New Zealand American Submarine Ring of Fire 2005

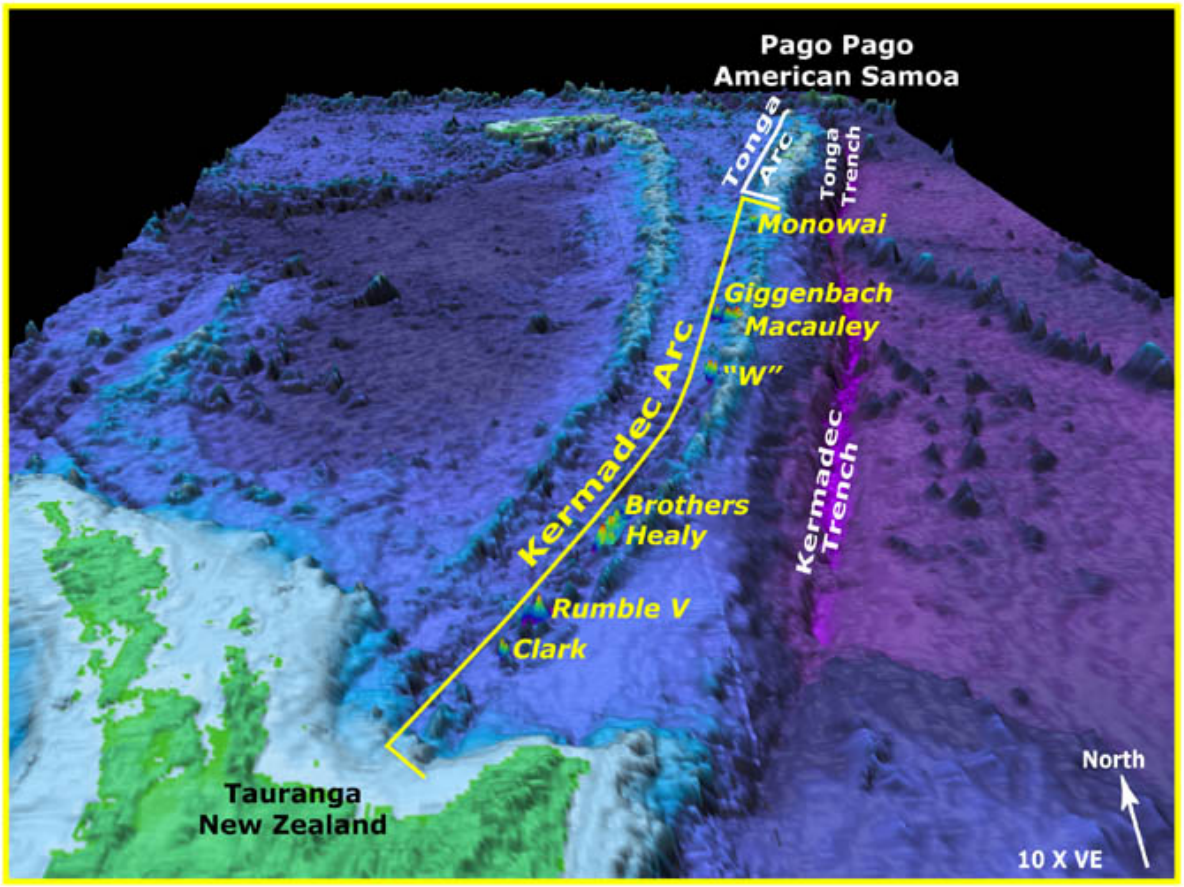
Kermadec Arc Submarine Volcanoes

***R/V Ka'imikai-o-Kanaloa*, Cruises K0K-05-05 and KoK-05-06**

***Pisces V* Dives PV-612 - PV-628**

***RCV-150* Dives D310 - D312**

Leg I: April 3 (Pago Pago, American Samoa) - April 22 (Tauranga, New Zealand)
Leg IIa: April 25 (Tauranga) - April 29 (Tauranga)
Leg IIb: April 29 (Tauranga) - May 10 (Tauranga)



An overall image of the New Zealand American Submarine Ring of Fire 2005 expedition dive sites. Yellow text indicates *Pisces V* dive sites. The cruise track between Pago Pago and Tauranga covered over 2900 kilometers. Bathymetry data sets for this image include low-resolution satellite altimetry data from Sandwell and Smith (bottom layer), and high-resolution EM300 bathymetry data in the area of the dive sites (top layer). The EM300 bathymetry data are provided courtesy of New Zealand National Institute of Water and Atmospheric Research (NIWA). Bathymetry data are vertically exaggerated. ten times.

New Zealand American Submarine Ring of Fire 2005 (NZASRoF'05)
Kermadec Arc Submarine Volcanoes
R/V Ka-imikai-o-Kanaloa, Cruises KOK05-05 and KOK05-06

Leg I: April 3 (Pago Pago, American Samoa) - April 22 (Tauranga, New Zealand)
Co-Chief Scientists: Gary Massoth and Bob Embley
Leg IIa: April 25 (Tauranga) - April 29 (Tauranga)
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Co-Chief Scientists: Bob Embley and Gary Massoth

Cruise Report Compiled by: Susan Merle, Bob Embley and Bill Chadwick

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1.1 NZASRoF'05 Expedition Summary

Bob Embley, Gary Massoth and Alex Malahoff: Co-Chief Scientist Legs 1 and 2

The NZASRoF-o5 cruise track between Pago Pago, American Samoa and Tauranga, New Zealand transited more than 2900 kilometers during the first leg, stopping at 5 volcanoes (Monowai caldera, Macauley, Giggenbach, "W", and Rumble V) for 11 *Pisces V* submersible dives, 2 *RCV-150* remotely operated vehicle deployments, and 3 CTD vertical casts. The second leg transited over 1350 kilometers between Tauranga, New Zealand and Brothers Volcano, stopping at 4 volcanoes (Clark, Rumble V, Healy and Brothers) for 6 *Pisces V* dives, 2 CTD tows and 1 vertical cast. Seven moorings were also recovered at Brothers (requiring 1.5 operational days). A single potential dive day was lost to weather during the first leg and 7 days were lost during the second leg. No dives or over-the-side operations were lost to equipment malfunctions. Seventeen interdisciplinary (geology + chemistry + macro-biology + micro-biology) dives were completed, compared to 20 planned dives (85%). All but one of the targeted volcanoes were visited and an extensive suite of samples (more than 200 fluid, rock, mineral and biology samples) was collected. Monowai cone was in a period of active volcanism, as validated by acoustic monitoring by French scientists in Tahiti, therefore we determined it was not safe to visit that dive site. We thank the HURL group and the *KoK* personnel who worked very hard to prepare for this expedition, ensuring that the science teams got the maximum possible return from the dive programs.

The mission findings include:

(1) A shallow hydrothermal system at one of the Kermadec volcanoes has yielded very high total gas contents equal to the highest values measured at Mid-Ocean Ridge (MOR) sites. Boiling vents produce gas bubbles at 202° C (396° F), which is about 2 times the boiling point at sea level. These hydrothermal systems are well within the photic zone at 160-180 meters (~290-330 feet). Schools of fish interact with abundant chemosynthetic life that includes prolific microbial mats and beds of mussels.

(2) The high gas content at some arc volcanoes is accompanied on the seafloor by abundant precipitation of sulfur directly from the vent fluids and from small sulfur “flows” oozing from fractures. This high gas content is evidence for direct degassing from underlying magma chambers. This “magmatic degassing” process may be ubiquitous on submarine arc volcanoes and could lead to new insights into ore-forming processes, including a better understanding of the processes that concentrate gold and other precious and exotic metals.

(3) The extreme and varied chemical and physical conditions within the subsurface and seafloor hydrothermal systems of arc volcanoes are likely to host microbial life with unusual adaptations including new and unique enzymes. We believe that these have a high potential for developing new natural products of interest to industrial and medical research.

(3) Results from the present dives on the Kermadec Arc and from the 2004 dives on the Mariana Arc appear to show a high productivity of chemosynthetic communities relative to MOR communities. This is probably at least partly related to the enhanced level of magmatic activity of arc volcanoes which typically yields more sulfur gases.

(4) The chemosynthetic biological communities on the Kermadec Arc are dominated by mussels. Although the individual communities have, from initial observations, lower biodiversity relative to MOR vents, the biomass at some sites is high and each appears to have a unique combination of macrofauna. A

number of species are new records for the New Zealand region, and some may be new to science.

(5) The ongoing seismic activity of one of the Kermadec submarine volcanoes prohibited its direct study using an underwater vehicle. Since there is high potential for rich scientific rewards from making observations and sampling fluids from submarine volcanoes, this has prompted an initiative to develop new technology and methods for remote monitoring and time-series sampling of submarine volcanoes with long-term volcanic activity. Studies of extreme oceanic environments, such as active submarine volcanoes, using new exploration technology could also have important implications and lessons for future remote explorations on other planets and moons in our solar system.

(6) The extensive iron-dominated venting at Healy volcano was a surprise. Large areas (acre size) on several young volcanic cones within the southern caldera were covered with actively forming or recently active microbial mat. As this microbial by-product ages, it forms crusts over large areas that may mimic lava flows in some places. This extensive iron-venting process and crust formation has also been observed on NW Eifuku Volcano, on the Mariana Arc, and may be common during some stages of evolution of arc volcanoes.

(7) Brothers Volcano is an exciting laboratory for studying hydrothermal processes at arc volcanoes. There are two major types of active venting (gas-rich venting on the young cone in the southern caldera and metal rich high-temperature venting on the northwest caldera wall). This site deserves more detailed exploration at a smaller scale and would be an ideal place to explore the evolution of a submarine ore deposit in an arc setting in both space and time.

(8) The success of the New Zealand American Submarine Ring of Fire 2005 Expedition underscores the value of international collaborations in ocean exploration, particularly those where both partners bring expertise, resources and a commitment to a multi-year effort to define sites for more focused exploration.

1.1.1 Acknowledgments

Funding for the New Zealand American Submarine Ring of Fire 05 expedition was provided from the NOAA Ocean Exploration Program (OE), the Institute of Geological and Nuclear Sciences -New Zealand (GNS) and the National Institute of Water and Atmospheric Research - New Zealand (NIWA). NIWA support for the expedition was funded by Capability Funds, and FRST contracts C01X0203 and C01X0224. NOAA's Undersea Research Program (NURP) provided funding for some of the transit time from Hawaii to New Zealand that made the entire expedition possible (there were several other legs of the expedition). The Hawaii Undersea Research Laboratory very capably operated the *Pisces V* submersible and the *RCV-150* remotely operated vehicle used on this expedition. The *R/V Ka'imikai-o-Kanaloa* provided excellent support for the operation.

1.1.2 Contacts for Cruise Archives and Related Data

- The dive data, including video and digital still camera images are archived at Hawaii Undersea Research Laboratory (HURL). Contact John Smith (johnrsmith@hawaii.edu).

- EM300 multibeam bathymetry data are proprietary, archived at New Zealand National Institute of Water and Atmospheric Research (NIWA). Contact Ian Wright (i.wright@niwa.co.nz)

- Edited *Pisces V* navigation data are available from PMEL. Contact Susan Merle or Bob Embley (susan.merle@noaa.gov or robert.w.embley@noaa.gov)

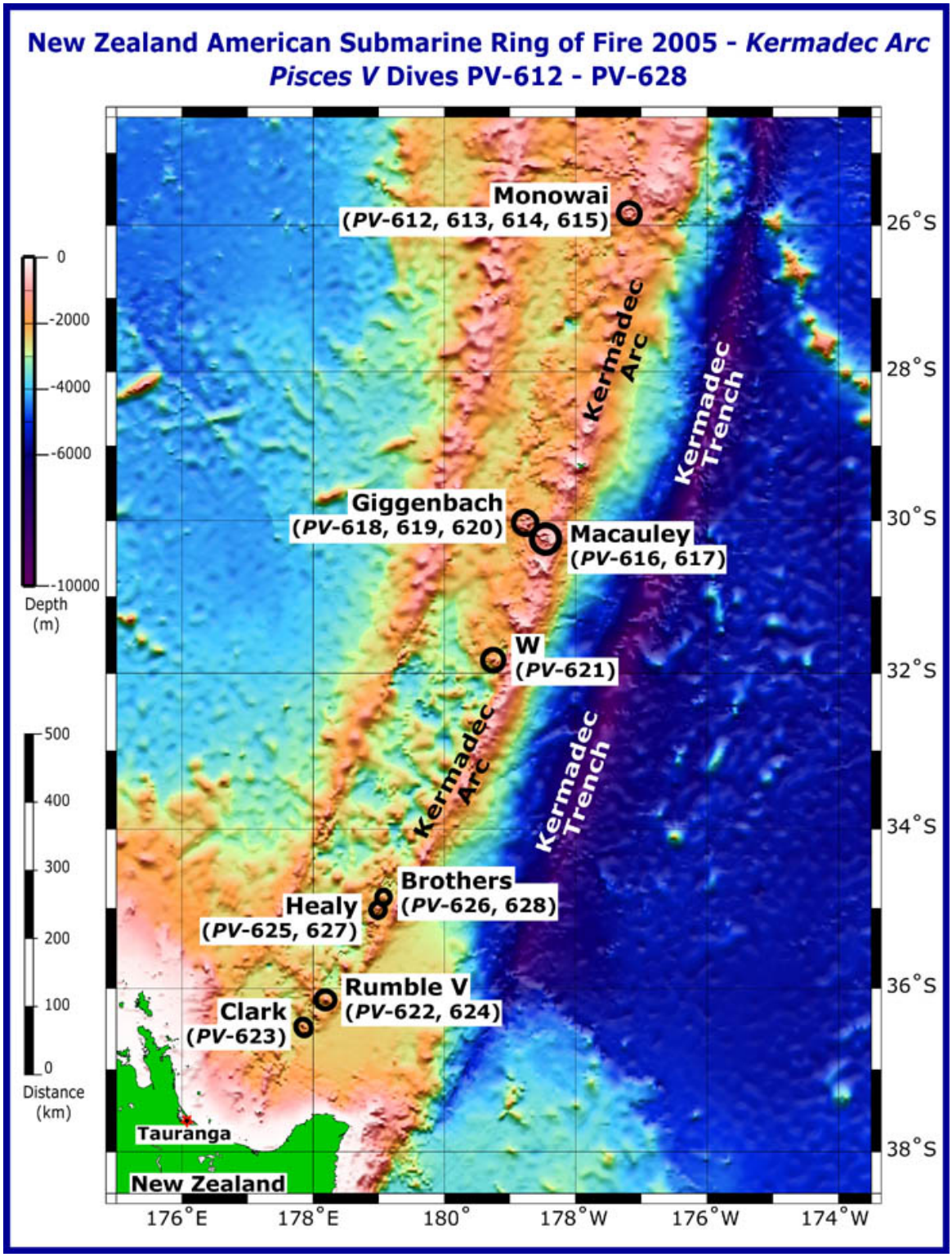

Figure 1. Map of the Kermadec Arc area. NZASRoF'05 expedition *Pisces V* dive sites and numbers are indicated. Bathymetry data sets for this image include low-resolution (3500 m) satellite altimetry data from Sandwell and Smith (bottom layer), and high-resolution (25 m) EM300 bathymetry data in the area of the dive sites (top layer). The EM300 bathymetry data are provided courtesy of New Zealand National Institute of Water and Atmospheric Research (NIWA).

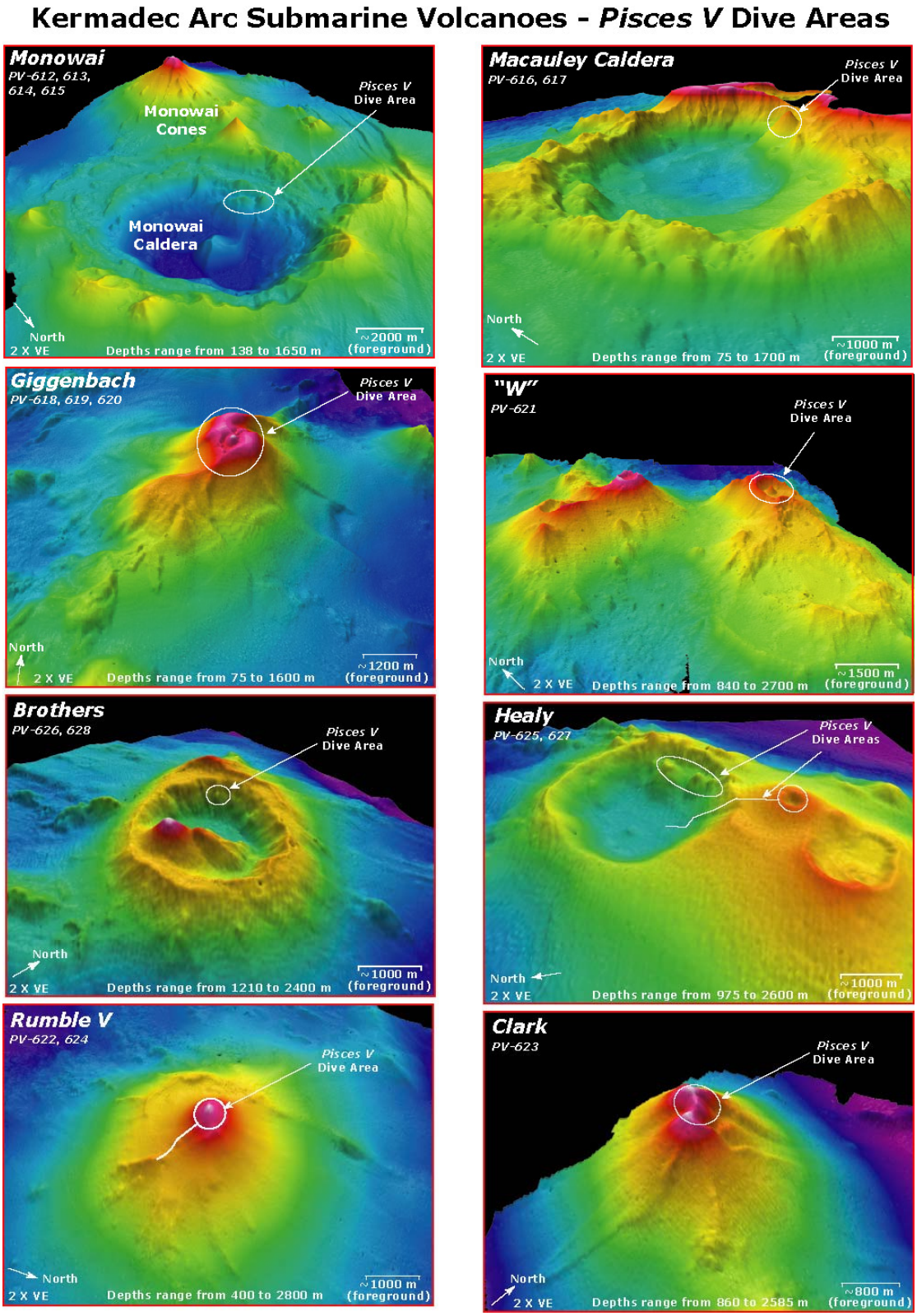

Figure 2. 3-Dimensional views of the submarine volcanoes visited on the NZASRoF'05 expedition. The EM300 bathymetry data are provided courtesy of New Zealand National Institute of Water and Atmospheric Research (NIWA). Bathymetry data are vertically exaggerated two times. Data resolution is ~25 meters.

