HAWAII UNDERSEA RESEARCH LABORATORY

QUICK LOOK REPORT MISSION NO. P5-399

MISSION STATUS

Location: LOIHI

Mission Date: OCTOBER 14, 1998

Maximum Depth: ~1213 m.

Project Title: SUBMARINE HYALOCLASTITES

Principal Investigator: RODEY BATIZA

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Scientific Data Acquired : **Prepare an abstract outlining your objectives, techniques, findings, etc.**

Objectives were to explore for evidence for explosive volcanic eruptions on the Loihi summit area at depths of ~1200 m. Specific objectives were to look for evidence of deposits, do systematic sampling, find evidence for diversity, and try to locate source vents. A secondary objective was to locate and examine HUGO for changes since last inspection to prepare for revisit and instrument deployment.

We planned to investigate and pursue objectives through visual examination, video documentation, sampling (rock, sediment scoop, box core).

We achieved our objectives: We found ① vertical stratigraphic sequence of interbedded hyaloclastites, ② Mounds of hyaloclastites of possible hawaiian eruption origin, ③ possible hydromagmatic

deposits, ④ scoria-like deposits, ⑤ pillow mound with hyaloclastite mantle, and ⑥ we relocated HUGO.

Dive P5-399

MISSION EVALUATION:

Limitations, failures, or operational problems noted:

① NON-DIGITAL VIDEO WAS NOT TURNED ON: Thus all except digital video was lost.

② ALL AUDIO RECORD WAS LOST: (Because of 1). Attached Dive log is compiled from my notes taken during dive.

③ DIGITAL VIDEO WAS POORLY DONE: Much of this was off in space at sampling sites. See my video log notes.

④ SAMPLE BOX CORE FAILED: ④ Pilot made heroic effort. Such cores would probably have been better

Recommendations for corrective action or improvement:

FOR ① ② increase co-pilot training; provide check list to scientist observer so that they can ask and be shown the operational nature of such systems. For ③, provide lesson no for co-pilot in scientific video photography or turn videography control over to scientist observer.

In your opinion, did the mission essentially achieve its purpose? Compare actual work accomplished with the work that was expected to be accomplished.

The mission achieved its purpose; we found in situ evidence for hyaloclastite emplacement in three and possibly four different environments and we located candidate source landforms for these types of deposits. The loss of the video/audio is a major concern for the scientist observer and his obligations to the PI, but the copious notes taken during the dive offset the loss to some degree.

List specimens or samples collected on the mission.

These are listed in dive log and table in sample log.

Dive 399

DATA RELEASE

Data may be retained by the project leader for up to 2 years after the mission date with the following exception. NOAA may request to use photos for publication or publicity purposes at any time.

Fill in the appropriate statement below and sign this form.

I hereby release the data archived by HURL for public consumption following mission

SUBMARINE HYALOCLASTITES (project title)

held on OCTOBER 14, 1998 (date) in the following way:

a. CTD data by N/A (date)

b. voice transcripts, video, and still camera film by 10/14/1999 (date)

c. other N/A (date)

d. I will give my written consent to individuals wishing to use these data prior to the above dates depending on the nature of the request(s).

Principal Investigator

TRAVERSE OBSERVATIONS, SEDIMENT SCOOP AND ROCK SAMPLE DESCRIPTION LOG:
PISCES 5 DIVE 399: OCTOBER 14, 1999: J. W. HEAD, OBSERVER.
Notes recorded October 15, 1998.

-8:12 AM Hatch closed.
-Over water at 8:13 AM.
-In water at 8:15 AM.
-Began descent at 8:24 AM.
-Touched down at 9:30 AM at depth of 1196 m; Location 18 54.875, 155 14.628. About 240 m bearing 185 from HUGO.
-Turbulence obscures bottom for about 5 minutes.

-In patchy gray and light gray sediment. A few ripple marks present. There are some tan/brown linear ridges a few cm high and a few cm across looking like plunging folds at times. Appear to be surface exposures of buried nontronite layers.
-We descend into a sediment covered low area with small scarps which reveal outcrops with tan fragments at the base in a talus-pile-like arrangement. There doesn't appear to be much of a local source for these tan fragments so perhaps they are from elsewhere. Appear to be some darker layers in this but couldn't stop.

