

***Jason Dive J2-208, August 2-3, 2006 (GMT)***

**09:25 Off Deck**

**10:47 On Bottom: 3° 43.27'S, 151° 40.60'E, 1689 mbsl.**

**23:55 Off Bottom: 3° 43.14'S, 151° 40.45'E, 1907 mbsl**

**01:03 On Deck**

**Aim**

The target of the dive is a hydrothermally active area within the Pacmanus field on the Pual Ridge in about 1700 m water depth. Highest priority is to sample two solid / fluid sample pairs at sites of active venting of high-T fluids in the Roman Ruins and Roger Ruins area. 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 locations of ODP Leg 193 drill holes. Hole 1189B should be easy to locate by looking for two re-entry funnels stuck on top of each other. It will be particularly interesting to learn whether or not these drill holes produce fluids. Upon surveying the area, samples of sulfides as well as fresh and altered rocks characteristic of the area should be collected.

**Landing coordinates**

- **Lat/long:** -3°43.27' S, 151°40.60'E
- **UTM:** 353041, 9588583 (WGS84 Zone 56S)

**Summary**

Upon descent, and about 150 m E of the location of Roman Ruins, low Eh values (down to 186 mV) and very murky water was noticed around a depth of 1500 mbsl.

Jason landed on target in an area of moderately sedimented blocky lava flows and moved towards the target area (Hole 1189B; x2796, y3249), with a bearing of 293° and a range of 180m. We crossed several steep slopes of blocky lava; the lack of talus at the base of the lava flow suggests that the blocky appearance is due to autobrecciation, indicating highly viscous flows probably having a felsic composition. Crests of ridges are very rugged owing to the large number of big blocks (up to meter-sized) and platy fragments of lava. Small plateaus exist within this rough terrain that have smoother lava flow surfaces and a few cm of sediment accumulation.

The first indication of hydrothermal activity was in the form of microbial mats on a sedimented mound just E of a steep flow front with chimney talus in an area of diffuse venting and colonized by shrimp. On top of that slope are active chimneys in an area around the ODP re-entry cone of Hole 1189B. Several chimneys are lined up along a ridge striking around 340°. Multi-spined chimney complexes of considerable height (estimated 5-6 m) contrast with small solitary smokers with white beehive-tips that are occasionally developed in the area. The color of the smoke ranges from gray to black at the multispined complexes and from white to light gray for the white-tipped chimneys. Jason set up to take a sample of a 15 cm long chimney that is part of a multispined chimney complex. As we later realized, a sample of a relict chimney, densely colonized with barnacles fell into the basket at this point (sample J2-208-1-R3). T-probe measurements yielded temperatures of 307°C for the chimney targeted for sampling and 277°C for a neighboring chimney that was also venting black smoke. The top of the chimney was extremely friable and broke away upon measuring the temperature. The

more solid sulfide part of the structure remained and was picked for solid sampling following fluid sampling. IGT bottles 8 and 5 were successfully filled with fluid of 312°C and 314°C, respectively. A major sampler was also filled at this location. Sampling the solid chimney failed, because the piece fell away and could not be found near the bottom of the structure despite a 20 minute long survey. However, a small piece with obvious chalcopyrite inner linings could be retrieved from the stump of the former chimney. T-probe measured 6°C for outside wall of base of stump and 315°C for the venting fluids. We also sampled a piece of the core of the chimney structure with a knobby surface that turned out to be inactive sulfide. We left “Marker 2” in this area (x2795, y3254) and prepared to leave the station when a large inactive chimney collapsed and big chunks of it fell into the basket. All but one (sample J2-208-1-R4) of the debris pieces were removed from the basket. After covering the beautiful chimney scenery with the digital still camera, the area was left, bearing 230 to move deeper into the vent field. We went through a deep trough with sedimented blocky lava, until more sulfide talus going up the opposing slope led us to the next chimney field. Shimmering waters and rich biota (polychaetes, gastropods, crabs, and shrimp) in between fallen chimneys indicated hydrothermal venting. The actual vent field (x2799, y3237, z1670) has exclusively white beehive-tipped chimneys. They form structures between 0.5 and 7 m in height. The tall chimneys have rusty-looking, tree trunk-like stems crowned by porous and friable white tips that commonly vent gray fluids through poorly defined orifices. A knob-topped beehive smoker was selected for sampling (x2802, y3234, z1675). The T-Probe broke off parts of the extremely friable top of structure and measured 284°C. IGT bottle sampling collected fluids with temperature of 270 to 272°C. A majors sample was also taken here; but the snorkel was loose. Recovered rock samples include a small sulfide knob (208-2-R1), pieces of active chimney tip (solid to go with fluid) (samples 208-2-R2 and R3) as well as a large piece of white tipped smoker that was knocked over incidentally (208-2-R4). The stump of that chimney was venting fluid of 264°C. After being placed in the basket, a temperature of 40°C was measured from the center of the base of sample 208-2-R4). “Marker 1” was deployed before station 2 was left. The sulfide field of station 2 extends to the northwest in a line of tall, free-standing chimneys.