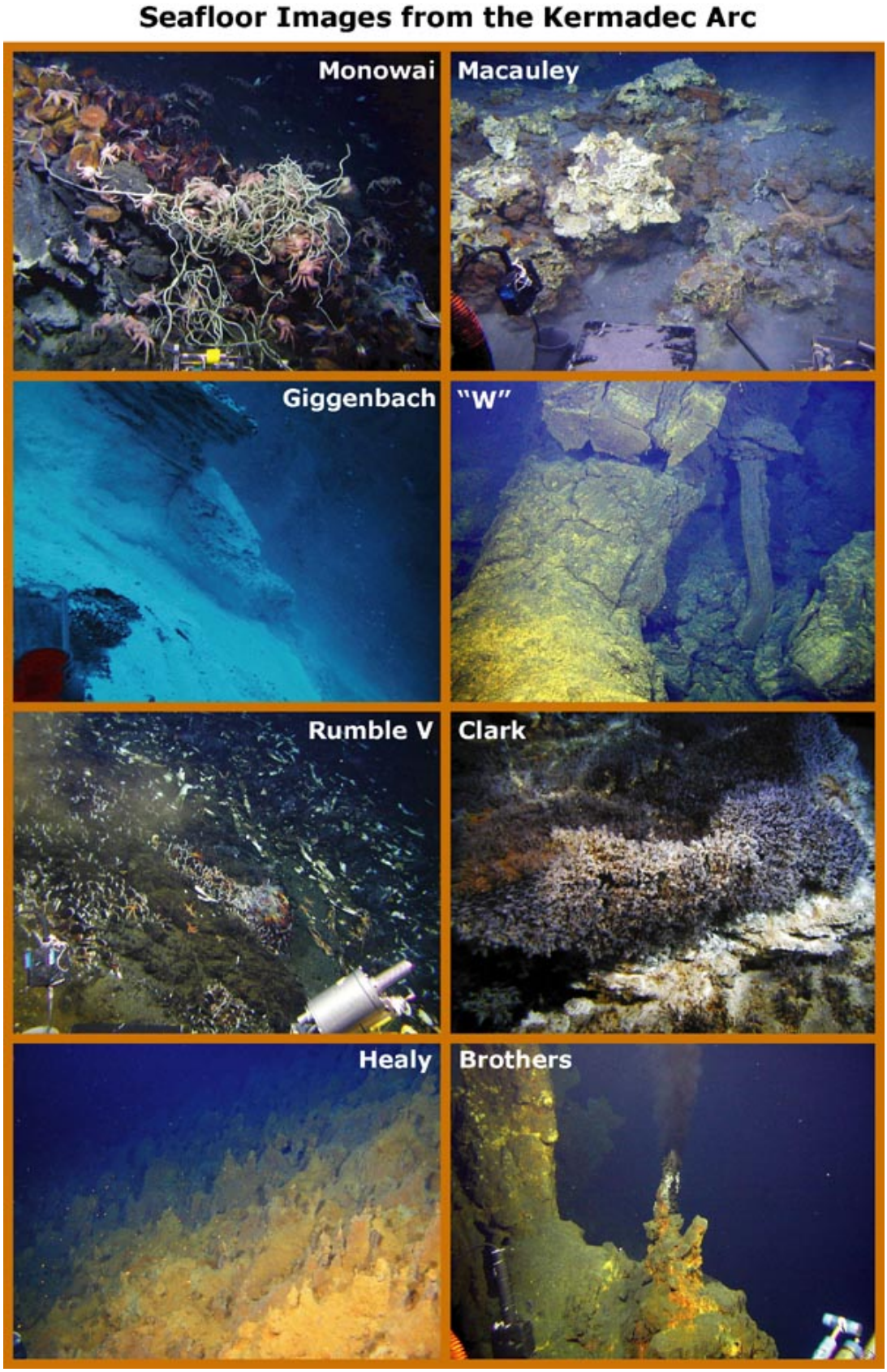

Plate 1: Selected *Pisces V* digital images of the seafloor at the Kermadec Arc. Images are several meters across.

1.2 Volcano Geology

Ian Wright

Eight Kermadec arc volcanoes (Monowai, Macauley, Giggenbach, Brothers, Healy, Rumble V, and Tangaroa), extending between 25°48'S and 36°27'S, were *Pisces V* dive targets during the 2005 Ring of Fire Expedition. These volcanoes provide contrasting settings for water-depth (and hence confining pressure), eruptive style and subsequent eruptions products, and different hydrothermal system and plume chemistries.

From the perspective of water-depth and dominant eruption style these nine volcanoes can be broadly classified as:

- Shallow water-depth (< 300 m) silicic volcano — **Giggenbach**
- Intermediate water-depth (1000-300 m), silicic calderas, with a succeeding phase of basaltic volcanism — **Monowai, Macauley**
- Deep water-depth (> 1000 m) silicic calderas — **Brothers, Healy**
- Intermediate water-depth (1000-300 m), basaltic-andesite stratovolcanoes — **Rumble V, Clark**
- Deep water-depth (> 1000 m) basaltic volcanoes — **"W"**

Giggenbach is a bimodal composition (basalt - dacite) volcano, with a significant crestal area shallower than 200 m water-depth. The general structure of the crest is one of an outer and older caldera rim, with subsequent phases of central cone construction, and small lineated craters that traverse across the edifice. Much of the edifice comprises dacitic outcrops or pumice that provides a prominent source of talus within the old caldera structure. In contrast the central cone, although un-sampled, appears to comprise basaltic talus and finer volcaniclastic sediment. The latter may include fine black sand recovered in sediment samples. Consistent with its shallow depth, and bimodal composition, the crest is dotted with explosion pits and craters. These pit / crater structures appear to be arrayed around the inner caldera rim, and are typically 30-50 m in diameter, and are at least 15-20 m deep. Ash units and finely commuted volcaniclastic sands provide further evidence for significant phases of explosive eruptions.

Monowai and Macauley are both large (~10 km wide) silicic calderas interpreted to have formed by explosive eruption, associated caldera collapse, with a succeeding phase of post-caldera basaltic volcanism. These post-caldera volcanic constructs, comprising a ridge on the lower western Monowai caldera wall ("Mussel Ridge") and a cone on the eastern Macauley caldera wall ("Macauley Cone") were the targets of the submersible dives, though two ROV dives were run over the Lloyd Dome and southern caldera rim at Macauley volcano (Fig. 14). The lower flanks of Mussel Ridge below ~1200 m are dominated by pillow lavas and associated breccia, with some talus. Above ~1200 m talus and sand – granule volcaniclastics, mantled over outcrop, are the dominated substrate. At Macauley, the basaltic cone mostly comprises blocky talus, which at depths above ~350 m increasingly is intercalated with black ?ash-lapilli units. The crest of the cone consists of an 80 m long and 40 m wide crater elongate along a northeast – southwest trend. The crater is ~40-50 m deep, but has a discontinuous crater rim.

Brothers and Healy are deep-water, 3 km wide dacite – rhyodacite calderas with subordinate basaltic volcanism. Both caldera walls and floors consist of substantial quantities of talus. For Brothers the talus is generated by the collapse of fault controlled terraces and weakening of the caldera wall by hydrothermalism. Typically the terraces are 5-10 m wide and bounded by 10-20 m high fault escarpments, though the apparent magnitude and youthfulness of faulting decreases up the wall. For Healy, the pumiceous talus, mostly lying at the angle of repose, forms the sole substrate with no caldera wall outcrop exposed. The pumice blocks have "woody" vesicular fabric and range up to maximum length of ~5 m. Post-caldera basaltic volcanism at Healy appears localized to a series of cones aligned

northeast – southwest. Each cone comprises blocky talus that is mostly mantled with iron alteration. Small pits that are typically 40-50 m wide and ~30 m deep occur at the crests of the two larger cones. Likewise the main Healy cone is pervasively mantled with iron alteration, but includes localized occurrences of rippled medium black sand at the crest that can only be sourced from the cone.

Rumble V and Clark are archetypal stratovolcanoes dominated by basaltic lavas, and show a typical progression from effusive to explosive eruption products with decreasing water-depth. Below ~700 m and ~900 m for Rumble V and Clark, respectively, volcanic substrates are dominated by pahoehoe and pillow lavas, but locally include massive flows, pillow tubes, lava walls, and exposed ?dikes, with variable but generally small volumes of talus and breccia. Above these depths volcaniclastic sediment and talus slope are increasingly more voluminous, though local ridge highs do persist to comprise pillow lavas on Rumble V. These ridges generally trend northwest – southeast. The crests of both volcanoes are complex and include small ? craters, and in the case of Rumble V, < 6 m high pinnacle structures. The origin of the latter structures is unknown.

"W", the sole deep-water basaltic volcano comprises two small (1 km wide) calderas that have sustained extensive phases of effusive basalt volcanism. The genesis of the calderas is unknown though only basaltic lavas were observed and sampled. Both the northern and southern caldera walls below water-depths of ~ 1100 m reveal pillow lavas, pillow tubes, localized sheet flows, and pillow breccias. Above ~1100 m there is an increasing proportion of sandy – granule volcaniclastic detritus, but the dominant substrate remains pillow lavas and associated breccias. The lower flanks central cone of the northern caldera, where not mantled by Fe-crusts and bacterial floc, consists of blocky talus with few coherent flows.

1.3 Macrobenthic Ecology

Ashley A. Rowden and Malcolm R. Clark

Introduction

Vent macrofauna communities are of interest to biologists worldwide who wish to understand how these chemosynthetic-based systems function, and also to elucidate the means by which the diversity of isolated habitats in the marine environment are maintained *(Van Dover 2000)*. It has been hypothesized that vent organisms have dispersed over evolutionary time from the East Pacific to the West Pacific, and then via the Indian Ocean to Atlantic Ocean *(see Van Dover et al. 2001)*. Thus, studies of the vent macrofauna of the south west Pacific, the area proximal to the Southeast Indian Ocean Ridge, are particularly important for refining description and understanding of the global biogeographic pattern of vent macrofauna communities. In particular, improved knowledge of the macrofaunal composition of the relatively understudied vent communities associated with the Kermadec volcanic arc (New Zealand) will contribute to filling in one of the "missing pieces" of the "evolutionary puzzle of seafloor life" *(Shank 2004)*.

Accordingly, the present study of the macrofauna of vent systems on the Kermadec volcanic arc had the following objectives:

1) To describe and compare the community composition of vent macrofauna on seamounts of the Kermadec volcanic arc
2) To determine the phylogenic relationship of vent endemic species on seamounts of the Kermadec volcanic arc

Method

The methodology employed, including the locating of study sites and the sampling and observation of macrofauna communities using the *Pisces V*, are described elsewhere (see dive plans and dive reports).

Results

Study sites

The physical, geological and geochemical setting of the study sites are briefly described in the dive logs.

Community composition

The following brief descriptions of the macrofauna community composition for the vent sites are based on provisional shipboard identifications of the dominant taxa sampled, observer logs and interim reviews of video records for each dive. Further analysis will be required to support these preliminary descriptions and the subsequent discussion of results.

Monowai

?*Bathymodiolus* sp. (Mytilidae)
Alvinocaris niwa (Alvinocaridae)
Alvinocaris ?longirostris (Alvinocaridae)
?*Chorocaris* sp. (Alvinocaridae)
Paralomis sp. (Lithodidae)
?*Lamellibrachia* sp. (Lamellibrachiidae)
large anemone (?Actinostolidae)
eel-like vent fish (Zoarcidae)

Giggenbach

?*Bathymodiolus* sp. (Mytilidae)
unknown small seastar (Asteroidea)
unknown small crabs (?Grapsidae)

Macauley

?*Bathymodiolus* sp. (Mytilidae)
Gigantidas gladius (Mytilidae)
Rumbleaster eructans (ms name) (Asteriidae)
Bathyaustriella thionipta (Lucinidae)
small striped tongue-sole (Cyanoglossidae)
unknown scale worms (Polynoidae)

Volcano W

unknown tubeworm (Vestimentifera)
unknown stalk barnacle (?Eolepadidae)
unknown polychaetes

Brothers

pink scale worm (Polynoidae)
Vulcanolepis osheai (Eolepadidae)
Paralomis sp. (Lithodidae)
?*Austinograea* sp. (Bythograeidae)
Alvinocaris sp. (Alvinocarididae)

Rumble V

Alvinocaris niwa (Alvinocarididae)
Gigantidas gladius (Mytilidae)
Rumbleaster eructans (ms name) (Asteriidae)
unknown small anemone (family?)

?*Fusitriton* sp. (Cymatiidae)
unknown small seastar (Asteroidea)

Healy
No vent macrofauna

Clark
Giganidas gladius (Mytilidae)
Vulcanolepis osheai (Eolepadidae)
pink scale worm (Polynoidae)

Discussion

The Kermadec volcanic arc comprises a series of mostly submarine volcanoes associated with the Pacific-Australian plate convergence north of New Zealand *(Wright 1994)*. Whilst aspects of their volcanism and hydrothermal venting are becoming better known *(e.g. de Ronde et al. 2001)*, to date there have been few biological investigations of these volcanoes. In 1990 vent sites on the continental shelf, in the vicinity of White and Whale Island, were first sampled by SCUBA and dredge/trawl *(Kamenev et al. 1993*). In 1998 a joint German-New Zealand expedition further investigated the biota in the area south-west of White Island known as the "Calypso vents" by remote sampling devices and the submersible *Jago*. This study also located sites of active venting and revealed something of the composition of the associated macrofaunal communities on Brothers volcano *(Stoffers et al 1999)*. Subsequent investigations by New Zealand institutes in 2000 and 2001 imaged and sampled directly the fauna of vents on Rumble V, Rumble III and Brothers volcanoes on the southern Kermadec arc *(Clark & O'Shea 2001, Rowden et al. 2003)*, and in 2002 and 2003 on Giggenbach, Macauley and Monowai volcanoes further north on the arc (voyage reports of NIWA cruise TAN0205 and New Zealand-USA projects NZAPLUME II and NZAPLUME III). In 2003 a joint Japanese-New Zealand expedition utilized the submersible *Shinkai 6500* to directly observe and sample macrofauna at two vent sites on Brothers volcano (voyage report of YK-0409 (leg2)). Relatively little biological data have been formally reported from the preceding sampling. However, species formally described (or identified) to date from these sampling efforts (i.e. *Volcanolepas osheai, Gigantidas gladius, Alvinocaris niwa, Alvinocaris longirostris, Bathyaustriella thionipta (see Buckeridge 2000, von Cosel & Marshall 2003, Webber 2004, Glover et al. 2004)* indicate that the faunal communities of the Kermadec arc vent systems are both taxonomic similar (families, genera and even species found at other vents e.g. Eolepadidae, Mytilidae, *Alvinocaris, A. longirostris*) and apparently dissimilar (records of taxa not found at other vents e.g. a species of Lucinid bivalve) to vent assemblages found elsewhere in the western Pacific *(cf south-west Pacific, Desbruyeres et al. 1994; north-west Pacific, Kojima 2002)*.

The macrobiological sampling conducted during the present study has been more extensive than any previous effort to describe the composition of macrofauna communities associated with the vents of the Kermadec volcanic arc. An initial assessment of the results suggests that there are compositional differences in communities on and between the seamounts sampled. The precise nature of the apparent similarity/dissimilarity in community composition will be determined by future data analysis, once the identities of sampled species have been formally established and video and photographic records have received further evaluation. Nonetheless, it is reasonable to suggest now that the apparent difference in macrofauna community composition observed between the vent sites on a seamount and between seamounts is most likely, in-part, a result of the difference in the site's venting characteristics. Differences in site geochemistry will influence macrofauna either directly e.g. toxicity of certain chemicals, or indirectly e.g. extent and type of bacterial growth on which some of the fauna may rely (Van Dover 2000). The influence of the site's environmental characteristics on the faunal composition will be more thoroughly explored during future analysis that incorporates the findings of geochemical and microbial studies undertaken by other members of the present expedition, as well considering factors such

as fluid temperature and water depth.

A robust comparison of the vent macrofauna community composition/taxonomic relatedness of the Kermadec arc with vent communities in other regions will not be possible until species sampled by the present study have been formally identified. However, a preliminary comparison can be made at a high taxonomic level for the apparently dominant fauna. Here such an exercise is limited to a comparison with the vent communities of the Lau Basin *(Desbruyeres et al. 1994)* and the Central Indian Ridge *(Van Dover et al. 2001)*, for these are the described vent communities at sites that are currently known to be contiguous with the Kermadec arc. As would be reasonable to suppose, considering their relative proximity in the south-west Pacific, the vent communities of the Lau Basin and those sampled on the Kermadec volcanic arc during the present study appear to be generally similar in composition at the family level. That is, representatives of the Mytilidae, Lamellibrachiidae, Alvinocarididae, Bythograeidae, Eolepadidae, Polynoidae, and Zoarcidae are found at the Kermadec vent sites and the Vai Lili, Hine Hina, South Hine Hina and Momoko sites in the Lau Basin. The most notable difference between the Lau Basin vent site communities and those on the Kermadec volcanic arc is the presence of lithodid crabs and asteroids, and absence of provannid gastropods, chionelasmatid barnacles from the present study sites. Provannids are also a component of the macrofauna communities described from two vent sites on the Central Indian Ridge. So the apparent absence of this taxon from Kermadec volcanic arc vents is perhaps one of the most significant distinctions. Indian Ocean vent communities do possess representatives of families found at Kermadec volcanic arc vent sites (e.g. Mytilidae, Alvinocarididae, Bythograeidae, Eolepadidae, Polynoidae, Actinostolidae), but notably absent are any vestimentiferan worm families at the Edmond and Kairei vents. Thus, while vent communities of the Kermadec arc have a degree of similarity with those on the Central Indian Ridge and Lau Basin, dissimilarities are significant enough to support the current proposition that Indian Ocean vent communities are located in a separate biogeographic province from those in the south-western Pacific Ocean *(Van Dover 2001)*, and that possibly the macrofauna communities of the Kermadec arc vents are distinct from those found elsewhere in the south-west Pacific. Clearly the preceding represents a very cursory biogeographical examination of the preliminary data obtained by the present study of macrofauna community composition. A more robust biogeographical analysis will be undertaken not only when species identities are established, but when the genetic differentiation of populations of certain key taxa are known.

For reference information contact the authors: Ashley Rowden and Malcolm Clark.