-1202 m, 9:55 AM. Excellent examples of small scarps less than one-half meter high with some stratigraphy exposed and small talus piles at base. There are thin laminations and layers, and the talus is fragmental black sand and nontronite-like material. Brown material is gelatinous and forms balls that roll across surface. This is probably what we are seeing in the local lows at the base of scarps (not to be confused with the black sand material).

STATION 1: (Lateral Mirostratigraphy Outcrop) Excellent layered outcrop of a variety of different colored fine-grained units overlying a coarser grained black fragmental unit in which the fragments appear loose and to form talus at the base. Definitely the talus is not a collection from the whole slope but is from a separate black layer underlying the others.
-Description of Layers:
Top:
1-Slopes back up to gray rippled surface.
2-Tan Brown to tan.
3-Black layer: Thicker by factor of 2-3 than the black laminae.
4-Gray-White; this unit consists of a lower gray unit and a middle white unit, with a thinner gray unit on top. Finer laminae in here are grey.
5-Yellowish-Brown-Tan with distinctive black laminations. Very distinctive colored layer. There are at least three of these toward the top of this layer and they are very laterally continuous. There appears to be a black lamination at the base of this unit and the top of the brown mottled layer.
6-Brown Mottled: Unlaminated, not internally layered coarsely mottled layer that is somewhat brown with what appear to be gray and white specks and splotches.

7-Black fragmental layer in which the fragments appear much coarser grained than the layers exposed above. This unit forms a break in slope and is the talus pile, but digging underneath the other layers, and the sharp upper contact indicate that it is a discrete and distinctive layer.
Bottom:

-Layers are thin and laterally continuous over 1-3 meter scale. The thickness between top of layer 6 and bottom of layer 4 is 10 cm as determined by laser. Interlayers are variations on dominant color (e.g., light tan versus dark tan) but black thin layers also occur throughtout. See detailed notes for cross section description and column. Brown material is gelatenous and forms balls that roll across the surface. Need to try to sample thin black layers because they might be individual laminae of specific events. Although layers are distinctly different in color and texture, they do not appear to have sedimentary scour or lateral variations between them suggesting large amounts of erosion between layers or laminae. Could some of them be related? This is a good area for the box core. Thde number of what appear to be black sand layers and laminae should provide evidence for different events in stratigraphic sense.

First Sediment Scoop: #5 (Box core site)
-Depth and time: 1203 m, 9:49 AM.
-Position: N54.812, W14.627 (Tracking Room Log has 54.818, 14.652).
-Description: Black sand, from basal layer underlying the coherent layers.

-Attempted to deploy the Box Core but were unsuccessful because of the large amount of sediment that was kicked up, creating turbulent white clouds that obscured even the sample basket.
-10:15 AM Still waiting for sediment to clear. May be down in a depression because we the current is not clearing away the sediment. Sub, however appears to be drifting somewhat.
-10:30 AM, 1202 m. Still waiting for sediment to clear.
-10:43 AM, 1201.7 m. Clearing a little and can now see the marker in sample b asket. Set to deploy marker, go to HUGO and then return to retrieve box core when sediment cloud is dispersed.
-10:45 AM Marker #7 is deployed on the bottom at 1201.6 m. 54.812, 14.627.

-10:53 AM, 1202 m, underway to HUGO heading 195. Leave some tracks to find our way back.

-En route: Sole-mark-like current scour in light gray and dark gray sediment, dominantly in southerly direction. No real deposits of black sand either on the surface or in scarps. Interspersed brown nontronite units of three different types:
1) Patchy discontinuous nontronite: brown material is covered with two-tone gray sediment and sticks out as 'kipukas' of brown islands that are often current scoured by vortices, producing horseshoe shaped collars that point upcurrent.

2) Continuous patches of brown material that appears to be stratigraphically above the two-toned gray sediment. These range from patches several cm to tens of cm across up to regions that are very laterally continuous. These deposits have a rough, often botryoidal surface, and have occassional chimneys.
3) Chimney dominated-occurrences: These are characterized by small chimneys a few cm across and up to several cm high. Some of these are oriented leaning away from the dominant current direction.

-Discovered HUGO cables and tracks and followed them to HUGO.

