**HAWAI'I UNDERSEA RESEARCH LABORATORY**
**QUICK LOOK REPORT**
# DIVE: PIV-137

## MISSION STATUS

**Location:** Volcano 19, South Tonga (Tofua) Arc

**Latitude:** ***Begin*** 24° 48.395'S **Longitude:** ***Begin*** 176° 59.997'W

**Mission Date:** June 20, 2005 **Duration:** 3 hours 15 min (Bottom Time)

**Maximum Depth (m):** 540 m

**Project Title: SITKAP**
(Submersible Investigations of the Tonga-Kermadec arc using PISCES)

**Principal Investigator:** Prof. Peter Stoffers, Kiel University
Guest Scientist from Canada, Mark Hannington

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**Observer 1:** Mark Hannington **Observer 2:** None
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**Pilot 1:** Terry Kerby **Pilot 2:** Max Cremer

**Scientific Data Acquired:** Video, hand-held still photos, CTD, rock samples, bio sample, scoop samples, water samples, gas samples, geological map

**Objectives:**

Land close to the pit on the SE corner of the cone to sample clams (WP1). Transit to the area of active venting at the southern end of the summit (WP2, 430 m). Investigate possibility of more vigorous venting near the southern field. Transit to the large barite chimneys (WP3, marker #37, 385 m). Investigate smaller chimneys surrounding the main "barite tower". Sample a range of chimney types, knocking over one or two with active flow to create better vents for fluid sampling. Resample vigorous flow at the top of the large tower. If time permits, investigate areas of the cone along the 450-500 m contours for additional venting.

**Observations, findings, etc: (Also see Appended Dive Log)**

Summary: The dive was delayed due to a problem with the manipulator on Pisces V, and the morning was spent switching to Pisces IV. Pisces IV was launched in good weather conditions

at about 13:15, allowing a bottom time of 3.5 hours (extended to 17:15). The original objectives were not fully achieved, owing to the shortness of the dive and because of unexpected findings in the pit crater SE of the summit ridge. A vigorous high-temperature vent (ca. 270 deg C) was located on the SW slope of the pit in which clams had been observed during P5-639. The vents occur in an area of sedimented talus, close to the projection of the EW-trending dikes noted on the east wall of the pit. A large area of sedimented talus (approx. 50 m x 50 m) at the SW corner of the pit is littered with clams and mussels, partially buried in the sediment. Outside the area of sediment, more diffuse venting was observed in the bare talus. Several fractures and ridges in the sediment-covered talus are punctuated by active venting through holes in the sediment and as small (<1 m) anhydrite spires, leading up to the rim of the pit. One sample of a smaller spire was collected (R1) and a minimum temperature of 200 deg C. was measured in the flow after the chimney was samples (only the low-temperature readout was available, so the actual temperature of the vent was likely higher). Marker #40 (560 m) was deployed immediately down slope from this vent. Near the center of the area of diffuse venting, on the sedimented slope, two large anhydrite spires (one active and one inactive) were found on low mounds of anhydrite debris (collapsed material from former chimneys). The active vent comprises a single large spire, about 1.5 m tall (narrow at the base and branching into 3 spires at the top). Several smaller active chimneys occur through the anhydrite talus at the base of the larger spire. Three small 2-phase vents (flame-like steam venting) were observed on the spire. When knocked over, an open hole at the base of the spire (ca. 10 cm diameter) began to vent vigorous 2-phase fluid. Two major samples and two gas-tight samples were collected in this hole. A precise temperature could not be measured, but 2-phase venting at this depth (540 m) indicates a minimum temperature of about 260-270 deg. C. Several small pieces of the large spire that was knocked over were collected: R2 (a) several friable anhydrite-rich pieces from the top of the chimney, (b) several small pieces of chalcopyrite-lined chimney wall, (c) one large coarsely crystalline, massive anhydrite sample with chalcopyrite and sphalerite/wurtzite from the base of the spire. A short transit upslope from the vent revealed several additional patches of venting. At the rim of the pit, venting was no longer observed, but the rim is covered in thick deposits of Fe-Mn crust. No Fe-Mn crusts were observed in the pit, suggesting possibly that the crater and active hydrothermal vents are relatively recent features associated with late intrusions of dikes.

**Species List:**

As for Dive P5-639, except for the large mussel collected at the first station (near R1).

**MISSION EVALUATION:**

**A. Limitations, failures, or operational problems noted:**

Absence of a high-temperature probe. Otherwise none.

**B. Recommendations for corrective action or improvement:**

None.

**C. In your opinion, did the mission essentially achieve its purpose?**

Yes. The results were quite different from the planned objectives, owing to the discovery of the new vent.

**D. Compare actual work accomplished with the work that was expected to be accomplished.**

An excellent collection of both waters and hydrothermal precipitates was recovered, together with biological samples from the vicinity of the vents.

**E. List specimens or samples collected on the mission. (See Sample List Below):**

| Sample Number | Time (L) | Latitude Min/decM 24degS | Longitude Min/decM 176degW | Depth(m) | Comments Volcano 19: |
|---|---|---|---|---|---|
| PIV-137-R1 | 14:29 | 48.443 | 0.003 | 555 | Small 30-cm-high anhydrite chimney from 1m sq, venting area in sediment. |
| PIV-137-Bio Sample | 14:45 | 48.433 | 0.003 | 555 | Single large mussel and multiple smaller white clams partially buried in sediment around the small vent. |
| PIV-137-Scoop#2 | 15:45 | 48.450 | 59.985 | 542 | Soft anhydrite from collapsed material produced by knocking over the large spire. |
| PIV-137-MS-blue | 16:00 | 48.450 | 59.985 | 542 | Water sample (blue major) from vigorous 2-phase venting out of the hole left by knocking over the spire. |
| PIV-137-GT-y | 16:14 | 48.450 | 59.985 | 542 | Water sample (yellow gas tight) |
| PIV-137-GT-r | 16:21 | 48.450 | 59.985 | 542 | Water sample (red gas tight) |
| PIV-137-MS-r | 16:37 | 48.450 | 59.985 | 542 | Water sample (red major) |
| PV-636-3-R1 | 14:09 | 48.450 | 59.985 | 542 | Pieces of the large spire: (a) soft anhydrite from the top of the spire; (b) several small pieces of harder chimney wall lined with fine-grained chalcopyrite; (c) one large coarsely crystalline, massive anhydrite sample with chalcopyrite and sphalerite/wurtzite from the base of the spire. |