1.4 Microbiology

Andrew Opatkiewicz and Matthew Stott

Objectives

Much of our current knowledge of the microbial diversity of hydrothermal vents has been established using data collected from mid-ocean spreading ridges (MOR). Because of the similarity of the hydrothermal fluid chemistry between MOR systems, the diversity of microbial communities, with exception to a few isolated sites, are largely comparable. In contrast, the hydrothermal fluid chemistry from oceanic subduction arcs has a heterogeneous nature, suggesting that there is potential for diverse and unique microbial communities to exist. The primary objective of the microbiology component to this expedition was to determine whether the Kermadec Arc submarine volcanoes harbour unique microbial communities. In addition, it is hoped that the microbial survey will assist in understanding biogeochemical interactions and subseafloor biosphere production of the Kermadec Arc, and its input to larger-scale oceanic cycling.

Sampling

Hydrothermal fluid and substrate samples were collected from eight submarine volcanoes using the HOV

Pisces V. Samples used for molecular diversity studies and microbial culturing were collected from a variety of sources including vent fluids, bacterial mats, soils and sediments, hydrothermal rocks and some macrofauna. Fluid samples were collected using Major Sampling bottles (MS) or were filtered *in situ* using the Butterfield Fluid Sampler (HFS) onto a 0.22µm sterivex filter. The *Pisces V* suction sampler and robotic arms were used to retrieve biological mats, macrofauna and sediment/rock samples. All samples used for microbial culturing were either stored at -80°C or were inoculated into media immediately after submarine retrieval. All samples used for molecular diversity studies were stored at -80°C.

Analysis

The molecular and microbial surveys of microbial communities inhabiting the Kermadec Arc volcanoes are currently being conducted in parallel between Andrew Opatkiewicz (University of Washington) and Matthew Stott and Peter Dunfield (GNS Science, Wairakei).

The microbial diversity of each hydrothermal vent is being examined by phylogenetic analysis of the 16S rDNA genes of the bacterial and archaeal populations extracted from each sample. 16S rDNA genes are amplified using the Polymerase Chain Reaction (PCR) and then individual sequences are generated via clone banks or via Denaturing Gradient Gel Electrophoresis (DGGE). In addition, subunits of functional genes specific to CO oxidation, methane oxidation and methanogenesis (*coxA*, *pmoA* and *mcrA* respectively) are being cloned to give insight to the metabolic diversity at each site.

A range of energy and terminal electron sources are being used to enrich hydrothermal vent microorganisms. Targeted microorganisms include those with iron and sulfur metabolisms, and microbes that utilize dissolved gases such as hydrogen, methane and carbon monoxide and/or complex organic carbon sources. In addition, microbial cultures able to tolerant acidic conditions are also being targeted. Enrichments are being conducted at a range of temperatures between 25-90°C.

Microbiology Table

Note: Media used to target microorganisms with sulfur and iron metabolisms and microbes tolerant to acidic conditions.

Media Type	Incubation Temps. (˚C)
Anaerobic Fe-reducer	70˚, 90˚
Anaerobic YE-free	70˚, 90˚
Anaerobic MJAIS-YTF	50˚, 70˚, 90˚
Anaerobic Acidophile	50˚, 70˚, 90˚
Aerobic Acidophile	70˚, 90˚

Results

The molecular and microbial analysis of samples collected on this expedition is currently on-going and no definite results can yet be reported. However, the initial culture-independent data, as expected, shows that the microbial diversity is largely dictated by the chemistry of the hydrothermal fluids. The data collected will assist in understanding the seafloor hydrothermal vent biosphere and its interaction with geochemistry. In addition, these data are being used to target the culturing of specific microbial groups identified. Individual strains are currently being isolated through enrichment cultures and used to correlate potential metabolic activity with geochemistry.

1.5 Volcano Chemistry: Vent Fluids

Gary Massoth, Dave Butterfield and John Lupton

Vent fluids (mixtures of liquids and gases) moderate and are moderated by the geological substrate and organisms (macro-and micro-) that border their seafloor pathways. Hence, knowing the physico-chemical state of vent fluids can provide important clues about processes occurring within the subseafloor and at its ocean interface, where we observe prolific communities of macro- and micro-organisms and mineral assemblages that derive life and form from these same fluids. By deconvoluting the chemical changes that occur during fluid transport or by choosing vent fluid components that are inert, such as ^{3}He, information about fluid origins is possible. In arc settings, where multiple fluid origins are possible, quantification of the relative source contributions is important to understanding geochemical cycling. Thus, the collection and study of vent fluids provides an important interdisciplinary tie that justifies the significant effort required to sample them *in situ* and determine their various components at sea and ashore.

During the New Zealand American Submarine Ring of Fire '05 expedition (NZASRoF'05) a total of 69 vent fluid samples were collected: 43 liquid-phase samples for determination of aqueous ionic chemical species abundances and isotopic fractions and 26 gas-phase samples for determination of gaseous components and isotopic signatures. Liquid samples were collected *in situ* using either 750 ml titanium piston syringes (Major Samplers, designated as MS on sample lists) or the NOAA Hot Fluid Sampler (designated as HFS on sample lists). The HFS is a flow-through sample manifold configured with up to 8 collapsible plastic bags, 6 PVC pistons, 10 in-line filters, and 5 gas-tight samplers, each selectable by an operator within the diving sphere. Sample flow rates are controlled by pump speed and can be slowed to match diffuse-flow rates observed on the seafloor. Sampling times for HFS discrete samples nominally range from instantaneous for gas-tight samples to about 5 minutes. Gas-phase samples were collected in 150 mL gas-tight bottles (Lupton bottles, designated as GT on sample lists) either attached to the HFS or, like Major Samplers, by placing an intake snorkel directly into the sample flow stream using the submersible's manipulator arm. Phase separated gas bubble emissions observed venting at Giggenbach volcano were captured within a scoop sampler adapted to accommodate gas expansion during ascent to the sea surface. Fluid temperatures were determined continuously during fluid collection using the HFS and immediately prior to discrete sample collections by Major and gas-tight samplers.

Onboard determinations included pH, alkalinity, hydrogen sulphide, silica and total gas concentration. Hydrogen sulphide and silica were determined colorimetrically in batch mode using the methylene blue (nominal precision: 4%) and silicomolybdate (nominal precision: 1%) methods, respectively. Aliqouts used for hydrogen were fixed within minutes of sampler opening and sub-samples for Si were diluted to preclude polymerization artifacts. Potentiometry was used to assess pH (nominal precision: 0.3%) at room temperature relative to NBS buffers and to measure alkalinity (nominal precision: 0.5%) by the Gran method. Total gas concentrations were determined using manometric and gravimetric procedures (nominal precision: 2%).

Sample splits were separated and selectively preserved at sea for shore-based determinations of major and trace dissolved ionic species abundances (Li, B, $NO_3^-+NO_2^-$, NH_3, Mg, Al, SO_4^{2-}, Si, PO_4^{3-}, Cl, K, Ca, Mn, Fe, Cu, Zn, Se, Br, Rb, Sr, Mo, Ag, Te, I, Cs, Ba, Hg, Pb, Bi, and U, etc.). These determinations are being conducted under the direction of David Butterfield at NOAA/PMEL and UW in Seattle, Washington, USA. Methodologies will include high-precision titrations, color spectrophotometry, ion chromatography, flame and graphite furnace atomic absorption (+ hydride generation in some cases), ICP-MS, and ICP-OES.

Shore based determinations of gas abundances are being performed under the direction of John Lupton (He and other noble gases) at NOAA/PMEL in Newport, Oregon, USA, and by Bruce Christenson (CO_2,

H_2, N_2, H_2S, CH_4, and other C-species) of GNS at the Rafter Laboratory, Lower Hutt, New Zealand. In addition, a full inventory of archived gas samples will be held by John Lupton in Newport.

Isotopic determinations of $\delta^{34}S$, $\delta^{2}H$, $\delta^{18}O$, DIC- $\delta^{13}C$, and gas phase C and N species will be performed in New Zealand, coordinated by Gary Massoth of GNS. Lead and Sr isotope determinations will be performed in the US, coordinated by Dave Butterfield. Helium isotopes will be determined by John Lupton in Newport. Collaborative agreements with Lui Chan, LSU (Li), Udo Fehn, U. Rochester (I), and M. Sharma (Os) for other isotopic determinations are in place. A collaborator for B isotopes is being sought.

Some vent fluid samples were selected for determinations of metal ligand abundance (Sylvia Sander, U. Otago, New Zealand) and others for DOC studies (Susan Lang, UW, USA).

The most striking result of the shipboard chemistry is the high gas abundance at Giggenbach volcano, where visible observations of phase separated fluids are corroborated by the ultra-high gas-phase abundances (up to 500 mM of total gases, or almost 11 L of gas per L of water with up to 26 mM H_2S!). Also, unusually low pH values (less than pH 2) were observed at the Macauley cone site. These examples attest to the marked magmatic signature that can be overprinted on fluid compositions in arc settings compared to water-rock reaction moderated fluid compositions observed at most MOR systems.

1.5.1 Chemistry Table: Onboard Vent Fluid Data

Note: Data are subject to correction and any use for presentation or publication must be cleared with the originators of the data. (Total gas: John Lupton; Alkalinity, pH, H2S: Dave Butterfield and Gary Massoth)

Site	Dive	Date	Sample	Depth	Temp	pH	Alkalinity	H_2S	Si	Total Gas
		d/m/y		m	ºC	NBS	meq/kg	µmol/kg	µmol/kg	mmol/kg
Monowai Caldera	612	7/04/05	MS Blue	1111	3	7.75	2.38	0	59	
			MS White	1111	3	7.68	2.35	0	57	
	613	8/04/05	MS Blue	1171	56	6.20		684	537	
			GT10 Red	1165	57					16.0
			GT7 Black	1165	54					12.0
	614	9/04/05	HFS 8 bag	1166	44	5.64	1.74	3169	983	
			HFS 11 f/bag	1166	43	5.53	1.80	3306	1032	
			HFS 6 piston	1166	35	5.72	1.82	2590	833	
			HFS 14 f/bag	1157	26	5.88	1.51	769	886	
			HFS 17 f/bag	1157	26	5.43	0.00	2688	1490	
			HFS 20 piston	1157	32	5.79	1.61	1363	974	
			HFS 1 f/piston	1143	6	7.00	2.09	1	118	
			HFS 5 piston	1143	9	6.65	1.88	130	230	
			HFS 19 bag	1141	52	5.39	1.63	3869	1470	
			HFS 18 f/bag	1141	52	5.47	1.70	3537	1431	
			HFS 16 f/bag	1141	52	5.41	1.61	4017	1431	
			HFS 22 piston	1079	25	5.77	1.36	1054	925	
			HFS GT12 Yellow	1166	28					6.7
			HFS GT6 Blue	1166	46					10.4
			HFS GT11 White	1141	52					11.3
			HFS GT2 Green	1141	52					9.3
	615	10/05/05	MS Blue	1025	13	6.21	1.80	685	408	
			GT7 Black	1025	13					4.3

Site	Dive	Date	Sample	Depth	Temp	pH	Alkalinity	H_2S	Si	Total Gas
		d/m/y		m	ºC	NBS	meq/kg	µmol/kg	µmol/kg	mmol/kg
			GT10 Red	1025	13					4.1
Giggenbach	618	15/05/05	MS Blue	164	72	6.38	2.12	<.5	1043	
			MS White	158	70	6.62	2.27	95	118	
			GT2 Green	164	72					4.8
			GT11 White	158	70					4.3
	619	16/05/05	HFS 6 piston	164	195 boil	4.51	0.80	24201	2802	
			HFS 5 piston	164	202 boil	4.58		25361	2242	
			HFS 22 piston	164	204 boil	4.57	0.96	21530	2476	
			HFS 18 f/bag	164	204 boil	4.04		24284	5166	
			HFS 9 bag	164	204 boil	3.90		23928	5005	
			HFS GT6 Blue	164	202 boil					418.0
			HFS GT12 Yellow	164	203 boil					500.0
			HFS GT7 Black	164	204 boil					255.0
	620	17/05/05	MS White	191	164	6.30	2.21	129		
			MS Blue	156	203 boil	4.86	2.06	25019	367	
			GT11 White	191	164					5.0
			GT2 Green	156	203 boil					2.8
Macauley Cone	616	12/05/05	MS Blue	336	129	1.96		439	2710	
			MS White	?	ambient	6.84	1.98		57	
			GT11 White	336	129					8.9
			GT2 Green	336	129					8.0
	617	14/05/05	MS White	335	30	2.24		204	1832	
			MS Blue	336	104	5.08		36	388	
			GT6 Blue	335	30					7.4
			GT12 Yellow	336	104					9.7
Wright	621	18/05/05	MS White	1065	10	5.83		<.5	384	8.3
Brothers NW	626	2/05/05	MS Blue	1642	265	6.87	2.26	6	296	2.9
			MS Yellow	1616	290	2.78		5474	12973	33.5
			GT7 Black	1616	290					20.1
Healy	625	1/05/05	MS Blue	1373	28	5.33	4.94	<.3		
			MS Yellow	1373	34	5.51	3.32	1		
			MS White	1384	28	5.31	2.57	<.3	631	
			GT10 Red	1373	28					34.0
			GT12 Yellow	1373	34					26.7
Rumble V	622	21/05/05	MS Blue	Bkgd SW		7.89	2.32	<.5	10	
			MS White	Bkgd SW		7.95	2.35	<.5	8.31	
	624	30/04/05	MS Blue	454	22	4.75	0.62	39	730	
			MS Yellow	379	40	5.06	5.16	2550	2027	

Site	Dive	Date	Sample	Depth	Temp	pH	Alkalinity	H_2S	Si	Total Gas
		d/m/y		m	ºC	NBS	meq/kg	µmol/kg	µmol/kg	mmol/kg
			GT12 Yellow	379	40					70.1
Clark	623	28/04/05	MS White	872	221	4.88	1.51	264		
			MS Blue	880	185	5.31	1.99	122	2289	
			GT7 Black	872	221					3.0
			GT12 Yellow	880	185					9.3

2.0 NZASRoF'05 CRUISE PARTICIPANTS

2.1 Participating Organizations (alphabetical order)

Hawaii Undersea Research Laboratory (HURL)
National Oceanic and Atmospheric Administration (NOAA) - Pacific Marine Environment Lab (PMEL)
New Zealand National Institute of Water & Atmospheric Research (NIWA)
New Zealand Institute of Geological and Nuclear Sciences (GNS)
Oregon State University - Cooperative Institute for Marine Resource Studies (CIMRS)
University of Washington - Joint Institute for Study of the Atmosphere and the Ocean (JISAO)

2.2 Personnel on New Zealand American Submarine Ring of Fire 05 Expedition

Captain of the *R/V Ka'imikai-o-Kanaloa*: Ross Barnes

2.2.1 Leg 1 Scientific Party

Name	Science Specialty	Affiliation	E-mail Address
David A. Butterfield	Chemistry	JISAO	David.A.Butterfield@noaa.gov
William W. Chadwick, Jr.	Volcanology	CIMRS	Bill.Chadwick@noaa.gov
Malcolm Clark	Benthic Ecology	NIWA	M.Clark@niwa.co.nz
Cornel de Ronde	Economic Geology	GNS	Cornel.deRonde@gns.cri.nz
Robert W. Embley*	Marine Geology	NOAA/PMEL	Robert.W.Embley@noaa.gov
Ronald R. Greene	Gas Tracers Tech. Support	CIMRS	Ronald.R.Greene@noaa.gov
John E. Lupton	Gas Tracers	PMEL	John.E.Lupton@noaa.gov
Gary Massoth*	Chemistry	GNS	G.Massoth@gns.cri.nz
Matt Stott	Microbiology	GNS	M.Stott@gns.cri.nz
Ian Wright	Marine Geology	NIWA	I.Wright@niwa.co.nz

* Co-Chief Scientists

2.2.2 Leg 2 Scientific Party (Legs 2a and 2b)

Name	Science Specialty	Affiliation	E-mail Address
Allan Bue[2]	Geology	GNS	a.beu@gns.cri.nz
Cornel de Ronde	Economic Geology	GNS	Cornel.deRonde@gns.cri.nz
Robert W. Embley*	Marine Geology	NOAA/PMEL	Robert.W.Embley@noaa.gov
Leigh J. Evans	Marine Chemistry (Gas Tracers)	CIMRS	Leigh.J.Evans@noaa.gov
Kevin Faure[2]	Geochemist	GNS	k.faure@gns.cri.nz
Alexander Malahoff*[1]	Microbiology	GNS	A.Malahoff@gns.cri.nz
Gary Massoth*	Chemistry	GNS	G.Massoth@gns.cri.nz
Kevin Roe	Marine Chemistry	JISAO	Kevin.Roe@noaa.gov
Ashley Rowden	Benthic Ecology	NIWA	A.Rowden@niwa.co.nz
Matt Stott[1]	Microbiology	GNS	M.Stott@gns.cri.nz
Ian Wright	Marine Geology	NIWA	I.Wright@niwa.co.nz
Andrew Opatkiewicz	Microbiology (Student)	PMEL/JISAO	apatka@u.washington.edu

* Co-Chief Scientists (Malahoff for Leg IIa; Massoth for Leg IIb; Embley for IIa and IIb)
[1] On Leg IIa only [2] On Leg IIb only

2.2.3 HURL Personnel

Doug Bloedorn	Submersible Support Technician
Maximilian Cremer	Deputy Director of Operations and Submersible Pilot
Dan Greeson	Chief Engineer, ROV Pilot
Terry Kerby	Operations Director, Chief Submersible Pilot
Steve Price	Maintenance Chief and Pilot in Training
Peter Townsend	Engineering Manager, ROV Pilot
Colin Wollerman	Electrical/Electronic Technician, Pilot in Training

3.0 NZASRoF'05 CRUISE OPERATIONS

3.1 General Information

Geographic Area of Operations
Submarine volcanoes along the Kermadec Arc, Southwestern Pacific

Expedition dates and itinerary

Leg I	3 April	Depart Pago Pago, American Samoa
	22 April	Arrive Tauranga, NZ
Leg IIa	25 April	Depart Tauranga, NZ
	29 April	Arrive Tauranga, NZ for personnel change
Leg IIb	29 April	Depart Tauranga, NZ
	10 May	Arrive Tauranga, NZ; end of expedition

Vessel Identification
R/V Ka'imikai-o-Kanaloa (operated by University of Hawaii)
Captain Ross Barnes

Primary Equipment
***Pisces V* submersible; *RCV-150* remotely operated vehicle**

Submersible Dives (*Pisces V*)

Monowai Caldera	(PV-612, PV-613, PV-614, PV-615)
Macauley Cone	(PV-616, PV-617)
Giggenbach	(PV-618, PV-619, PV-620)
Volcano "W" SE Caldera	(PV-621)
Rumble V	(PV-622, PV-624)
Clark	(PV-623)
Healy	(PV-625, PV-627)
Brothers	(PV-626, PV-628)