STATION 2: HUGO. 18 54.716, 155 14.651
-11:08 AM, 1206.6 m. HUGO looks the same, only the block is gone. No scouring and no more burial than before.

11:15 AM, underway from HUGO; traverse north along cable, then north along tracks.

STATION 3: Nontronite field 11:28 AM 1195.4
Percolating nontronite covering large area. This occurrence has a botryoidal texture and is dominantly tan, with a few gray to black mounds that appear to be venting. Thermal probe was inserted within this black mound and the ambient was 3.4 and the measured temperature 7 degrees (add 2.5 degrees to this according to Terry).

11:41 AM, 1201 m. Some black sand on the surface.

STATION 4: 11:44 AM, 1194.2 m. Black sand grid sampling stop.

Second Sediment Scoop: # 2
-Depth and time: 1194.2 m, 11:44 AM.
-Position: 18 54.75, 14. 60
-Description: Mostly black sand underlying gray layered strata containing other thin gray, whitish and black layers mm thick. Check to see if any of the gray layers are retained in the core to see if it is finer-grained equivalent of coarser-grained black sand or something completely separate.

11:53 AM, 1193 m. Underway again back toward Sampling station 1 (Box core site).

STATION 5: 11:55 AM, 1202.4 m. (Box core reoccupation site)
-1205 m, 12:53 PM, Attempted second try with box core; tried to emplace in the upper part of the stratigraphic sequence above basal black sand layer: Unsuccessful.

Third Sediment Scoop: #4 (Box core site)
-Depth and time: 1203 m, 12:11 PM.
-Position: 54.812, 14.627
-Description: From base of layered sequence in layer of black sand. In adjacent area about a meter away from the other.

Fourth Sediment Scoop: #8; but top came off so poured into #1; #8 used as pour scoop from here on.
-Depth and time: 1203.42 m, 12:25 PM.
-Position: 54.812, 14.627 (tracking room log shows 54.856, 14.636) Taken to the left previous sampling site by less than a meter or so (outcrop runs essentially E-W, so this came from slightly to the west).
-Description: After failure of box core, tried to sample upper stratigraphy, and sampled uppermost layers of layered sequence; sampled upper gray, black, lower gray down. Virtually all of this sample should be above the basal coarse black sand layer.

1:06 PM, 1201.77 - Recovered marker.
1:07 to 1:26 PM across sediment plain then up blocky talus slope, no evidence of fresh material except some nontronite. Lines of nontronite with spicule-like features. Some darker sand in these regions but probably just sediment; stopped and confirmed.
1:31 PM, 1166 m. Note old cable.
1:43 PM, 1153 m., on side of blocky talus slope; nothing fresh.

STATION 6: Fresh nontronite-encrusted black sand mound, almost to top of ridge.
Sixth Sediment Scoop: #9 (Nontronite-encrusted black sand mound)
-Depth and time: 1129 m, 1:50 PM.
-Position: 55.152, 14.473.
-Description: Nontronite-covered area with intersecting polygonal 'seams' of what appears to be freshed nontronite, almost like little linear vents. Polygons are about 0.5 m across. Could this be good evidence for relatively recent venting? This is sample of dark sand from under mostly poorly indurated nontronite polygons and fragments. This contains blocks and fragments which were also sampled.
-Left 2:02 PM. Proceeded up the slope of this mound.

STATION 7: Side o' mound.
Seventh Sediment Scoop #3
-Depth and time: 1110.75 m, 2:14 PM
-Position: 55.152, 14.473.
-Description: On side of mound, very blocky and large outcrops, inserted probe (4 degrees); Below nontronite layer appears to be some coarser black fragments, maybe scoria size. Scoop #3 is filled with coarse sand to small pebble sized; larger fragments appear to be rocks and to be somewhat vesicular. Intermediate to large sized fragments appear to be very glassy. Dug into this loose material with sampling arm to see if one could get evidence of layering or to reach other stratigraphic horizons. However, it was the same coarse black sand and scoria-like material as deep as we could dig (which was about 1-2 times the depth of the claw). As we dug down, material was not indurated and collapsed into micro-talus piles; as we did this, larger rock fragments appeared in the talus (derived out of the interior of the deposit) and these were sampled in detail, attempting to get a range of the observed rock types and sizes contained in this sample. Some of the

larger fragments are vesicular basalts. This outcrop and sampling site is well-displayed in the digital video.
-Rocks collected at this site: 3 basalt samples in gray (port box, aft compartment??) box. 1 in blue box (middle compartment). Last sample is large basaltic block that looks relatively unaltered and angular. As noted above, these came from within the fragmental material below the nontronite layer.

