumnavigate the structure looking for an appropriate fluid and chimney sample spot. We move into one side of the structure but too difficult to get Jason into so go around to other side. Here we knock over a large inactive sulfide that crushes our intended black smoker chimneys. We let the dust clear and try to get a fluid sample from remaining stump. Temp of bottle #2 gave 75°C but is suspect, may have broken the thermocouple. We collect the fluid anyway as J2-210-4-W1-IGT2 (x2490 y2376 z1716), no temperature record. We start to sample with gas tight #1, outside temp of stump is 2.5°C while fluid temp gets to 255°C. Decide not to sample here in the end and stow the bottle. Take a piece of the extinct sulfide that was knocked over (J2-210-4-R1) at same location. Decision is to move off and look for a more promising smoker and chimney target.

Vanko watch: We moved up the slope of a knoll to the NE; the relief was low, with mixed sediment and crusty-looking rock, a lot of biology (mussels, crabs and worms), and patches of white sediment (with lineatinos downhill) and Fe-staining. This all suggested the presence of diffuse venting throughout the area. A ridge on the way up has an angular cusped crest suggesting a current-generated bedform. Here and there are larger boulder-sized rocks. In an area of particularly abundant fauna, a platy rock (J2-210-5-R1) was sampled at a depth of 1702m (x2514 y2394; vvan 26100) and the T probe deployed. T(ambient) was 2.4°C, T at the sediment surface was about 5.5°C, and T with the probe inserted to the hilt was 20.4°C. Nearby, a shimmering water flow was measured at 8.2°C, but the probe could not be inserted very far. Pushing it in half way got a T of 12.9°C. The organisms are obviously concentrated along cracks and around the bases of rocks. Continuing up slope the biology drops off to a low background level, and the knoll is covered by an indurated sediment crust(?), sampled using a scoop bag (J2-210-6-R1; vvan 26256). At this site, the T measured with the probe inserted to the hilt was 11.4°C.

Coming down off the knob to the SW we encountered the chimneys visited previously by the 12-4 watch (according to Chris Yeats). We decided to try for a black smoker sample, and set up with some difficulty owing to the confined space. There are many dead spires here, as well as many that are coated in white but do not appear to have any flow. The number of actual venters is rather small (3-4 in view). The first sample was a small inactive spire (J2-210-7-R1), and finally, Phil got a good active chimney sample (J2-210-7-R2; vvan 26444). The whole >1-meter-high chimney was lifted, and the lower portion placed in the sample basket. The top fell off. The basal orifice was cluttered with biology and debris, nevertheless we sampled fluid with the gas-tight sampler (J2-210-7-W1-IGT1; T max = 296°C) and a majors sampler (J2-210-7-W2-M4; this was red M4, even though the sample log indicates the first majors sample was M4). Finally, we sampled loose rock immediately adjacent to the orifice (J2-210-7-R3; vvan 26643).

Leaving this chimney field we headed N to check out three small bumps up the valley, without finding much but mud and some rocks. Niskin bottles 1 and 2 were fired, and a course was plotted for a larger target hill to the SSW. At a SE-facing scarp of old volcanic rocks there was some iron-staining and an outcrop of white crusty rock that looked like indurated sediment. Pieces of it were disintegrating, but as sampling

commenced the rock was surprisingly tough (Sample J2-210-8-R1; vvan# 26847, 26858). This was a meter-wide outcrop (or more) of crystalline anhydrite rock.

Bach watch: A second, much larger sample was taken from the same location ((sampleJ2-210-8-R2; vvan# 26931). Going up the slope of the outcrop and pick up rusty looking sample of altered sulfide (x2461, y2366, z 1716; vvan# 26951; sampleJ2-210-8-R3). Upon reaching the top of the slope we spot mostly dead chimneys that appear gray (anhydrite?) and rusty (x2462, y2357, z1708; vvan# 26984). They are mostly inactive, except venting of gray smoke through tiny spires. We measure a temperature of 190°C at the tip of one spire. Sample a small piece of that spire and measure a temperature of 260°C in fluids venting from the stump (only 2 cm in diameter). We leave Maker 7 (vvan# 27088) and turn south to explore the chimney field further. Huge clouds of black smoke lead us to a chimney complex that is vigorously venting black smoke (vvan#27122). On closer inspection, we realize luminescence around the orifices of most pronounced venting (vvan#27134) and episodic, pulse-like emanations of what appears to be vapor. The entire structure, which is large and has a large number of orifices, is blowing black smoke at full steam. Yet, the structure is very sparsely colonized by macrofauna. This observation in addition to the fact that vigorous black smoker activity was not reported in any of the Shinkai dives to the larger Satanic Mills / snowcap area may suggest that this phase of activity started fairly recently. A temperature measurement gives temperatures up to 353°C (x2461, y2352, z1710). The water depth is 1710 meters, corresponding to a pressure of 172 bar. These pressure/temperature data fall exactly onto the boiling curve of 3.2 wt.% NaCl solution. The pulse-like bursts we observed might hence indeed relate to vapor generated by boiling of fluids. Dave Vanko suggested earlier that the luminescence we see around the orifices could be due to collapse of vapor bubbles – he could be right! What a way to end a dive! Not quite, we drive around the base and slopes of the mound and see hydrothermal activity in some form (diffuse seeps, staining, venting, biota) everywhere. The field is named “Fenway”. We will be back here soon!