Remotely Operated Vehicle Dives (*RCV-150*)

Flank cone of Monowai	(RCV-310) Dive aborted
NW of Macauley Caldera - Curtis Ridge	(RCV-311)
SW rim of Macauley Caldera	(RCV-312)

3.2 Cruise Operations Log

All Times Local (HURL Protocol). *PISCES V* Dive Bottom Times are In Bold

Date	Cruise Operation
3-Apr-05	Depart Pago Pago, begin transit to Monowai.
4 Apr.-05	Transit to Monowai.
5-Apr-05	Transit to Monowai.
6-Apr-05	Transit to Monowai.
7-Apr-05	**Dive PV-612**; SW side of Monowai Caldera. Diver: Bob Embley.
7-Apr-05	**CTD V05A-01** in evening near dive site SW caldera.
8-Apr-05	**Dive PV-613**; SW side of Monowai Caldera. Diver: Ian Wright.
9-Apr-05	**Dive PV-614**; SW side of Monowai Caldera. Water sampling. Diver: Dave Butterfield.
9-Apr-05	Aborted **RCV-150 Dive 310** (aborted) on flank cone of Monowai. RCV-150 out of commission with thruster problem
10-Apr-05	**Dive PV-615**; SW side of Monowai Caldera. Diver(s): Bill Chadwick and Malcolm Clark.
10-Apr-05	Leave Monowai. Begin transit to Macauley Cone site.
11-Apr-05	Transit to Macauley.
12-Apr-05	**Dive PV-616**; Macauley Cone. Diver: Gary Massoth.
13-Apr-05	Weather day. Dive on Giggenbach Volcano aborted in a.m.
14-Apr-05	**Dive PV-617**; Macauley Cone. Diver: Cornel de Ronde. Lee side (NW) of Macauley Island provided enough shelter to conduct the dive - it made the difference!
14-Apr-05	**CTD V05A-02** in evening into crater of Macauley Cone.
15-Apr-05	**Dive PV-618**; Giggenbach Volcano exploration. Diver: Matt Stott.
	RCV-150 Dive 311 on Curtis Ridge. Begin 1951 (284m). End 2233 (332m). Ship nav only.
16-Apr-05	**Dive PV-619**; Giggenbach Volcano. Water Sampling. Diver: Dave Butterfield.
16-Apr-05	**RCV-150 Dive 312** along SW rim of Macauley Caldera. Begin 1905 (665m) End 2331 (408m).
17-Apr-05	**Dive PV-620**; Giggenbach Volcano; Diver(s): Cornel de Ronde and Ron Greene.
	Transit to Volcano "W" overnight.
18-Apr-05	**CTD V05A-03** in southeastern most caldera of Volcano "W".
18-Apr-05	**Dive PV-621**; Volcano "W". Diver: Ian Wright
19-Apr-05	Transit day from "W" to Rumble V Volcano
	Crossed date line and moved clocks back 1 hour. Now in time zone +12.
	20 April skipped due to crossing date line.
21-Apr-05	**Dive PV-622**; Rumble V Volcano. Diver: Malcolm Clark.
22-Jan-00	In Tauranga NZ at 9 a.m.
23-Apr-05	Press briefing.
24-Apr-05	In Tauranga NZ waiting out storm.
25-Apr-05	Depart Tauranga NZ at 1600.
26-Apr-05	Weathered out.
27-Apr-05	Weathered out.
27-Apr-05	Weathered out.
28-Apr-05	**Dive PV-623**; Clark Volcano. Diver: Alex Malahoff.
29-Apr-05	In and out of Tauranga NZ for personnel exchange.
30-Apr-05	**Dive PV-624**; Rumble V volcano. Diver: Ashley Rowden.
1-May-05	**Dive PV-625**; Healy Volcano. Diver: Gary Massoth.
	CTD T05A-01 Tow in evening into morning of May 2nd.
2-May-05	**Dive PV-626**; Brothers Volcano (NW caldera wall). Diver: Bob Embley.
	CTD T05A-02 Tow in evening into morning of May 3rd.
3-May-05	**Dive PV-627**; Healy Volcano. Diver: Ian Wright.
4-May-05	Recovered 3 current meter moorings at Brothers Volcano. Didn't start until 10:30 a.m. because of bad weather.
5-May-05	Bad storm: 45 knots with gusts to 50-60 knots; 25 ft and above seas.
6-May-05	No operations. 35-40 knot winds most of day.
7-May-05	Weathered out.
8-May-05	Recovered 4 OBH moorings in morning.

Date	Cruise Operation
8-May-05	Short **Dive PV-628**; Brothers Volcano. Diver: Cornel de Ronde.
8-May-05	CTD in evening.
9-May-05	Weathered out.
10-May-05	Arrive Tauranga, New Zealand. End of NZASRoF'05 Expedition.

3.3 *Pisces V* Dive Information

Dates, Times, Sample and Video Information

Local Times. Sample Types: B=Biology, G=Geology, W=Water, GT=Gas Tight

Operation	Volcano	Date (2005)	On Bottom	Off Bottom	Bottom Time	Sample Types	Sample #	Video Tapes / DVDs
Leg I					**hours**			
Dive PV-612	Monowai	April 7	10:09	15:33	5.66	B, G,	6	3
Dive PV-613	Monowai	April 8	9:30	15:52	6.38	B, G, W, GT	13	4
Dive PV-614	Monowai	April 9	9:57	15:59	4.98	B, W, GT	21	3
Dive PV-615	Monowai	April 10	10:16	15:49	5.55	B, G, W, GT	8	3
Dive PV-616	Macauley	April 12	8:45	15:44	6.98	B, G, W	11	3
Dive PV-617	Macauley	April 14	8:50	15:29	6.65	B, G, W, GT	14	4
Dive PV-618	Giggenbach	April 15	8:54	16:04	7.17	B, G, W, GT	16	4
Dive PV-619	Giggenbach	April 16	9:38	15:13	5.58	B, G, W, GT	9	3
Dive PV-620	Giggenbach	April 17	10:57	16:27	6.5	B, G, W, GT	10	3
Dive PV-621	Volcano W	April 18	9:24	15:23	5.98	B, G, W	9	3
Dive PV-622	Rumble V	April 21	9:08	11:47	2.66	B, G, W	6	2
Leg II								
Dive PV-623	Clark	April 28	9:13	15:16	6.083	B, G, W, GT	20	3
Dive PV-624	Rumble V	April 30	8:53	15:24	6.53	B, G, W, GT	22	4
Dive PV-625	Healy	May 1	9:23	15:51	6.46	B, G, W, GT	14	3
Dive PV-626	Brothers	May 2	10:20	15:05	4.75	B, G, W, GT	9	3
Dive PV-627	Healy	May 3	9:48	14:59	5.18	B, G	8	3
Dive PV-628	Brothers	May 8	14:47	16:20	1.55	G	2	1
Totals (Leg I and Leg II)					**94.64 hrs**		**198 + 9 combo samps**	

3.4 CTD Plume Profiling

Gary Massoth

While only a few (6) deployments of the GNS MINTS CTD-O plume profiling package were made, they provided critical insight regarding vent locations and depths, and also provided plume samples that are time-linked to the vent fluids being characterized. Historical plume data suggest that source fluid chemistries at arc volcanoes can be variable on yearly time scales making the latter connection even more important. At Brothers volcano, tow-yo samples were collected to provide a measure of the concentration gradients for key hydrothermal tracers as they advect away from their hydrothermal source. This information is primary to a novel hydrothermal Flux Experiment being conducted at this site, jointly funded by N.Z. GNS and PMEL. Discrete water samples for He abundance and isotopic ratio (42), methane (33), pH (63), total CO_2 (36), total dissolved Fe and Mn (37), dissolved Fe and Mn (9) and suspended particulate matter abundance and elemental composition (10) were collected for shore-based determinations.

One particular operation was standout and unprecedented: at Macauley cone the MINTS package was successfully lowered to within 20 meters of the bottom of a 30-meter-wide and 89-meter-deep explosion pit that had been recently explored and sampled (for fluids issuing from the pit floor) using *Pisces V*. The plume samples collected were among the richest in recently vented magmatic-hydrothermal plume effluent that have been sampled anywhere to date. The samples will provide an excellent and unique link between vent fluid and more distal plume chemical results. The highly skilled station keeping provided by Chief Mate Clary Gutzeit was critical to allowing this deep pentration and rare sampling of a confined (hence concentrated) hydrothermal plume.

3.4.1 CTD Cast Table (Gary Massoth)

Positions are approximate. Analysis is preliminary.

Cast	Station	Lat°	Lat'	Long°	Long'	3He	CH4	pH	TCO2	TDMe	DMe	SPM	Notes
1	V05A-01	-25	48.389	-177	9.819	11		15					Monowai Caldera S
2	V05A-02	-30	12.790	-178	26.950	8	6	12		8	2	2	Macauley
3	V05A-03	-31	51.830	-179	11.130	6		12				1	Volcano W East (mid caldera)
4	T05A-01 (start)	-34	54.150	179	5.209	16	13	22	16	16	5	5	Brothers caldera SE to NW
	T05A-01 (end)	-34	49.430	179	0.679								
5	T05A-02 (start)	-34	53.630	179	1.350	10	10	14	10	10	4	4	Brothers caldera SW to NE
	T05A-02 (end)	-34	50.599	179	4.909								
6	V05A-04	-34	47.759	179	6.089	10	10	15	10	11			Brothers Bkgd

3.5 Instrumented Deep-Sea Mooring Recovery

Gary Massoth

Seven deep-sea moorings were deployed/recovered at depths ranging from about 1600 m to 2200 m near or within the Brothers volcano caldera. Three of the moorings were ~2000-m-long arrays consisting of 3 current meters, a MAPR, and 22 glass balls for floatation. The current meter/MAPR moorings were deployed over 200 days previous to the cruise, in order to assess the advective field responsible for plume dispersal at this site. Upon deployment, and again during this expedition, several key chemical tracers (^{3}He, pH-DIC, Fe, Mn, CH_4) of hydrothermal discharge were measured along their respective concentration gradients. This chemical information, when coupled with current meter data, will allow a flow-model-based 'backward interpolation' of the source flux, hence the Flux Experiment, a first within the submarine arc environment. This Flux Experiment was jointly funded by N.Z. GNS and PMEL. Given the high (relative to MORs) gas concentrations that are known to emanate from arc volcanoes, the results of this experiment may provide a new (and in fact, first quantitative) perspective on the chemical impact of submarine volcanoes on the oceans.

The remaining four moorings were 35-m-long Ocean Bottom Hydrophone (OBH) modules. The OBH experiment was a separately funded Ocean Exploration (OE) project; PIs Robert. Dziak and Haru Matsumoto (CIMRS/PMEL). The hydrophones are used for passive underwater acoustic monitoring, which allows the detection of a variety of deep-ocean processes at long distances. Some of the sound sources that can be detected include earthquakes, volcanic eruptions, landslides, marine mammal and fish vocalizations, weather, and manmade noises.

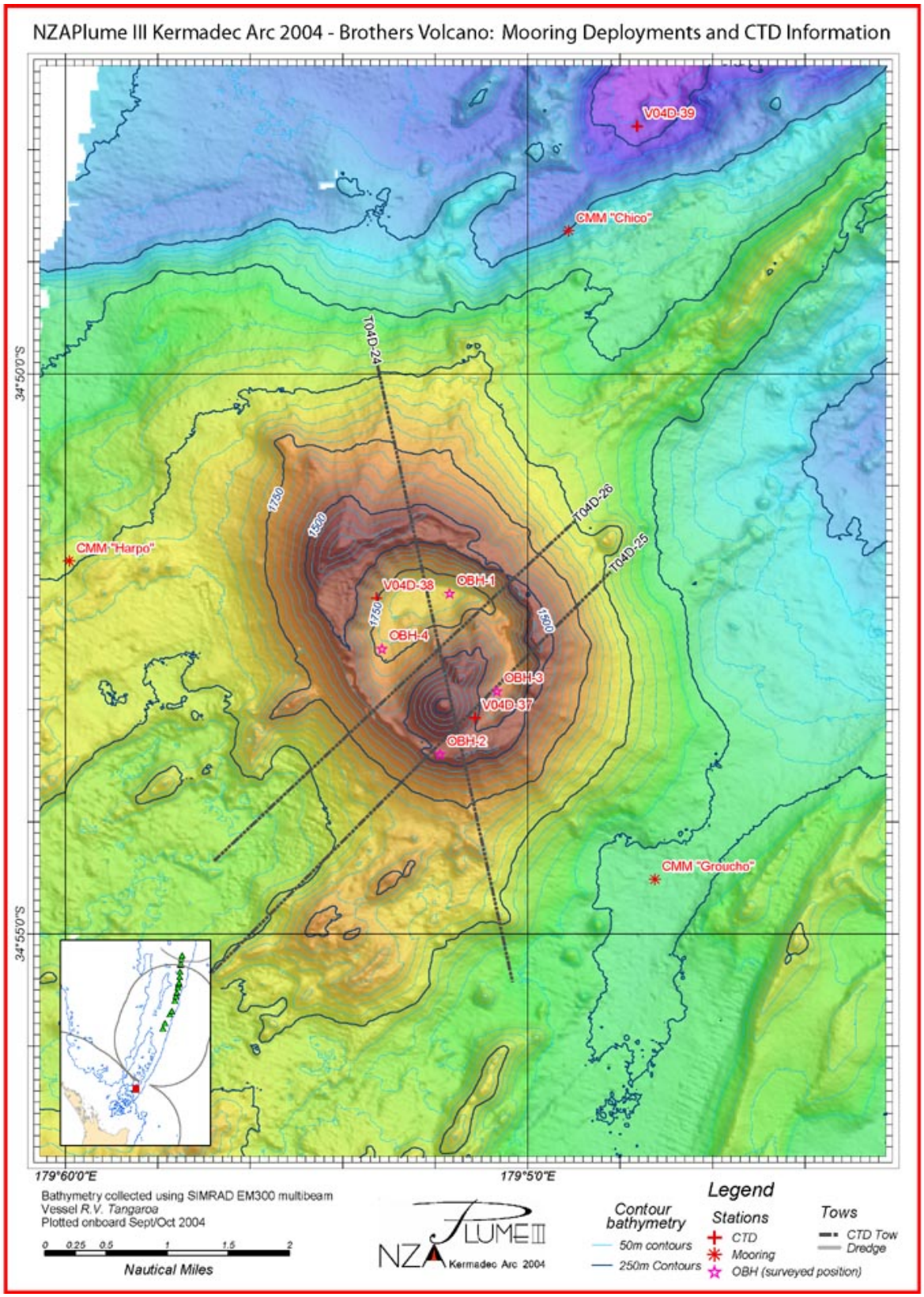

Figure 3. Location of mooring deployments and CTD stations on the NZAPlume III Expedition. This figure was provided courtesy of Ian Wright, New Zealand National Institute of Water and Atmospheric Research (NIWA).

4.0 PUBLIC OUTREACH

Susan Merle, Bill Chadwick and Bob Embley

The updated expedition website is posted on the NOAA Ocean Explorer site:
http://www.oceanexplorer.noaa.gov/explorations/05fire/

(1) Submarine fly-through movies, 3D views, other images and written material for the Ocean Exploration website for the 2005 expedition were prepared by Susan Merle, Ltcdr Shannon Ristau, Bill Chadwick, Bob Embley and Ed Baker before the expedition.
(http://www.oceanexplorer.noaa.gov/explorations/05fire/background/kermadecarc/kermadecarc.html

(2) Because of the limited berths on the *KoK*, Susan Merle served as the shoreside webmaster for the cruise, translating and editing the draft reports and images sent from sea before passing them onto the OE web coordinators (Kyle Carothers and Mike Shelby). Bill Chadwick (Leg I) and Bob Embley (Leg II) coordinated the data on board and sent it back to shore.

(3) A set of fourteen movies excerpted from the 2005 dive videos were produced at sea by Bill Chadwick during Leg I of NZASRoF. Fourteen additional dive movies for Leg II have been produced by Bill Chadwick. At present the Leg II movies have not been posted on the OE website. All movies can be made available on a ftp site. For more information contact Bill Chadwick (**bill.chadwick@noaa.gov**), Bob Embley (**robert.w.embley@noaa.gov**) or Susan Merle (**susan.merle@noaa.gov**)
http://www.oceanexplorer.noaa.gov/explorations/05fire/logs/photolog/photolog.html

Expedition news releases were posted on several New Zealand web sites as well:
http://www.gns.cri.nz/news/release/nooa.html
http://www.gns.cri.nz/news/release/spoils.html
http://www.niwascience.co.nz/pubs/news/latest
http://www.niwascience.co.nz/pubs/mr/archive/2005-04-04-1

5.0 *PISCES-V* NAVIGATION

Susan Merle, Bob Embley and Bill Chadwick

A new ultra-short baseline navigation system (TrackLink) was installed prior to the expedition. It worked adequately, although it was found that there were some serious excursions of the tracking during ship turns, even during times when the submersible was stationary on the seafloor. These were in the form of "loops" of the track which took place over several minutes. Sometimes the looping continued the entire time the submersible was stationary (for example during sampling). We surmise that the source of the problem is due to calibration errors, which were magnified when the ship went back and forth over the dive site.

The navigation was edited after the cruise using the following navigation processing methods:
1) Outliers were removed from the navigation using an IDL program written by Bill Chadwick (navedit4.pro). The program visually displays all the navigation points, plus allows one to edit out any outliers and errant points. Sometimes when errant points are removed a small amount of navigation is eliminated - usually at the start or end of a dive.
2) The navigation track was smoothed using an IDL program written Andy Lau (OSU) and updated by Bill Chadwick (get_ropos_llt.pro). This program allows one to smooth the navigation by applying a smoothing factor to the data. The more noise in the data, the larger the smoothing factor applied. Generally, the deeper the water, the larger the smoothing factor that is applied.

3) The edited, smoothed navigation files were brought into ArcGIS to visually analyze the data. The "loops" and their corresponding times were noted.
3) The dive video was reviewed. Times when the submersible was stationary (for example sampling and getting a position from the ship) were noted.
4) Obvious loops, most likely caused by calibration errors, were removed from the navigation data.
5) **Pisces-V sample logs and marker positions have been adjusted to agree with edited navigation files. *Pisces-V* positions in the Quick-look dive reports have NOT been adjusted to agree with edited navigation files.**

Jags and gaps in the navigation tracks are the consequence of eliminating the "loops" from the data. Absolutely straight lines from one point to another on the trackline are good indicators that the track has been edited, removing the "loops". However, because the exact source of the errors is not known there are likely residual errors embedded in the files that could not be removed.