Moved with a bearing of 225°, following the contours of the chimney field, and sampled lava from talus field at x2778, y3225, z1683 (208-3-R1). Continuing to the SW, we came across inactive chimneys with rich biota (gastropods, shrimp, scale worms), but only patchy diffuse venting. Active smokers were seen at x2750, y3188, z1679 (target 17), where a sample of rusty-looking active sulfide spire was taken from a diffuser chimney (208-4-R1). The T-probe gave 236°C for the fluid venting from the sampled chimney. A second sample of a 20 cm high spire, colonized by shrimp, was also recovered (208-4-R2). Upon continuing to the SW, we came across Fe-stained volcanic rocks, fallen chimneys, and microbial mats. At x2727, y3181, z1677, active chimneys were observed (clear and gray venters, T around 178°C) growing next to fallen chimneys that were still smoking. A small cone in the bathymetry turned out to be a large extinct tall chimney, with a much smaller white smoker next to it (x2728, y3178, z1673).

The 0400GMT watch took over as Jason was reaching the top of the volcanic mound in the western Roman Ruins area. The seafloor was covered with fresh-looking blocks of

lava surrounded by sediment patches showing orange Fe-oxide and white bacterial colors. Smokers were not far, though, as the water was periodically cloudy, and more chimneys, both active and inactive and fallen, were discovered at the top edge of the mound. Heading southwest, Jason set up for a rock sample to characterize the nature (especially the magnetic properties) of the lava here (208-5-R1). Leaving the station with the intent or circumnavigating the volcanic hill in a clockwise direction, Jason traversed more blocky volcanic rocks with patches of orange sediment among them, then more wisps of smoke, then more of the rather “subdued” topography at the top of the hill. Before long a fallen chimney and then a small vent group was encountered. The group consisted of a half dozen gray smokers and a small clear fissure vent, with 106°C fluid emerging from the several cm-wide crack in presumably altered volcanic rock (the fissure walls were very fragile; vvan 20551). A few meters away a gray smoker was studied. The top 10-20 cm were easily knocked off like cigar ash by the temperature probe; the T was 277°C.

Leaving station 6 there were chimneys to the west, in the aft-facing camera to the east. Jason moved to the next large chimney, a 5-m high forked one to the NE with no venting at the top but vigorous venting about half-way up (vvan 20708). The temperature measured at the most vigorous orifice, which might be sampleable in the future, was 316°C. Marker 4 was deployed and should be visible if the chimney is approached on a 250° heading (vvan 20780, there is also a nice beehive near the marker, vvan 20796).

At this point Jason was most of the way around the volcanic hill, so a traverse was initiated northward into a bowl-shaped depression. Numerous chimneys were seen until the bottom began to drop away. The bowl is floored by large volcanic rocks (talus or in-place?) and sediment.

Jason then explored the ridge that encloses the bowl from the NW to the NE and found massive fallen chimneys among massive volcanic rock blocks. There were also active upright spindly spires. Station 8 was an unusual m-high knobby and globular chimney emitting clear fluid like a diffuser (vvan 20933). Grasping the top, the structure fell over and gray smoking commenced out of the stump. This was measured at 266°C. It was suggested that one could measure the clear flow at such a chimney, knock it over to initiate higher-T flow and measure it, then sample the chimney for fluids and solids. The two T measurements would provide a maximum for the temperature gradient across the wall of the chimney. Because of the unusual globular shape to this and other chimneys in this area, which contrasts greatly with other morphologies that we had seen, we coined the term “coproform” to describe them (as in “coprolite,” or fossilized dung).

The ridge north of the bowl is covered in sulfide. Station 9 was a 1-m y-shaped chimney that was diffusively venting clear fluid (vvan 21093). We decided to attempt the chimney knock-down procedure with temperature measurements before and after. The right-hand knob had a 39°C surface T, while the left-hand knob was 13, 4, and 11°C. The right-hand knob was sampled (not ideal, broken up, 208-9-R1) and the stump excavated to help initiate flow. A new T measured was 196°C. In theory, the chimney wall thus had a maximum gradient from 196°C inside to 39°C outside (although the new flow probably pulled isotherms up the chimney, so that’s why it is a maximum).

Continuing east along the little ridge the ship’s navigation went haywire for a short time (the ship lurched forward about 100 m), but good navigation was restored soon and Jason was still at Roman Ruins. At first the bottom was just rock and sediment, but chimneys were soon encountered again heading west.

Jason then was sent to the east toward station 1. On the way it passed areas of chimneys and areas of rock plus sediment (approx. 50-50 in extent).

We took a sample of the ridge crest basement that hosts the chimney structures at x2776, y3246, z1677. It is a mix of sulfide and completely altered volcanic rock baked together by hydrothermal alteration. The location of the sample was in a patch of diffuse venting (55°C), densely populated with shrimp. A 45 minute sonar survey of the area around station 1 and 2 was conducted SE and SW of location x2776, y3230.

Following the SM2000 survey, Jason headed for the presumed location of the Rogers Ruins vent field. At x2756, y3298 and after crossing rough, blocky lava flow terrain mostly through clouds of gray smoke, we found another large active chimney complex, venting gray fluids through chimney with varied shapes and heights, up to 10 m tall.

This was the northernmost high-T venting in the Roman Ruins field encountered during the dive. Continuing on a bearing of 308, we came up over two volcanic ridges. The first one lacked hydrothermal activity, while the second one shows oxide deposits and patches of diffuse venting (x2718, y3393). After going down the north slope of Pual Ridge a bit, we reached Rogers Ruins, which appears to be confined to a large complex of largely inactive chimneys sitting on top of a mound of block lava, with diffuse venting through oxide mats around its base. A small multispired chimney complex in the area is vigorously venting black smoke (x2672, y3426, z1716).

Finally, the Niskin bottles were fired in an area outside the immediate venting area at x2680, y3430.