Ascendedfrom 1110 to 1101 m on this feature and turned into knife-edge about 18-30 heading, and then stopped at station 8.

STATION 8: Top o' Mound.
Following station 7, we ascended to the summit to see what we could find in terms of the source structures and relationships of the deposits just sampled. We reached the summit at 2:40 PM, at depth 1101, about 9 m higher than the last sampling site. We were in the range of 18-30 degrees of the previous heading. We observed that the slopes dipped off steeply on both sides. Summit has something like a pavement of somewhat platy fragments but not much evidence of larger outcrops. Looking for the possible extrusive component of the black sands.
-Rock samples: Total of 6 samples in port rear basket. The last is a large apparently vesicular very dark rock.

-2:52 PM, Left summit.

Underway again, and at
-2:55 PM we 'hit' and briefly 'grounded on' a small 'cinder-like' black sand ridge. When we hit this there was a very distinctive 'scrunching' sound as if we were going into coarsely granular material, as opposed to rock outcrop or block fragments (in which the noise was much more 'clanky.' We were of this and continuing on the traverse before we could really stop and observe more.

-2:59 PM at depth 1110 m. We encountered another knife edge ridge. In this area there was an extensive series of ridges and scarps. We encountered a distinctive pillow mounds. There were a wide range of these which showed very little evidence for associated black sands or pyroclastic candidates. We saw no nontronite deposits or layers on these in the patchy sense of what was seen on previously observed regions with lower slopes in which the nontronite was covering black sand or other sediment.

STATION 9: Summit of blocky ridge. This ridge has a lot more blocks and pillow-like structures than previous ones with black sand. Looks like a mixed mound, with pillows and black sand.

Eighth and Last Sediment Scoop: #6 (Mixed Ridge Site: Pillows and abundant black glass). This station is on an elongate ridge and we are on the summit! Blocky surface with nontronite cover; good black sand with more finely laminated gray and dark gray

sand/silt on top, but below nontronite). This material might be the upper part of the black sand deposit or it could be sediment overyling the black sand.
-Depth and time: 1109 m, 3:12 PM.
-Position: 55.208, 14.438.
-Description: Sampled patch of black glassy sand with more finely laminated material on top and lots of black sand below. The surface layer below nontronite has mm up to maybe a cm laminae (but dominantly mm) layers. Surface layer is only a few cm thick. Thickest laminae are lighter gray or perhaps white. Scoop sample #8 was used to take sample and then pour it into Sediment Scoop #6. The first part sampled, and thus the bottom of Sediment Scoop # 6 is the upper laminated layers. The rest is the coarser black sand below. Look for this stratigraphy in the scoop sample.
-Rock samples: Rock samples from this site near the black sand patch are going into forward port box. One jammed into thermistor probe container to hold it in. This includes four blocky angular fragments of basalt.

The two water bottles were filled here.

Ascent initiated to the surface from 1109 m, at 3:44 PM. Reached surface at 4:50 PM.

Summary of notes made during ascent for preliminary findings of Dive 399:
1) Excellent microstratigraphy of thick black sand and thinner laminae of black sand in overlying complex layered stratigraphy. Saw lateral continuity of individual black sand layers and vertical occurrence of numerous black sand layers. At least the major one (basal) appears primary. Could they be related in any way vertically?

2) Mound o' cinders/scoria: Nontronite covered but just below this almost all cinders and some vesicular basalt fragments. Scoop 9 partway up, scoop 3 near top and rock samples at top.

3) Pillow Mounds: Distinctive pillow mounds but no fresh deposits (young lavas) associated with these. These have little evidence of black sand or other pyroclastic deposits.

4) Mixed Cones: These have pillows and significant quantities of black sand.

5) Systemmatic spacing of samples: tried this wherever we could see evidence of black sand. Need to plot on map.

6) Relocated HUGO and made observations.

7) Relocated box core!! This took less time to find than the marker!!