Anyone requiring the final navigation files as text or ArcGIS shapefiles contact:
susan.merle@noaa.gov or robert.w.embley@noaa.gov

5.1 Marker Positions

***Pisces-V* marker positions HAVE BEEN ADJUSTED to agree with edited navigation files.**

Marker	Volcano	Longitude	Latitude
Mk-8	Monowai	-177.167881	-25.803914
Mk-r9	Macauley	-178.449000	-30.212900
Mkr-10	Giggenbach	-178.714345	-30.037879
Mkr-12	Giggenbach	-178.710369	-30.033714
Mkr-13	Volcano W	-179.184847	-31.847971
Mkr-14	Clark	177.839008	-36.447137
Mkr-15	Rumble V	178.197646	-36.140399
Mkr-16	Rumble V	178.195482	-36.140751
Mk-r17	Brothers	179.057314	-34.862469
Mkr-18	Healy	178.990933	-35.004683
Mkr-19	Healy	179.007114	-34.996139
Mkr-20	Brothers	179.060533	-34.861405
Mkr-21	Brothers	179.057074	-34.860970

6.0 *PISCES-V* DIVE SUMMARIES

PV-612: Monowai (Observer Bob Embley)
Mission Date: April 07, 2005. **Bottom Time:** 5 hours 40 minutes (5.66 hours) **Summary:** The dive began on the floor of the caldera near a SW-NE trending tectonic ridge that extended from the central cone of the caldera floor into the SW wall of the caldera. The plan was to precede upslope to the SE to the top of the NW-SE trending volcanic ridge where mussels had been dredged by the New Zealand Research Vessel *Tangaroa* in 2005. A constant heading to the SE was not obtained because of faulty compass readings and the dive track veered south to southwest (the navigation fixes were called down from the surface). A traverse upslope towards the target ridge passed over alternating areas of pillow lavas, heavily sedimented areas and talus slopes. At about 1200 meters depth, those portions of the lavas not covered with sediments were colonized by dense communities of small bivalves and limpets. At 11:37 L *Pisces V* changed course to the SE to traverse directly upslope to the crest of the target ridge. At 11:53 at a depth of 1078, swarms of shrimp were observed on the ledges of outcrops and at 12:26 at 1056 meters dense mussel beds and swarms of crabs and shrimp were observed. The remainder of the dive occurred at the top of the ridge. The mussel beds were mapped for more than 300 meters along the crest of the ridge to the southeast. In places the mussels almost completely covered the seafloor. The crab population was very large, and competition for space on the mussel beds was fiercely contended. Samples of mussels, rocks (with animals attached) and whelks were collected during the dive.

PV-613: Monowai (Observer Ian Wright)
Mission Date: April 8, 2005. **Bottom Time:** 6 hours 23 minutes (6.38 hours) **Summary:** The dive started on the lower southeastern flanks of the ridge imaging pillow lavas and associated talus. The western flanks of the ridge comprised a similar geology on the lower slopes. The upper slopes consisted of volcanic talus and mussel shell detritus. The northeastern flank comprises a NE-SW structurally controlled hydrothermal vent field extending from a depth of 1170 m to the ridge crest. The field consists of discrete vents with associated mussels beds, crabs, shrimps, and tube worms. Most vents occur at outcrop bases (though not exclusively) with evidence of elemental sulphur extrusion on the seafloor. Vent temperatures ranged between 47°C and 55°C. Major fluids, gas tights, and bacterial mat sampling were attempted at various vent sites.

PV-614: Monowai (Observer Dave Butterfield)
Mission Date: April 9, 2005**. Bottom Time:** 4 hours 59 minutes (4.983 hours) **Summary:** The dive began SE of HURL marker 8. Marker 8, on the south caldera wall, was located at 10:59 (1165m). A 44º C vent fluid sample was taken at marker 8. The search for additional vents moved upslope, and further hydrothermal fluid sampling was conducted at 12:53 (1157m), 14:01 (1143m) and 14:33 (1140m). The dive ended further upslope of marker 8 after another venting area was discovered at 15:41 (1079m). The sub left bottom at 15:56 (1028m).

PV-615: Monowai (Observers Bill Chadwick and Malcolm Clark)
Mission Date: April 10, 2005**. Bottom Time:** 5 hours 34 minutes (5.55 hours) **Summary:** Started dive near Marker 8 on the NE slope of the volcanic ridge that the previous 3 dives have been. Headed upslope to top of the ridge, collecting samples along the way. The Imagenex scanning sonar was on the sub for this dive, but we could not establish communication with it, and so no sonar data were collected. Instead we explored the cone located NW of Mussel Ridge and found another distinct biological community on the southern flank.
Notes: On this dive the video recorder was only recording in black and white due to a loose connection. Also the Fornari digital still camera was not turned on until very late in the dive, so the only digital still for most of the dive are from the handheld camera. Finally the CTD data was not written to a file at the end of the dive, so there is no digital record of sub depth during the dive.

PV-616: Macauley (Observer Gary Massoth)
Mission Date: April 12, 2005. **Bottom Time:** 6 hours 59 minutes (6.983 hours) **Summary:** Started dive at 521 m on N slope of Macauley caldera cone. Proceeded upslope observing sparse biology to about 325 m when see crust coating basalt pillow outcrops and then broken 'plates' throughout the area. Between this depth and 300 m become totally underlain by dense biology (mussels on and in ash seds, starfish) and still a metallic crust. Ascend to cone crater rim at about 280 m and proceed counter clockwise to pinnacle peak of cone at 248 m. Descend then 89 m to base of explosion pit which is 80 m in diameter at top and 30 m in diameter at the base, which is a flat, ash and sulfur covered floor. Sample 129C fluids but measure max T of 155C nearby on base floor, north all. Video survey all on ascent, shows huge mass accumulation of elemental S as diked (ash conglomerate?) wall and sulfur chimneys. Very little biology inside pit rim. Mostly confined to outer cone slope within 290-350 degree sector as demonstrated by circum navigation of cone at 290 m, depth of densest biology on north slope.
Notes: On this dive the video recorder was off between 12:41 to 13:41 (1 hour) during which fluid sampling, basket rearrangement and an ascent up the N wall took place. Once the video omission was noted, we descended to the base of the pit to repeat the video survey of the north wall face. NAVIGATION GAP: 1224-1337.

PV-617: Macauley (Observer Cornel de Ronde)
Mission Date: April 14, 2005. **Bottom time:** 6 hours 39 minutes (6.65 hours) **Summary:** Started dive on ~NW slope and traversed up slope. Collected numerous animals (mussels, gastropods and starfish) on slope above ~365 m. Also collected non-vent related animals (urchin and cup coral) and piece of old Fe-oxide crust. Inside main crater, sampled diffuse vent fluids ~8 m E of Marker #9 (30.1°C) and also resampled vent fluids at Marker #9 (103.8°C). Collected two different pieces of layered volcaniclastic rock, one with Fe-oxide coating and both with abundant elemental S binding the rock matrix. Reconnoitered crater at ~365 m (crater ~80 x 40 m) depth and again at 290 m depth (rim not continuous at this depth). Finished by moving to northern rim of crater.
Notes: On this dive tracking was partially lost with the ship while the submersible was adjacent to (inside) the crater wall. Communication with the ship was also difficult thus positions for some samples were estimated.

PV-618: Giggenbach (Observer Matthew Stott)
Mission Date: April 15, 2000. **Bottom Time:** 7 hours 8 minutes (7.1333 hours) **Summary:** Diffuse and focused low temperature venting was found along a NE/SW line bisecting the main cone. Phase separation of fluids was observed at 2 sites (Mkr #10 & Mkr #12); the most vigorous field (Mkr 12) contained both diffuse and focused venting at 205°C. The Mkr #12 field was made up of an extensive wall (~30m x >50m (LxH)) of white sulfur (and presumably microbial biofilm) and vigorous venting. Geologically this field had a mixed morphology exhibiting a pumice scree slope and ash terraced features (E & W edges respectively). The central cone comprised mainly of new talus and was dominated by fish, soft corals and extensive purple algal carpeting near the summit. Some shimmering water was observed. However, strong surface surges and a malfunctioning compass meant that no further exploration was possible. Large numbers of chimney structures were found at Mkr #10 (primarily composed of siliceous material with some sulphide (perhaps pyrite) material. Of note at both markers, but in particular in the vicinity of Mkr #12, were outcrops of mussels covered in a thick white microbial biofilm. The outcrop of mussels near Mkr #12 was perhaps 1 acre in size. Fun was had by all.
Notes: Navigation was effected by a lack of a reliable compass especially around the cone area. Directions were given by headings given by the tracking on the ship. All directions in the log are given as an approximate and should not be taken as gospel.

PV-619: Giggenbach (Observer Dave Butterfield)
Mission Date: April 16, 2005**. Bottom Time:** 5 hours 35 minutes (5.583 hours) **Summary:** The main objective of the dive was to sample a range of vent fluids from Giggenbach caldera, including the marker 12 area in pit and marker 10 to the SW. The dive was delayed due to communication problems with the fluid sampler on deck. Underwater cables were re-connected and problem went away. The comm. problem returned during descent, but was resolved prior to landing at 134 meters depth. We drove a vector to marker 12 area and found the pit. We selected the vent next to marker 12 and set up with the fluid sampler. We took 3 pistons, two bags, and 3 gas-tight samples in the boiling vent. We then moved down slope to take more samples, lost the grip on the intake nozzle, drifted down to the bottom of the pit, and then could not get the sampler working again. We surveyed the pit thoroughly, took a gas scoop sample at the boiling vent by marker 12, then gradually climbed up to the east and ended the dive.

PV-620: Giggenbach (Observers Cornel de Ronde and Ron Greene)
Mission Date: April 17, 2005**. Bottom Time:** 6 hours 230 minutes (6.433 hours) **Summary:** Started dive on southern slope of main summit cone, landing much further north than anticipated. Worked around NW slope of cone (fresh basaltic talus), then headed ~S down NW margin of main depression where lower (~180 m) slopes were covered in bacterial mat (sampled). Moved ~SE and eventually found silica chimneys are getting lost navigating around numerous holes that mark the boundary of the eastern side of the depression. Sampled silica chimney, moved to Marker #10 and sampled fluids and sediments. Then moved ~NE to Marker #12 in smaller depression and sampled rock, boiling vent fluids (203 °C @ 156 m) and gases. Much fewer animals than at Macauley.
Notes: Dive launch postponed ~2 hours due to leaking hydraulic hose/connection on A-frame. Some confusion at beginning of dive as to where we landed. Ended up being considerably (several hundred m) further N than intended landing point. Meant had to double back to main summit depression. Also, had great difficulty finding Marker #10 when approached from W and found numerous deep holes that bound the eastern side of the depression. No time stamp first part of the dive!

PV-621: Volcano "W" (Observer Ian Wright)
Mission Date: April 18, 2005**. Bottom Time:** 5 hours 59 minutes (5.983 hours) **Summary:** The northern wall of the southern caldera comprises precipitous slopes with pillow lavas, pillow tubes, and localized sheet flows with minimal sediment cover and epifaunal encrustation. The upper part of the wall also has columnar cooling joints. On the upper part of the wall localized bacterial mats occur, with dead mussel shells, and live worm tubes. At separate sites bacterial mats with diffuse venting at 8.9□C and tube worms were collected. The crest of the caldera rim is covered with ?dead bacterial mats. The southern wall of the northern caldera comprises rugged volcanic topography. The lower slopes of the central resurgent cone are comprised of blocky talus and some in situ lavas. The upper flanks are covered in bacterial floc that includes diffuse venting and small Fe finger chimneys. Bacterial floc was recovered from a diffuse vent with 28.0□C venting at a depth 1047 m. The crest of the cone comprises a ~16 m wide and 15 m deep pit. Diffuse low temperature venting also occurs inside the pit with temperatures of 10.0□C. Major fluids were sampled from this pit.

PV-622: Rumble V (Observer Malcolm Clark)
Mission Date: April 21, 2005**. Bottom Time:** 2 hours 40 minutes (2.666 hours) **Summary:** Started dive at 795m on the southern slope and explored northwards up the slope cutting across strong structural flows of pillow lava. A high diversity of deep invertebrate and fish fauna was seen. We were advised 2.5 hours into the dive that weather at the surface was deteriorating, and the dive might be shortened. Consequently we headed straight for the best vent target, known mussel beds to the east of the summit. Large expanses of dead mussels were seen, and at 11:30 a live bed was seen at 486m. Sampling was carried out hurriedly there before having to abort the dive because of the topside wind and sea conditions.

PV-623: Clark (Observer Alex Malahoff)

Mission Date: April 28, 2005**. Bottom Time:** 6 hours 5 minutes (6.083 hours)

Summary: The dive began east of the summit and traversed up to the summit. The major discovery was of a field of sulfide chimneys on the northern summit ridge just south of the northern summit. The vent field (~100 m in diameter) consists of lots of diffuse venting and several chimneys are about. Mkr-14 was placed at the "Twin Towers" vent site, which consisted of two large chimneys. A temperature of 221° C was measured near the base of the largest one. The southern summit was not hydrothermally active. Lots of broken corals and displaced rocks attested to recent dredging/trawling activity on the southern summit.

PV-624: Rumble V (Observer Ashley Rowden)

Mission Date: April 30, 2005**. Bottom Time:** 6 hours 32 minutes (6.533 hours)

Summary: Landed someway SE of proposed landing point (WP1) at 08:52 at 651 meters water depth. Moved towards WP1 over dark sediment with occasional small patches of yellow. Benthic fauna was generally sparse, although there was an area of large sea pens and small white urchins on a low ridge. After reaching the vicinity of WP1, changed direction to move upslope towards the summit of the cone. Encountered on route, first dead *Gigantidas gladius* (mussel) shells, and then an area of diffuse venting characterized by live *G. gladius* and predator red seastar *Rumbleaster*. Placed Marker 15 here at 452 meters (is the same vent site as discovered on dive PV-622). Continued to move upslope (NW) and mussel bed started to run out at 430meters. At 413 meters we encountered small white patches where shimmering venting was occurring. Moved towards the summit in hope of finding more active venting. At the summit (approx 370m) we saw a number of large - 2+m high - pinnacles (old chimneys?) from the bases of which venting is taking place, marked by white/yellow slashes on the pinnacle sides. Unfortunately, the pinnacles are strewn with old fishing lines (like a cobweb). The entanglement hazard was sufficient to make sampling these vents too dangerous to even consider. Moved downslope towards the northwest. At 379 meters we found white patches and shimmering venting from cracks beneath the rocks, cracks coated in white (bacteria?) and yellow (sulphur?). Vent fauna was characterized by alvinocarid shrimp (*Alvinocaris niwa*?) nearest to the vent, and then 50 centimeters away G. gladius, small white anemones, and a gastropod (brown banded) whelk-like predator. Sampled vent fluids. Temp=39.7° C. This vent site also had fishing lines present. We moved downslope (southwards) encountering small patches of mussels and the red seastar. Once we reached the 452 meter contour, Marker 16 was placed (to act as future guide upslope to venting just beneath summit). Began to circumnavigate (anticlockwise) the cone along the 452m contour (below fishing line hazards but at depth which diffuse venting occurs - judging by occurrence of mussels at Marker 15) to explore the reminder of the cone. Encountered a yellow/brown patch of bacteria and crust, sampled some of this material and fluid where it was coming out of the cracks (Temp=22°C). We passed Marker 15 (and noted that the mussel bed in that area is about 20 meters wide). Thereafter the substrate was of dark sediment (talus), which is densely populated with small white anemones (indicative of diffuse venting?) but not much other benthic fauna. On the north side of the cone we came across another mussel bed - but here there were no *Rumbleaster*, rather the main predator appears to be a gastropod (*Fusitriton*?), also there are numerous small orange seastars. The mussel bed is similar in dimensions to the one at Marker 15. Also on the north side of the cone we encountered a fresh looking band (20m) of lava pillows. The pillows have anemones on them, including a large white/purple species. Numerous fish (roughy and alfonsino?) were also associated with the pillows. On the remainder of the track along the 45 2 meter contour the pattern is repeated: dark sediment sparse fauna (though in some places masses of small white anemones) with patches of yellow/brown bacteria/crust, sometimes smaller white patches. Arrived back at Marker 16 at 15:24 to complete the dive. Left the bottom at 15:31.

PV-625: Healy (Observer Gary Massoth)
Mission Date: May 1, 2005. **Bottom Time:** 6 hours 28 minutes (6.466 hours) **Summary:** Started dive at 1389 meters in the saddle between the east and west summit pits of NW (#1) cone. Observed ubiquitous covering of FeOOH-Si deposits overlying black 'basaltic-looking' sand/ash. No lava outcrops or talus was in view. Proceeded to E pit (<50 meters diameter, 13 meters deep) where a thicker (half-meter or greater) blanket of FeOOH-type sediments was punctuated by up to meter-high chimneys of the same material. Also, many intricate smaller chimneys of varying morphologies were observed, many with intact flow orifices. Although the temperature probe registered up to 15.9º C compared to 4º C ambient temperature, no schlieren was observed here, or at the larger W pit (30 m by 60 m oval, 19 m deep), which was relatively devoid of the chimney structures. The full extent of the outer slope of this cone was coated in FeOOH with occasional outbreaks of coarse-grained black sands and even rarer basalt outcrops. Hundreds of 'flocaberries' up to several centimeters in diameter were observed cascading down this slope, with accumulations in low pockets. The slope of the adjacent pit (#2) was bare, black sand to within a few meters of the summit where the FeOOH sediments again became thick. Schlieren marked a 20-meter band of diffuse discharge on the NW rim (Mkr 19). A circumnavigation of this rim located a second, small region of discharge on the WNW rim sector. No venting was observed within the 4-m deep, 40-m diameter. pit - other than on the inner upper NW wall adjacent to Mkr 19, which was too diffuse to sample, with overlying FeOOH deposits approaching 1 meter in depth. Where vent fluids were collected from the outer rim region at Mkr 19, the fluid temperature was 33.9º C. The next cone (#3) was similar, although smaller in dimension. Here, venting through FeOOH sediments was again observed, at temperatures up to 28.4º C. The fourth cone in this sequence was not explored due to time constraints. The FeOOH sediments in most areas were dark orange overlain by a lighter yellow filamentous-looking covering. A large squid was observed enroute to pit #3 but no sessile macro fauna. Fish were observed, but rare. The consistent venting depths (1373±10 m) plus the persistent plume visible near the cone summits provide strong evidence that these sites are the source of the plume mapped by CTD tows during previous expeditions.

PV-626: Brothers (Observer Bob Embley)
Mission Date: May 2, 2005. **Bottom Time: 4 hrs 45 minutes** (4.75 hours) **Summary:** The dive began on the lower part of the caldera wall at 1774 meters. The talus included many pieces of white, highly altered volcanic rock. Several samples of this were used as ballast and one was retained as a sample (PV-626-1R). *Pisces* proceeded up the wall towards the vents. The second rock sample (PV-626-2R) was an in-place piece of altered pillow lava from an outcrop of altered volcanics at a depth of 1729 meters. The first active hydrothermal activity was noted at 11:00 with the first occurrence of yellow-orange low temperature patches and small chimneys at a depth of 1691 meters. A suction sample of the oxide chimney was taken (PV-626_3SS). After traversing a zone of active Fe venting the zone of high temperature sulfide chimneys was reached. The chimneys appeared to line up along an approximate E-W trend going directly upslope. *Pisces* descended to the maximum depth of the sulfide chimneys at about 1680 meters. A small inactive chimney (PV-626_4Min) was taken here. The large chimney adjacent to the one sampled had a *Shinkai 6500* marker 4 next to its base. *Pisces* again ascended the slope and took water samples at two sites. The lower site was near the top of a chimney (PV-626_5MS (Blue) at 1644 m). The maximum temperature recorded was 260° C. The upper site was easier to sample and both a major (PV-626_6MS_yellow) and a gas tight were taken (PV-626_7GT_Black). *Pisces* headed east to explore the eastern extent of the active area and came across another small chimney field at 13:45L in a water depth of 1647 meters. Samples of true crabs were taken here (PV-626_8B and PV-626_9SS). A traverse to the east encountered extensive areas of oxide venting between depths of 1620 and 1632 meters. A thruster problem limited the ability to maneuver in the rough terrain so the dive was terminated at 15:05.
Notes: the CTD depth was reading up to 25 m shallower than the *Pisces V* depth gauge throughout the dive. This was using the "corrected" CTD depth used on previous dives (by adding 10 meters to the CTD).

PV-627: Healy (Observer Ian Wright)
Mission Date: April 18, 2005**. Bottom Time:** 5 hours 11 minutes (5.183 hours) **Summary:** The lower southern wall (below ~1350 m) of Healy Caldera comprises pumice talus with very rare encrusting epifauna. A single outcrop shows evidence of older hydrothermal alteration and breccia deposition. On the upper wall (above ~1350 m) pumice talus is increasingly winnowed and partially covered with rippled sand. Above 1300 m rippled sand is dominant. Above ~1150 m the flanks of the Healy cone are covered with Fe-crusts and small Fe chimneys. Diffuse venting is recorded at 1140 m with T=20.1° C. Along the eastern and southern Healy crater rim diffuse venting, with chimneys, crusts, and bacterial floc is pervasive. The northern and western rims are dominated by rippled sand. The upper crater wall consists of extensive areas of diffusively venting Fe chimneys, bacterial mat, and associated crusts. The lower crater wall has precipitous outcrops 10-20 m in height and mostly covered in Fe crust. The crater pit comprises old Fe-crusts and a few dead small Fe chimneys. There is no sign of active venting on the crater floor.

PV-628: Brothers (Observer Cornel de Ronde)
Mission Date: May 8, 2005**. Bottom Time:** 1 hour 33 minutes (1.55 hours) **Summary:** Landed ~400 m E of massive sulfide wall. Landing point was area of talus with abundant altered rocks and pieces of massive sulfide crust (sampled). Diffuse venting here ~23° C. Upslope by only ~10-15 m was new site of active black smoker chimneys up to 4 m tall. Several chimneys here, and many dead ones that had fallen over. Did not sample due to lack to time (see below). Moved generally to W. Numerous vertical walls of massive lava, locally highly altered. Several 'shutes' of talus, commonly with highly altered rock. At one point saw very white sandy material (broken down altered dacite) that was covered with fine-grained pyrite such that it sparkled with the flood light on it. Further W discovered small field of chimneys, all dead, but up to 7 m tall. Sampled a small chimney. Did not locate the wall of massive sulfide as described by the Japanese, but feel we were close when dive ended.

7.0 *PISCES-V* SAMPLES

7.1 Sample Types and Numbers

36 Biology grabs
14 Suction samples of macrobiology
12 Suction samples of microbiology
62 Biological samples

22 HFS fluid samples
21 MS fluid samples
43 Fluid samples

25 Gas samples

22 Mineral grabs or scoops
8 Suction samples of minerals
30 Mineral samples

38 Rock samples

9 combination samples (e.g. R/B)

207 samples total

7.2 Sample Abbreviations

Abbreviation	Sample Type
R	Rock
B	Biology
SS	Suction
MS	Major Sampler (fluid)
GT	Gas Tight
HFS	Hot Fluid Sample
MIN	Mineral / Sediment
Gas	Gas Scoop
Bubbler	Sediment Scoop

7.3 *Pisces V* Sample Tables

***Pisces-V* sample and marker positions HAVE BEEN ADJUSTED to agree with the edited navigation files (see navigation section 5.0).**

7.3.1 PV-612 Sample Log: Monowai

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-612 Monowai Sample Comments
PV-612-1-R/B	1105	-177.172059	-25.800364	1198	Piece of old weathered vesicular basalt from talus with small bivalves.
PV-612-2-R/B	1207	-177.170987	-25.805148	1070	Top of lava flow (basalt) with limpets?
PV-612-3-B	1240	-177.170427	-25.805379	1050	Mussels.
PV-612-4-R	1321	-177.169952	-25.806013	1029	Gray rock.
PV-612-5-B	1334	-177.169915	-25.805927	1026	Large mussels (clams?).
PV-612-6-B	1439	-177.167584	-25.806955	1111	Whelk.
PV-612-7-MS	1545	-177.168579	-25.806963	1052	White MS for background water.
PV-612-8-MS	1545	-177.168579	-25.806963	1052	Blue MS for background water.

7.3.2 PV-613 Sample Log: Monowai

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-613 Monowai Sample Comments
PV-613-1-SS-B	1140	-177.168138	-25.806883	1064	Suction sample of shrimps.
PV-613-2-MS-blue	1344	-177.167795	-25.803762	1165	Fluid sample (MS Blue) from Vent-2. T=55.6°C.
PV-613-3-SS-B	1351	-177.167892	-25.803847	1168	Suction sample of shrimp / filamentous mats at Vent-3 orifice.
PV-613-4-B	1355	-177.167892	-25.803847	1168	Sample of crabs at Vent-3.
PV-613-5-B	1409	-177.168062	-25.804017	1152	Sample of tube worms at Vent-4.
PV-613-6-R	1416	-177.168056	-25.803993	1152	Rock sample from Vent-5.
PV-613-7-GT-red	1505	-177.167805	-25.804013	1165	Gas tight sample from Vent-6. T=57.4°C
PV-613-8-MS-failed	1531	-177.167805	-25.804013	1165	Failed sample at Vent-6.
PV-613-9-GT-silver	1533	-177.167805	-25.804013	1165	Gas tight sample from Vent-6. T=53.6°C
PV-613-10a-SS-B	1535	-177.167805	-25.804013	1165	Suction sample of shrimp / filamentous mats? Vent-6.
PV-613-10b-SS-B	1537	-177.167805	-25.804013	1165	Suction sample of shrimp / filamentous mats? T=53.6°. Vent-6.
PV-613-11-R	1540	-177.167805	-25.804013	1165	Fist sized rock sample from Vent-6 orificewith white surficial alteration.
PV-613-12-R	1546	-177.167805	-25.804013	1165	Rock sample from Vent-6 orifice
PV-613-13-R	1307	-177.167022	-25.803258	1220	Small altered rock sample from vent orifice.

7.3.3 PV-614 Sample Log: Monowai

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-614 Monowai Sample Comments
PV-614-1-HFS8	1125	-177.167917	-25.803958	1166	Unfiltered bag water sample near Mkr-8. T=44°C. Vol=602 ml.
PV-614-2-HFS11	1134	-177.167917	-25.803958	1166	Filtered bag (gff) water sample near Mkr-8. Tavg=43°C. Vol=620 ml.
PV-614-3-HFS6	1142	-177.167917	-25.803958	1166	Unfiltered piston water sample near Mkr-8. Tavg=35°C. Vol=650 ml.
PV-614-4-GT-yellow	1146	-177.167917	-25.803958	1166	Gas-tight water sample near Mkr-8. T=28°C.

Sample	Time	Longitude	Latitude	Z	PV-614 Monowai Sample Comments
PV-614-5-HFS3	1153	-177.167917	-25.803958	1166	Sterivex DNA filter near Mkr-8. Tavg=45°C. Vol=1451 ml.
PV-614-6-GT-blue	1205	-177.167917	-25.803958	1166	Gas-tight water sample near Mkr-8. T=46°C.
PV-614-7-HFS4	1209	-177.167917	-25.803958	1166	Sterivex DNA filter near Mkr-8. Tavg=46°C. Vol=1706 ml.
PV-614-8-HFS14	1309	-177.167773	-25.803996	1157	Filtered bag (0.22 micron) water sample. Tavg=25.6. Vol=314 ml.
PV-614-9-HFS17	1317	-177.167773	-25.803996	1157	Filtered bag (gff) water sample. Tavg=26°C. Note: mistake added 150 ml from site at 1140 m; so sample mixed.
PV-614-10-HFS20	1322	-177.167773	-25.803996	1157	Unfiltered piston water sample. Tavg=32°C. Vol=700 ml.
PV-614-11-HFS1	1347	-177.168283	-25.804156	1143	Piston water sample with 0.22 micron filter. Tavg=6°C. Vol=700 ml.
PV-614-12-HFS5	1355	-177.168283	-25.804156	1143	Unfiltered piston water sample. Tavg=8.9°C. Vol=703 ml.
PV-614-13-HFS7	1403	-177.168283	-25.804156	1143	Sterivex DNA filter. Tavg=8.6°C. Vol=1351 ml.
PV-614-14-HFS19	1446	-177.168317	-25.804113	1141	Unfiltered bag water sample in the hole. Tavg=52°C. Vol=633 ml.
PV-614-15-GT-white	1449	-177.168317	-25.804113	1141	White gas-tight. T=52°C
PV-614-16-GT-green	1450	-177.168317	-25.804113	1141	Green gas-tight. T=52°C
PV-614-17-HFS18	1451	-177.168317	-25.804113	1141	Filtered bag (gff) water sample. Tavg=51.5°C. Vol=603 ml.
PV-614-18-HFS17	1456	-177.168317	-25.804113	1141	Error: added 150 ml to 700 ml already taken.
PV-614-19-HFS16	1458	-177.168317	-25.804113	1141	Filtered bag (0.22 micron) water sample. Tavg=51.8°C. Vol=640 ml.
PV-614-20-HFS15	1504	-177.168317	-25.804113	1141	Sterivex DNA. Tavg=53.9°C. Vol=1829 ml.
PV-614-21-HFS22	1545	-177.168973	-25.804837	1079	Piston water sample. Tavg=25.4°C. Vol=322 ml.

7.3.4 PV-615 Sample Log: Monowai

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-615 Monowai Sample Comments
PV-615-1-MIN	1112	-177.168381	-25.804203	1143	Sulfur crusts from a large outcrop sampled with the sediment corer.
PV-615-2-B	1115	-177.168381	-25.804203	1143	Biology grab of tubeworms, crabs, mussels, anemones.
PV-615-3-MS-blue	1232	-177.169449	-25.805783	1025	Vent fluid from top of ridge. T=13.2°C.
PV-615-4-GT-black	1243	-177.169449	-25.805783	1025	Gas tight from top of ridge. T=13.2°C.
PV-615-5-GT-red	1248	-177.169449	-25.805783	1025	Gas tight from top of ridge. T=13.2°C.
PV-615-6-R/B	1334	-177.169215	-25.805442	1038	Rock & mussel from outcrop at top of ridge.
PV-615-7-SS-microB	1537	-177.175419	-25.802220	990	Suction sample of yellow fluffy bacterial mat from small vents at base of large pillows. T=11.0°C.
PV-615-8-R	1544	-177.175419	-25.802220	989	Lava rock with yellow iron oxide stain from top of cone.

7.3.5 PV-616 Sample Log: Macauley

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-616 Macauley Sample Comments
PV-616-1-MIN	945	-178.449896	-30.211281	345	Iron crust is plate-like, pervasive, broken - like old thick mat. Scoop sample was taken off this crust at base of a basalt pillow.
PV-616-2-MIN/R	1000	-178.449896	-30.211643	325	Mineral sample of crust coating (Iron oxide/silica 'flow coating') basalt rock.
PV-616-3-B/MIN	1024	-178.449729	-30.212205	292	Sample of starfish with mussels - and possible FeO sediments. This outcrop is heavily encrusted in FeO. T = 13.8°C.
PV-616-4-SS-microB	1032	-178.449860	-30.212582	284	White filamentous bacteria on clams and rocks.
PV-616-5-MIN/R	1107	-178.449950	-30.214080	345	Crust on loose boulder. The crust is Mn or Fe-Si.
PV-616-6-B	1132	-178.449120	-30.214330	248	Large gastropod on peak pinnacle.
PV-616-7-MIN/B	1227	-178.449238	-30.212938	337	Scoop Sample #2 of elemental sulfur plus a crab plus brown/red layer of lower plate or sheet crust, which is probably Fe/Si.

Sample	Time	Longitude	Latitude	Z	PV-616 Macauley Sample Comments
PV-616-8-MS	1243	-178.449000	-30.212900	336	Fluid sample (Blue MS). White gas tight (failed) at Mkr-9. T=128.6°C.
PV-616-9-MIN	1356	-178.449294	-30.213011	na	Elemental S 'worm casting' shape at base of pit.
PV-616-10-B	1422	-178.448688	-30.212937	270	Large batch of live mussels from clump near pit rim. Position approximate.
PV-616-11-B	1514	-178.450484	-30.212957	292	Single mussel with filamentous bacteria from outer slope. Tmax=7.4°C in the mussels.

7.3.6 PV-617 Sample Log: Macauley

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-617 Macauley Sample Comments
PV-617-1-B	909	-178.451002	-30.210296	438	Collect 'cup' coral from landing spot in area of talus covered slopes, winnowed sediments. (NW slope).
PV-617-2-B	930	-178.450353	-30.211377	438	Large red-brown urchin.
PV-617-3-R	938	-178.450211	-30.211647	345	Massive reddish-brown Fe-oxide crust encrusting lava blocks (several cm thick) from NW slope.
PV-617-4-B	950	-178.449733	-30.211887	316	3 long brown mussels. Small piece of Fe-oxide crus. 1 gastropod. 2 clams.
PV-617-5-B	1002	-178.449699	-30.211849	315	Up slope ~2 m - yellow starfish, 1 gastropod, mussel.
PV-617-6-R	1058	-178.449233	-30.213031	338	Collected piece of layered ash/volcaniclastic with matrix dominated by elemental S at bottom of small pit.
PV-617-7-SS-B	1113	-178.449233	-30.213031	338	Suctioned several flat fish same site as #617-6-R (jars 2&3).
PV-617-8-R	1145	-178.449000	-30.212900	336	Sampled Fe-coated volcaniclastic rock with 'box-work' texture on surface (126°C).
PV-617-9-MS-green	1203	-178.448966	-30.212927	335	Fluid sample ~8m E of Mkr-9 in area of diffuse venting. T=30.1°C.
PV-617-10-GT-blue	1207	-178.448966	-30.212927	335	Gas tight ~8m E of Mkr-9 in area of diffuse venting. T=30.1°C.
PV-617-11-B	1241	-178.448894	-30.213226	332	Collected black squat mussels (x3) in a cluster.
PV-617-12-MS-blue	1332	-178.449000	-30.212900	336	Re-sampled Mkr-9 vents - fluid sample. T=103.8°C.
PV-617-13-GT-yellow	1339	-178.449000	-30.212900	336	Re-sampled Mkr -9 vents - gas tight. T=103.8°C.
PV-617-14-SS-B	1423	-178.448402	-30.213357	260	Black squat mussels covered by white stringy bacterial mat sampled (jars 4&5).

7.3.7 PV-618 Sample Log: Giggenbach

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-618 Giggenbach Sample Comments
PV-618-1-R	917	-178.719931	-30.037917	276	Pumice "ejecta" with hypha & algae from area of small rubble field.
PV-618-2-R	938	-178.716378	-30.038154	164	T=72.3°C. Took sample of shelf and suctioned red mat.
PV-618-3-MS-blue	1011	-178.716315	-30.038098	164	Fluid sample (MS blue).
PV-618-4-GT-green	1014	-178.716315	-30.038098	164	Gas tight sample.
PV-618-5-SS-microB	949	-178.716378	-30.038154	164	Suction sample of red bacterial mat with algal/Mn top.
PV-618-6-R	1044	-178.714065	-30.037895	189	Highly altered basalt rock with white mat. T=24°C. (position actually ~10m E of sample 7)
PV-618-7-B	1116	-178.714345	-30.037879	191	3 white (thick bacterial mat) coated mussels sampled at HURL Mkr-10. Venting with phase separation. T=99.1°C.
PV-618-8-R	1142	-178.713967	-30.037635	186	Sulphide? chimney piece sampled. (position actually ~10-15m N of HURL marker 10)
PV-618-9-R	1213	-178.713231	-30.036351	95	Purple encrusted algae and barnacle covering basalt talus.
PV-618-10-B	1328	-178.710883	-30.033784	160	3 - 4 white mat-encrusted mussels.

Sample	Time	Longitude	Latitude	Z	PV-618 Giggenbach Sample Comments
PV-618-11-MS-white	1417	-178.710930	-30.033847	158	Fluid sample (MS white) from diffuse vent at bottom of mussel field: T=70.4°C.
PV-618-12-GT-white	1435	-178.710930	-30.033847	158	Gas tight sample from diffuse vent at bottom of mussel field: T=70.4°C.
PV-618-13-B	1457	-178.710822	-30.033911	161	Sinter-like sponge sampled. (position actually 10m east of sample 12)
PV-618-14-R	1509	-178.710369	-30.033714	163	Scoop #1: Hard sulfur crust below 205°C vent. (Deployed HURL Marker 12).
PV-618-15-R	1534	-178.710215	-30.033858	163	Scoop #2 - Glassy black sand next to 205°C vent.
PV-618-16-R	1535	-178.710215	-30.033858	163	Thermocouple holder sampled pumice.

7.3.8 PV-619 Sample Log: Giggenbach

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-619 Giggenbach Sample Comments
PV-619-1-HFS6	1056	-178.710551	-30.033597	164	Mkr-12 Boiling vent. Piston water sample. Start:1056 Stop:1058. Tmax=195.3 Tavg=185.3.
PV-619-2-HFS5	1059	-178.710551	-30.033597	164	Piston water sample. Start:1059 Stop:110.1. Tmax=202.4 Tavg=201.8 (Mkr-12).
PV-619-3-GT-blue	1101	-178.710551	-30.033597	164	Gas-tight on HFS. Start:1101 Stop:1101. Tmax=202.4 (Mkr-12).
PV-619-4-GT-yellow	1102	-178.710551	-30.033597	164	Gas-tight on HFS; re-triggered at 11:12. Start:1102 Stop:1102.Tmax=203 (Mkr-12).
PV-619-5-HFS22	1105	-178.710551	-30.033597	164	Piston water sample. Start:1105 Stop:1107. Tmax=203.8 Tavg=203.6 (Mkr-12).
PV-619-6-GT-black	1109	-178.710551	-30.033597	164	Gas-tight on HFS. Start:1109 Stop:1109. Tmax=203.9 (Mkr-12).
PV-619-7-HFS18	1109	-178.710551	-30.033597	164	Bag sample with GFF filter. Start:1109 Stop:1110. Tmax=203.9 Tavg=203.7 (Mkr-12).
PV-619-8-HFS9	1115	-178.710551	-30.033597	164	Unfiltered bag sample; small volume. Start:1115 Stop:1115. Tmax=203.6 Tavg=203.5 (Mkr-12).
PV-619-9-Gas	1415	-178.710453	-30.033585	164	Gas in scoop with pressure relief; collected above boiling vents at Mkr 12. Start:1415 Stop:1419.