Loihi Pisces V Dive 399: Digital Video and Sample Log: 1218/98

Sample log:

	Time	Depth	N	W	Comments
Scoop 5:	0949	1203	18 54.812	155 14.627	Sand below layer.
Scoop 2:	1144	1194	18 54.75	155 14.60	Transit stop.
Scoop 4:	1155	1202	18 54.812	155 14.627	Sand below layer.
Scoop 1:	1225	1213	18 54.812	155 14.627	Upper layers.
Scoop 9:	1350	1129	18 55.152	155 14.473	
Scoop 3:	1414	1110	18 55.152	155 14.473	
Rock sample 1.					
Scoop 6:	1512	1109	18 55.208	155 14.438	
Rock sample 3.					

Rock Sample 2: Summit of station 9/3 mound.

Scoop 8: Not used for sampling as lid came off during deployment.

Video Log for Digital Video Tape 1:

00:00 En route over sediment surface that is heavily scoured with sole-marks and mixed gray and light gray, sorted by current. Some nontronite blobs at the beginning. Nontronite layers) (tan) show up through sediments at various levels.

02:15 Found trench and following up to HUGO. Some tan nontronite blobs in trench of HUGO.

03:53 White cable is visible in trench. Background is same two toned gray rippled sediment.

02:43 HUGO encountered and video of this and adjacent sediment.

12:00** Stratigraphic sequence of layers at Station 1/5..

14:23 Scoop.

16:04 Becomes murky and cloudy; arm.

18:46* Good high resolution of upper black sand layer.

20:00 Observations of side view of sediment scoop operations; mostly useless or just off into sediment cover.

25:00* Some good views of the upper part of the stratigraphy.

25:43* Good view of landsliding and mass wasting of upper black sand layer cascading down side of scarp.

26:47 Arm and sampling operatons but no direct view.

28:36** Good views of the upper part of the stratigraphy, particularly the upper balck sand layer.

29:04 More turbulence and side view of sampling.

34:28* Now panning to the left into the stratigraphy and pile of what appears to be nontronite blobs.

41:00** Beautiful examples of the stratigraphy with excellent closeups. Shows some evidence of GRADING!!! and also some evidence for a greenish brown fragment mottled layer below the lower black sand layer.

45:30 Drifting off into upper sediment and watching manipulation of box core.

53:50 End o' tape 1.

Video Log for Digital Video Tape 2:

00:00 (Station 7: 1110.75 m; Scoop 3; rocks #1) This appears to be to Tan Nontronite layer with floating bacterial mats all over the place. Good images of exposures of course material (cinder-scoria like), digging of this and good view of larger fragments too. these are loosely (02:07)

03:27 Good very closeup views of individual rocks. And detailed views of vesicles.

04:51 Rounded rock closeup.

06:42 Sediment scoop 3.

11:00 Sampling rocks at Station 7.

12:39 Sampling rocks at Station 7.

16:12 Sampling rocks at Station 7.

18:56 Sampling rocks at Station 7.

19:24 Ascent up toward summit: this then shows the polygonal aspectr of the nontronite covering layers with the cracked ground and the bright markings in the cradcks.

20:32 Start to see platy rocks interspersed among nontronite plates and in between.

20:47 See crest of ridge with topography going off on both sides. Nontronite plates ared being shed of the knife sharp ridge crest.

20:50 Working up the ridge to the summit.

21:40 Some blocks (?).

23:07 Into fragments and what appear to be rocks. Now at summit to sample. Station 8 at Top o' mound. View of nontronite fragments off on the horizon. Could extensive deposits of nontronite be low temperature modification of hyaloclastites (Dave Clague).

29:14 Now starting to look at the actual margins of the sampling station. Good view of upper nontronite stratigraphy and fragmental material below. But the view goes on forever.

38:45 Some view of the rocks at the top of the mound. These are like the ones that were sampled.

38:52 Ascent and into the black.

41:08 Pillow ridge.

42:20 Intermittent view of the surface.

43:02 View of pillow ridge.

45:25 Edge of pillow ridge. Good views. Proceeding along margin. Talus breccias.

45:46 Good pillow ridges and ourcrops, breccia in between.

47:22 Nice cored pillow.

50:00 End of tape 2.