7.3.9 PV-620 Sample Log: Giggenbach

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-620 Giggenbach Sample Comments
PV-620-1-SS-microB	1154	-178.715707	-30.036766	178	Massive orange/yellow bacterial mat into jar 1. T=33.3°C.
PV-620-2-MIN	1336	-178.714042	-30.037835	183	Top of ~1 m tall silica chimney - indurated. Retrieved chimney that was knocked off from downslope.
PV-620-3-MS-white	1406	-178.714322	-30.037869	191	Fluid sample (MS white) at area of diffuse venting. Mkr-10. T=164.5°C.
PV-620-4-GT-white	1412	-178.714322	-30.037869	191	Gas tight sample at area of diffuse venting. Mkr-10. T=164.5°C.
PV-620-5-MIN	1437	-178.714322	-30.037869	191	Sediment scoop of ash/bacteria at Mkr-10. T=164.5°C.
PV-620-6-R	1538	-178.710358	-30.033721	163	Sulfur-coated volcaniclastic rock from Mkr-12. T=205°C..
PV-620-7-MS-blue	1548	-178.710386	-30.033818	156	Fluid sample (MS blue) collected from boiling vent (position actually ~12 m upslope from Mkr-12). T=203°C.
PV-620-8-GT-blue	1548	-178.710386	-30.033818	156	Gas tight sample collected from boiling vent (position actually ~12 m upslope from Mkr-12). T=203°C.
PV-620-9-B	1600	-178.710386	-30.033818	156	Sampled small crabs collected near boiling vent (position actually ~12 m upslope from Mkr-12). T=203°C.
PV-620-10-bubbler	1626	-178.710462	-30.033736	166	Sampled gas bubbles in inverted sediment scoop from boiling vent below sample 7 (position actually ~12 m upslope from Mkr-12).

7.3.10 PV-621 Sample Log: Volcano W

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-621 Volcano W Sample Comments
PV-621-1-R	950	-179.187453	-31.864811	1293	Collected basalt with surficial alteration. 20 m upslope of position.
PV-621-2-B	1055	-179.187975	-31.861091	1165	Tubeworms sampled. 50 m south of position.
PV-621-3-SS-microB	1215	-179.186213	-31.857990	1052	Suctioned bacterial mat on southern caldera wall into jar #1. T=8.9°C.
PV-621-4-R	1227	-179.186749	-31.857777	1013	Sampled rock from caldera wall. 40 m upslope from position.
PV-621-5-SS-microB	1401	-179.183993	-31.847585	1047	Suctioned bacterial mat on cone flank into jars 2 and 3. T=28.0°C.
PV-621-6-MIN	1414	-179.184191	-31.847682	1039	Sediment scoop of ash/bacteria (scoop 2). 8 m upslope of position.
PV-621-7-SS-microB	1430	-179.184713	-31.848073	1047	Suctioned bacterial mat at orifice into jar 4. 5 m from position. T=10.0°C.
PV-621-8-MS-white	1445	-179.184713	-31.848073	1045	Fluid sample (MS white) from area of diffuse venting. 5 m from position. T=10.0°C.
PV-621-9-R	1454	-179.184847	-31.847971	1031	Collected glassy basalt from cone rim at Mkr-13.

7.3.11 PV-622 Sample Log: Rumble V

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-622 Rumble V Sample Comments
PV-622-1-B	927	178.200206	-36.150361	794	Dermechinus sea urchin.
PV-622-2-R	940	178.200133	-36.150558	796	Small pieces of surface pillow although it crumbles and only small pieces are recovered.
PV-622-3-B	1130	178.198183	-36.141018	486	Sample of Gigantidas mussels.
PV-622-4-MS	1133	178.198183	-36.141018	486	Fluid sample from above mussel bed. T=11.2°C. T ambient=10.2°C.
PV-622-5-MS	1136	178.198183	-36.141018	486	Fluid sample from above mussel bed. T=11.2°C. T ambient=10.2°C.
PV-622-6-R	1143	178.197606	-36.140610	474	Rock with encrusting mat.

7.3.11 PV-623 Sample Log: Clark

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-623 Clark Sample Comments
PV-623-1-B	945	177.842377	-36.448112	994	Sponge.
PV-623-2-R	950	177.842377	-36.448112	994	Lava with iron oxide crust.
PV-623-3-SS-microB	1010	177.840337	-36.447244	929	Microbial mat (white films) and other organisms sampled at venting on wall.
PV-623-4-MIN	1028	177.839795	-36.447382	895	Sediment scoop of sulfides and ash. T=92.6°C.
PV-623-5-SS-B	1034	177.839795	-36.447382	895	Suction sample scaleworm and bacterial mat into jars 3, 4 and 5 near vent.
PV-623-6-B	1051	177.83943	-36.447203	884	Long-neck barnacles sampled. T=15°C. Tmax=106°C.
PV-623-7-R	1100	177.839584	-36.447333	883	Small venting chimney. (T=?)
PV-623-8-R	1108	177.839502	-36.447315	879	Piece broken off large (6 m tall) chimney. T=185.2°C.
PV-623-9-MS-blue	1121	177.839502	-36.447315	879	Sampled vent fluid (MS blue). T=185.2°C.
PV-623-10-GT-white	1121	177.839502	-36.447315	879	Gas tight sample. T=185.2°C.
PV-623-11-R	1154	177.839008	-36.447137	872	Small rock samples off base of Twin Towers chimney.
PV-623-12-MS-white	1204	177.839008	-36.447137	872	Sampled vent fluid (MS white). T=221.1°C.
PV-623-13-GT-black	1204	177.839008	-36.447137	872	Gas tight sample. T=221.1°C.
PV-623-14-SS-microB	1204	177.839008	-36.447137	872	Suctioned bacterial material near vent.
PV-623-15-B	1227	177.839008	-36.447137	872	Yellow Deudrophilla (coral) plus urchin.

Sample	Time	Longitude	Latitude	Z	PV-623 Clark Sample Comments
PV-623-16-SS-MIN	1340	177.839894	-36.447957	879	Suctioned nontronite with green material. Max temp 56°C. (80 m N of w.p. #3)
PV-623-17-R	1343	177.839894	-36.447957	879	Sample of nontronite crust with green material. (80 m N of w.p. #3)
PV-623-18-MIN	1348	177.839894	-36.447957	879	Scooped green and red nontronite. (80 m N of w.p. #3)
PV-623-19-B	1433	177.839597	-36.450156	870	Red Corallium Regalia (coral).
PV-623-20-R	1515	177.839191	-36.451104	848	Mn-coated lava with anemone.
PV-623-21-B	1414	177.839871	-36.448941	883	Soft pink gorgonian coral. Sample taken earlier (after sample 18 but not given a number at that time).

7.3.11 PV-624 Sample Log: Rumble V

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-624 Rumble V Sample Comments
PV-624-1-B	950	178.199943	-36.139940	497	Large polychaete feeding on dead crab.
PV-624-2-B	1057	178.195863	-36.139439	379	Gigantidas gladius mussels. T=39.7C.
PV-624-3-SS-B	1105	178.195863	-36.139439	379	Suction of vent shrimps (?Alvinocaris niwa).
PV-624-4-SS-B	1106	178.195863	-36.139439	379	Sucation of vent shrimps (?Alvinocaris niwa).
PV-624-5-R	1107	178.195863	-36.139439	379	White/yellow rock from vent.
PV-624-6-MS-yellow	1112	178.195863	-36.139439	379	Major fluid sample (yellow).
PV-624-7-GT-yellow	1115	178.195863	-36.139439	379	Gas tight fluid sample (yellow).
PV-624-8-MIN	1134	178.195689	-36.139725	390	White sediment, gastropod, small white limpets - in scoop sample.
PV-624-9-B/R	1140	178.195689	-36.139725	390	Rock with white covering and small white limpets.
3PV-624-10-MIN	1209	178.195620	-36.139889	414	Red/yellow crust and anemone.
PV-624-11-R	1212	178.195620	-36.139889	414	Brown rock and anemone.
PV-624-12-SS-B	1214	178.195620	-36.139889	414	Crustal material and small orange seastars.
PV-624-13-SS-B	1216	178.195620	-36.139889	414	Crustal material and small orange seastars.
PV-624-14-B/R	1231	178.195482	-36.140751	452	2 brown/black rocks, hydroids and small anemone at Mkr-16.
PV-624-15-SS-MIN	1249	178.196545	-36.140910	453	Small yellow/white chimneys (4 cm), filamentous bacteria+F16 and brown crust.
PV-624-16-MS-blue	1309	178.196519	-36.141066	454	Fluid (MS blue) sample at vent. T=22.0C.
PV-624-17-B	1340	178.196435	-36.138147	452	Large turban-shape gastropod.
PV-624-18-B	1351	178.195822	-36.138233	448	Large Gigantidas gladius sampled in area of diffuse venting. T=12.6C.
PV-624-19-B/R	1406	178.195197	-36.138318	453	Lava pillow rock fragment, large white/purple anemones and gastropod.
PV-624-20-SS-MIN	1432	178.194109	-36.137890	453	Brown crust and small orange starfish.
PV-624-21-B	1453	178.193237	-36.139028	433	Large spiny crab (not well - missing two legs).
PV-624-22-SS-microB	1510	178.194640	-36.140037	452	Yellow 'bumps' of bacteria from substrate in area of diffuse venting. T=27.5C.

7.3.12 PV-625 Sample Log: Healy

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-625 Healy Sample Comments
PV-625-1-MIN	939	179.012372	-34.992400	1389	Scoop #5. <1 cm thick FeOOH-Si crust and black sand (ash).
PV-625-2-SS-MIN	1018	179.013849	-34.992796	1391	Suction sample of 25-30 cm thick FeOOH-Si crust. T=15.9ºC in sediments.
PV-625-3-SS-MIN	1215	179.008496	-34.994852	1483	Suction sample of FeOOH-Si seds mid-way between cones 1 & 2. T=8.7°C.
PV-625-4-MIN	1254	179.007131	-34.996131	1373	Scoop #4. FeOOH-Si that hot water was flowing thru (Mkr-19).

Sample	Time	Longitude	Latitude	Z	PV-625 Healy Sample Comments
PV-625-5-MS-yellow	1241	179.007131	-34.996131	1373	Fluid sample (MS Yellow). T=33.9ºC in sediments. NE rim of Cone #2 (Mkr-19).
PV-625-6-MIN	1319	179.006483	-34.996832	1373	Scoop #1 of fibrous FeOOH-Si chimney matter.
PV-625-7-SS-MIN	1325	179.006483	-34.996832	1373	Suction sample of fibrous FeOOH-Si matter.
PV-625-8-R	1341	179.006483	-34.996832	1372	Rock (basaltic, visicular) from within black sediments beneath FeOOH-Si matter.
PV-625-9-MS-blue	1430	179.007096	-34.996144	1373	Fluid sample (MS Blue). T=28.3ºC in sediments at Mkr-19.
PV-625-10-GT-red	1438	179.007096	-34.996144	1373	Gas tight (Red). T=28.3ºC in sediments at Mkr-19.
PV-625-11-GT-yellow	1440	179.007096	-34.996144	1373	Gas tight (Yellow). T=28.3ºC in sediments at Mkr-19.
PV-625-12-SS-microB	1528	179.004653	-34.998816	1384	Suction sample of white mat atop orange FeOOH-Si sediments.
PV-625-13-SS-microB	1529	179.004653	-34.998816	1384	Suction sample of white mat atop orange FeOOH-Si sediments.
PV-625-14-MS-white	1530	179.004653	-34.998816	1385	Fluid sample (MS White) T=28.4ºC in sediments.

7.3.13 PV-626 Sample Log: Brothers

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-626 Brothers Sample Comments
PV-626-1-R	1026	179.059570	-34.863286	1779	White altered talus. [3 pieces were put into biobox but for ballast. Only one was retained by the end of dive.]
PV-626-2-R	1050	179.058813	-34.863065	1728	Wedge of altered basalt taken from intact pillow.
PV-626-3-SS-min	1106	179.058558	-34.862987	1715	Suction of yellow oxide chimney (Jar #1).
PV-626-4-MIN	1217	179.058286	-34.862975	1679	Small inactive chimney from near base of large active one marked by Shinkai Marker #4.
PV-626-5-MS-blue	1246	179.057600	-34.862624	1644	Fluid sample (MS Blue) from top of large chimney. T=260°C. Difficult to tell how good sampler was in position. No GT because fear of dropping it.
PV-626-6-MS-yellow	1313	179.057315	-34.862474	1616	Fluid sample (MS Yellow). T=290°C (Mkr-17).
PV-626-7-GT-black	1320	179.057315	-34.862474	1616	Gas Tight (Black) sampler in 290°C fluid (Mkr-17).
PV-626-8-B	1346	179.059771	-34.861609	1647	Crab put into biobox. Crab was slightly crushed.
PV-626-9-SS-B	1347	179.059771	-34.861609	1647	Crabs sucked into hose and held in holder. Small gastropods in Jars 2 and 3.

7.3.14 PV-627 Sample Log: Healy

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-627 Healy Sample Comments
PV-627-1-MIN	1043	178.993937	-34.997268	1410	Old, pale alteration ~15 cm thick crust overlying black breccia. Scoop # 1.
PV-627-2-R	1047	178.993937	-34.997268	1410	?Basaltic rock from black breccia.
PV-627-3-B	1134	178.996001	-35.000594	1295	?Hyroid on rock sampled.
PV-627-4-MIN	1159	178.992224	-35.003284	1166	Older Fe crust on outer flank. Scoop # 4.
PV-627-5-SS-min	1228	178.991663	-35.003944	1140	Fe chimney and mat from diffuse active vent. T=20.1°C.
PV-627-6-B	1310	178.986788	-35.005286	1104	Hermit crab with anemone.
PV-627-7-SS-B	1357	178.990497	-35.007125	1121	Holothurian.
PV-627-8-MIN	1439	178.989942	-35.005623	1179	Fe crust from crater floor. Scoop # 5.

7.3.15 PV-628 Sample Log: Brothers

Time is local. Depth in meters. *Pisces-V* sample and marker **positions have been adjusted** to agree with edited navigation files.

Sample	Time	Longitude	Latitude	Z	PV-628 Brothers Sample Comments
PV-628-1-R	1453	179.061160	-34.861585	1692	2 altered rocks 1 sulfide crust.
PV-628-2-MIN	1608	179.057516	-34.861156	1577	Top of dead chimney spire.

8.0 *Pisces V* DIVE LOGS (OE Quicklook Reports)

***Pisces-V* positions in the dive logs/reports HAVE NOT BEEN ADJUSTED to agree with edited navigation files (see navigation section 5.0).**

8.1 PV-612 Monowai Dive Log

Location: Monowai Volcano, southwest caldera area
Latitude: *Begin* 25° 47.738'S, **Longitude**: 177° 10.253'W
Mission Date: April 07, 2005
Bottom Time: 5 hours 40 minutes (5.66 hours)
Maximum Depth (m): 1372
Observer: Bob Embley
Pilot 1: Terry Kerby
Pilot 2: Steve Price

Objectives:
(1) Explore the volcanic ridge at SW area of caldera of Monowai Volcano.
(2) Recover geologic, biologic and fluid samples, make video and camera surveys.

Observations, findings, etc: (Also see Appended Dive Log)
The dive began on the floor of the caldera near a SW-NE trending tectonic ridge that extended from the central cone of the caldera floor into the SW wall of the caldera. The plan was to precede upslope to the SE to the top of the NW-SE trending volcanic ridge where mussels had been dredged by the New Zealand Research Vessel *Tangaroa* in 2005. A constant heading to the SE was not obtained because of faulty compass readings and the dive track veered south to southwest (the navigation fixes were called down from the surface). A traverse upslope towards the target ridge passed over alternating areas of pillow lavas, heavily sedimented areas and talus slopes. At about 1200 meters depth, those portions of the lavas not covered with sediments were colonized by dense communities of small bivalves and limpets. At 11:37 L *Pisces V* changed course to the SE to traverse directly upslope to the crest of the target ridge. At 11:53 at a depth of 1078, swarms of shrimp were observed on the ledges of outcrops and at 12:26 at 1056 meters dense mussel beds and swarms of crabs and shrimp were observed. The remainder of the dive occurred at the top of the ridge. The mussel beds were mapped for more than 300 meters along the crest of the ridge to the southeast. In places the mussels almost completely covered the seafloor. The crab population was very large, and competition for space on the mussel beds was fiercely contended. Samples of mussels, rocks (with animals attached) and whelks were collected during the dive.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-612 Monowai - Observations
		25°S	**177°W**	Note: GMT is 11 hours ahead of local time. e.g., 1000 Local = 2100 GMT.
10:09:00	1372	47.738	10.253	**On Bottom.**
10:17:00				Sedimented slope with some pillow outcrops. Looking at long pillows covered with sediments.
				Still at landing place.
10:18:00				Discussion about Waypts. Tracking doesn't have them.
10:21:00				Begin moving south. Sedimented talus slope.
10:22:00				Nice Pillows. Sponges and anemones where there is bare rock. Extensive outcrop here.
10:24:00				Same but more truncated pillows with elephant-skin morphology. Terry sees bivalves (limpets?).
10:26:00				Looking at pillow tubes with sessiles on truncated lobes. See anemones and small white bivalves. Nice video.
				Nice video of pillows; also good still pictures??
10:27:15				Start moving south again; saw beautiful pillow skin.
10:29:20				See pumice? Stopping briefly.
10:30:00	1356			Begin moving upslope to south again. Still lots of sediment.

Time	Z	Lat	Long	Dive Log PV-612 Monowai - Observations
				Big Venus-flytrap anemone.
10:31:00				Hesitating again, and then moving.
10:32:15				On bench, going off bottom towards next target: 50 meters away.
10:33:00	1321			15 m off bottom, going south.
10:35:00				Wall in sight. More pillow tubes in place.
10:36:00				Holothurian. Lots of sediment.
10:36:30				Climbing steep slope.
10:37:30				Going up heavily sedimented slope.
10:38:15				Big hole - possibly collapse.
10:38:45				Heavily sedimented slope. No outcrops.
10:40:00				Off bottom a few meters.
10:41:45				Wall 60 m ahead.
10:43:00				Off bottom going south towards wall.
10:44:00				Realized compass is off: Going more west.
10:45:00	1294	47.877	10.284	Stopped on heavily sedimented slope to get fix.
10:50:15				Moving south again. Up in water column a few meters.
10:53:00				Slowly moving south?
10:54:30				Moving south again over talus chutes interspersed with sediment.
10:55:45				Moving some fresh talus chutes broken by sediment covered areas.
10:56:45				Mostly sediment covered with some talus.
10:57:30				More talus with old sedimented pillows between.
10:58:00				Solid talus, some large pillow fragments; talus chutes have different size pieces
11:00:00	1224	47.877	10.284	Over slope completely covered with pillow talus, mostly old.
11:00:45				Over slope completely covered with pillow talus, mostly old.
11:01:30				Still talus with some pillows. Going SSW (but supposed to go SSE). Either the current or a bad compass.
11:02:30				Talus.
11:03:45				Go back and forth from talus to sedimented slope.
11:04:20				Fresh surfaces on rocks covered with small bivalves (limpets?)
11:05:00	1198	48.045	10.318	Stopping to get fix on slope with alternating talus and sediment.
11:07:00				Getting fix.
				PV-612-1R/B (Sample 1)**.** Piece of old weathered vesicular basalt with from talus with small bivalves.
11:14:15				Start moving south again.
11:15:00				Talus faces completely covered by bivalves.
11:15:30				Stopping to look at octopus with big eyes.
				Good video and pictures.
11:17:00				Turned data frame off to get good video of octopus.
11:17:45				Moving on south again upslope.
11:18:00				Heavily sedimented old talus.
11:20:00				Stopped to see another octopus - even bigger eyes.
				All rock faces have sessiles.
				Great video of octopus. Same species as previous?
11:20:20				Took data overlay off video to get best results. Put on lower light.
11:22:45				Put data back on.
11:23:15				Moving upslope again.
11:23:35				See a crab.
11:23:47	1172			Heavily sedimented with some outcrop or large talus.
11:25:00				Heavily sedimented. Some anemones and fish. Sessiles coat rock faces.
11:25:30				Ripple marks at high angle to slope.

Time	Z	Lat	Long	Dive Log PV-612 Monowai - Observations
11:26:02	1156			Heavily sedimented with some outcrop or large talus.
11:26:30				More ripple marks.
11:27:15				Large field of ripple marks.
11:28:00	1150			Still ripple marks.
11:30:00				Ripples, continuous sediment cover.
11:31:00	1141	48.18	10.337	Stopping to get fix.
11:36:35				Moving south again.
11:37:15				Over talus and sediment, alternately.
11:46:45				Has been mostly sedimented slope- flying pretty high off bottom.
11:47:22	1127			Nice big ripple marks; heading 135, not sure it's accurate.
11:48:30				Shell debris in scour channel.
11:50:00				Mostly rippled and scoured sedimented terrain with occasional outcrops; outcrop faces completely covered with sessiles.
11:51:30				More rock outcrops. Nice picture of faces covered with bivalves.
				Nice video of faces covered with animals.
11:53:30				Beautiful ripples and channel with shell debris including. Crab parts.
11:54:00				More dead crabs or shed parts.
11:54:45				More outcrops. Outcrop faces completely covered with sessiles.
11:55:10	1078	48.316	10.262	Stopping -Tubular pillows with shrimp swarms under ledges.
				Stopping. This is the spot that the Fornari camera took great pics.
				No obvious flow here.
				Good video and pictures of pillow tubes.
12:02:33				Maneuvering around big pillow tubes looking for sample place.
12:03:40				Close in view of pillows.
12:05:00				**PV-612-2-R/B** (Sample 2). Taking sample of basalt crust with animals. Put in biobox.
12:20:10				End Station. Start upslope over solid pillow tubes. Lots of shrimp and sessiles on rock faces. Pretty steep slope.
12:21:30				See small reddish-brown mats, oxides.
12:22:15				Small dead oxide chimneys? Mostly sediment covered now.
12:23:00				Over the crest and onto bench or drop-off.
12:24:45				Pillows with lots of animals all over faces.
12:25:00	1056			
12:25:30				Seeing some bivalves on rock.
12:26:35				Stopped to look at mussel clumps. Definite venting on NW side of ridge. Lots of shrimp.
12:28:10	1050	48.334	10.25	
12:29:05				Still at same spot.
12:38:00				Same spot.
				Collecting mussels into biobox.
				Same spot.
				PV-612-3-B (Sample 3). Mussels.
12:43:20				Still at same spot. View of slope in front with anemones, mussels, crabs etc.
12:43:45				Moving upslope a bit to look at another spot to take temperature reading.
				Lots of crusts.
12:44:45				Stopped a few meters from Sample 2 spot.
12:45:00				Moving upslope again. Gets more sedimented again.
12:46;05				Seeing whelks on sediment surface.
12:47:15				Outcrop covered with shrimp and mussels.
12:47:20				Nice video of outcrop with biota; data off for a couple of spots (GOOD VIDEO CLIP)
				No sign of any shimmering water.
12:48:00				Going to try the Fornari camera. Data frame off again.

Time	Z	Lat	Long	Dive Log PV-612 Monowai - Observations
12:50:00				Start moving again.
13:51:00				Moving over sedimented terrain.
12:51:28				Crossed boundary with solid mussel base. Not much sediment or rock visible.
12:52:50	1040	48.337	10.23	Stopped for position.
12:53:30	1040			Vast plain of mussel beds and their companions. Lots of crabs, shrimp; lot of open valves, probably from crab feasts.
12:56:44				Just got position.
12:59:30				Start moving again.
12:59:45				A bit patchier now.
13:00:30				Thicker.
13:01:40				Are currents delivering the gases? Haven't seen any sort of venting. 7 m of altitude.
13:02:40				Extensive cover again.
13:03:20				Nice video of mussel mound.
13:03:30				Stopping to look at venting. Beautiful view of biology.
13:06:00				Maneuvered around to vent from other side. Microbial mats.
13:11:50				Moved around again; stirred everything up.
13:15:15				Maneuvered and waiting for cloud to dissipate to get temperature reading. Max T = 10.1 deg C.
13:20:00				Some excellent video of vent biology.
13:23:30				**PV-612-4-R** (Sample 4). Sample of grey rock.
13:24:00				Going to change soda-sorb.
13:27:30				Moving towards top; over dense biology.
13:28:45				Stopping at another vent. Very thin tube worm bunches.
13:31:00	1026			Taking temperature of fluids coming out of outcrop of grey rock. 8.6 C Tmax.
				Shallowest point on dive
				PV-612-5-B (Sample 5). Large clams and a few tubeworms (hardly any of the worms made it into the biobox).
13:37:50				Area of greyish rock with water coming out.
13:38:30				Moving north. Lose bottom as it drops off to the NW.
13:39:15				A few larger tubeworms.
13:42:30	1028	48.341	10.204	More venting. Still very dense. Stopped for position.
13:45:45				Begin moving again - going east.
13:47:00				Seeing chimney-type structures. Still lots of biota.
13:50:00				Bottom drops off.
13:50:40				Can't see bottom. Heading east.
13:51:50				Start moving SE; seeing dense biota and chimney structures; lot of vent fish/eels.
13:52:00				Dense biota. See chimneys. Stop for a minute.
13:53:00				Saw another old chimney-like structure.
13:53:30	1028	48.369	10.133	Stopped to get position. Dense biota here.
13:56:40				Begin moving again.
13:57:45				Start going SE.
13:59:00				Off bottom.
13:59:10				Bottom in sight. Lots of biota still.
14:00:00				Just saw another large structure. Still lots of biota.
14:01:20				Still lots biota. On and off bottom.
14:02:25				Going south - even though he's steering SE.
14:03:00				Off bottom. Can't see anything.
14:03:45				End Tape 2 of 3. Off bottom.
14;05:00				Begin Tape 3 of 3.
14:05:30				On bottom, still dense biota.
14:06:20				Turning to continue SE.

Time	Z	Lat	Long	Dive Log PV-612 Monowai - Observations
14:08:00				In cloud of stirred up stuff. Can't see much. Turning.
14:10:00				Can't see bottom. Heading SE. Going to sit and get a position.
14:10:50	1069	48:132	10.111	On bottom. No biota. Going to get position.
14:13:30				Lift off bottom and start moving.
14:15:10				Start moving upslope to north
14:16:00				Can't see bottom.
14:17:30				See bottom again-still sedimented. No vent biota
				Some burrowing.
14:18:10				Saw a few shells.
14:19:00				Seeing whelks on sediment surface.
14:20:20	1045			Seeing patches of mussels and others - patchy.
14:21:15				Still sitting at site. Want to go east.
14:22:00				Back in thicker mussel beds.
14:22:45				Lost bottom for a bit. Now seeing mussels again.
14:24:30				Seeing dense mussel beds here ~2 m off bottom.
14:24:50				Losing bottom again. Going SE.
14:34:45	1111	48.407	10:043	On bottom again. Several whelks, mussel shells. On periphery of venting.
14:39:00				**PV-612-6-B**. (Sample 6). Whelk shell in biobox.
14:41:45				Start moving again.
14:42:20				Back into patchy stuff.
14:43:00				Stopped briefly to take video of closed anemone.
14:44:00				Start moving again.
14:44:45				Going upslope up biodebris channel? Going south.
14:42:20				Back into patchy stuff.
14:43:00				Stopped briefly to take video of closed anemone.
14:48:50	1085			Going south. Patchy stuff. Not sure how much is alive.
				Mostly dead.
14:50:20				At outcrop with live shrimp. Bumped into overhang.
14:51:25				Getting near or at the top. Pretty barren, but debris must have come from somewhere.
14:53:10				Going to get position. Can't see bottom now.
14:56:30				Seeing bottom. Some shrimp. Position at 1457.
15:05;00				Been maneuvering. Now briefly see sedimented bottom.
15:11:20				On bottom again. Sedimented with pillow outcrop. No venting.
15:12:50				At SE end of ridge. No biota here.
15:13:00	1061			No animals here.
	1077			Back on bottom after being lost in clouds.
15:26:00				Rocks covered with shrimp, but no mussels.
15:28:30	1070			Up off bottom again.
15:32:15	1057			More biota.
15:32:45	1053			Back into thick live mussel beds.
15:33:20	1052			Stopped in mussel beds to get final position.
				Tripping majors for background water. **PV-612-7-MS** (Sample 7) and **PV-612-8-MS** (Sample 8).
15:48:45		48.403	10.121	**Off bottom; End Dive PV-612.**

8.2 PV-613 Monowai Dive Log

Location: Monowai Volcano, southwest caldera area
Latitude: *Begin* 25° 48.313'S, **Longitude:** 177° 09.843'W
Mission Date: April 8, 2005
Bottom Time: 6 hours 23 minutes (6.38 hours)
Maximum Depth (m): 1297
Observer: Ian Wright
Pilot 1: Terry Kirby
Pilot 2: Max Cremer

Objectives:
(1) Explore the western and eastern flanks of Mussel Ridge.
(2) Sample any discovered hydrothermal vent fields on the ridge flanks.
(3) Sample the diffuse venting associated with the dense mussels' beds at the crest of the ridge.

Observations, findings, etc: (Also see Appended Dive Log)
The dive started on the lower southeastern flanks of the ridge imaging pillow lavas and associated talus. The western flanks of the ridge comprised a similar geology on the lower slopes. The upper slopes consisted of volcanic talus and mussel shell detritus. The northeastern flank comprises a NE-SW structurally controlled hydrothermal vent field, extending from a depth of 1170 m to the ridge crest. The field consists of discrete vents with associated mussels beds, crabs, shrimps, and tube worms. Most vents occur at outcrop bases (though not exclusively) with evidence of elemental sulphur extrusion on the seafloor. Vent temperatures ranged between 47°C and 55°C. Major fluids, gas tights, and bacterial mat sampling were attempted at various vent sites.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat.	Long	Dive Log PV-613 Monowai - Observations
9:20	1140	**25°S**	**177°W**	Smoke / turbidity in water.
9:29	1297	48.313	9.843	On bottom. Steep volcanic wall with sediment cover.
9:30				Establishing sub trim.
9:37	1306	48.312	9.790	Shrimp in view.
9:43	1286	48.338	9.811	Start moving southeast.
9:44				Steep volcanic wall with sediment cover.
9:45				Sediment substrate with localised cobble talus.
9:46				Sediment covered pillow blocks and talus.
9:48	1266	48.362	9.822	Localised fractured pillow blocks.
9:49				Mostly sediment drape over volcanic talus.
9:49				Steep volcanic overhang with sediment drape.
9:51	1249	48.407	9.817	Sediment substrate over talus.
9:52				Localised talus and volcanic outcrops.
9:54	1242	48.438	9.812	Scree talus and sediment.
9:56	1231	48.462	9.791	Detached pillow blocks and sediment.
9:57				Steep volcanic outcrop.
9:58	1228	48.398	09.792	Position 2.
10:02				Moving northwest.
10:03	1215	48.492	9.805	Steep volcanic outcrops to port.
10:05				Poor visibility.
10:07	1201	48.475	9.827	Sediment covered volcanic talus.
10:08				Poor visibility.
10:12	1202	48.469	9.853	Sediment covered volcanic blocks.
10:14				Poor visibility.
10:18	1221	48.398	09.826	Position 3.
10:22				Moving southeast upslope.

Time	Z	Lat.	Long	Dive Log PV-613 Monowai - Observations
10:24	1211	48.396	9.872	Sediment covered with isolated blocks.
10:28				Steeper volcanic outcrops with sediment.
10:29	1169	48.432	9.924	Poor visibility.
10:31				Volcanic talus and volcanic outcrops.
10:32	1132	48.438	9.930	Sediment covered volcanic blocks.
10:33				Massive volcanic outcrop.
10:35				Sediment covered volcanic talus.
10:36	1080	48.456	9.987	Crested over localised ridge.
10:37				Poor visibility.
10:38				*Pisces* stops on seafloor.
10:41	1087	48.480	09.990	Position 4.
10:42				*Pisces* moving to the west.
10:43	1072	48.463	9.996	Mostly sediment with volcanic talus.
10:45				Poor visibility, but sediment substrate.
10:46				*Pisces* stopped on seafloor.
10:49	1063	48.446	10.011	Position 5.
10:50	1055	48.444	10.016	Moving through water to northeast.
11:06				*Pisces* back on sedimented seafloor.
11:07	1169	48.510	10.191	Position 6.
11:09	1166	48.499	10.197	Moving northeast upslope.
11:11				Sediment substrate with mussel debris.
11:14				Shell fragments. And granule talus chute with surrounding sediment.
11:16	1125	48.468	10.171	Sediment with rille and chute developing.
11:19				Sediment with volcanic outcrops.
11:20	1085	48.453	10.134	Pillow tubes with sediment cover.
11:21				Sediment rilles / poor visibility.
11:24	1061	48.409	10.110	Sediment substrate / hummocky with bioturbation.
11:27				Volcanic blocks / burrowed sediment substrate.
11:29	1060	48.443	10.091	*Pisces* stopped on seafloor.
11:32				*Pisces* moving again.
11:33	1069	48.400	10.098	Volcanic outcrops covered in shrimps + crab.
11:35	1060	48.416	10.079	*Pisces* stopped on seafloor.
11:38				Start sampling.
11:40	1064	48.432	10.090	**PV-613-1-SS** (Sample 1) Suction sampling shrimp.
11:42				Attempting to rock sample.
11:49				Moving again through water.
12:04	1176	48.486	10.287	Back on seafloor. Position 8.
12:10				Moving northeast upslope.
12:11	1181	48.465	10.302	Sediment substrate with mussel debris.
12:14				Sediment substrate with bioturbation / trails.
12:15	1132	48.438	10.249	Hummocky and burrowed sediment.
12:17				Sediment with dispersed white patches of bacterial mat(?).
12:18	1070			Live in situ mussels, crabs, gastropods.
12:19				Sediment and volcanic talus.
12:21	1075	48.399	10.210	Increasing volcanic talus and mussels.
12:23				High densities of mussels, crabs.
12:25	1057	48.391	10.193	High densities of mussels, crabs.
12:27				High densities of mussels, crab, / localized blocky topography.
12:28	1038	48.375	10.183	Rock outcrops covered in mussels / crabs.
12:30				*Pisces* on seafloor.

Time	Z	Lat.	Long	Dive Log PV-613 Monowai - Observations
12:33	1033	48.370	10.166	Position 9.
12:35				Moving through water to northeast.
13:00	1220	48.196	10.027	On seafloor, Position 10.
13:01				Isolated volcanic block with mussels / crabs / altered rock.
13:07				**PV-613-13-R** (Sample 13). Altered rock sampled.
13:11				*Pisces* off bottom, moving upslope.
13:12	1209	48.194	10.037	Sediment substrate.
13:13				Sediment substrate with white alteration / ?bacterial mats.
13:14	1187	48.200	10.043	Sediment with shell debris and white seafloor alteration.
13:16				Altered volcanic rocks / crabs.
13:17	1174	48.219	10.058	Increasing volcanic talus and white alteration crusts.
13:19				Attempting rock sample of white altered crust - no sample.
13:22				*Pisces* off bottom.
13:23	1169	48.224	10.065	Altered volcanic rocks / crabs, fragments of elemental sulfur.
13:25	1159	48.227	10.065	Altered rock with shimmering water.
13:27				Shimmering water venting beneath altered rock overhang at Vent 1.
13:30	1163	48.222	10.560	Vent 1, Probe temperature 47.5°C.
13:32				Shimmering water (Vent 2) 2 m along slope.
13:35	1159			Vent 2, Probe temperature 48.7°C.
13:36				Crabs and mussels associated with vents.
13:37	1170	48.223	10.074	**PV-613-2-MS-Blue** (Sample 2). fluid sampling (MS Blue) of Vent 2. T=55.6°C.
13:49				Move upslope 4-5 meters.
13:50	1168	48.215	10.061	Vent 3. Shimmering water; temperature 55.6°C.
13:51				**PV-613-3-SS** (Sample 3). Suction sample of shrimp and filamentous mats at Vent 3 orifice.
13:55				**PV-613-4-B** (Sample 4). Bio sample of crabs at vent 3.
13:57				Moving upslope through vent field.
13:58				Extensive seafloor alteration and elemental sulfur.
13:59	1172	48.227	10.084	Shimmering water. HURL marker # 8 deployed.
14:01				Further shimmering water venting at base of altered crusts.
14:02	1170	48.239	10.081	Moving upslope through vent field.
14:03				Fragments of elemental sulfur dispersed on seafloor.
14:04	1152	48.241	10.102	Venting (Vent 4) from altered outcrop / crusts with solidified sulfur flows.
14:06				Shrimps, tube worms, rat-tail fish, crabs, mussels proximal to vent.
14:07				Probe temperature of vent 4 56.5°C.
14:09				**PV-613-5-B** (Sample 5). Sampling of tube worms at Vent 4.
14:10	1152	48.255	10.082	Position of Vent 4.
14:13				Vent 5; <2 m along slope, small partially broken chimney.
14:14				**PV-613-6-R** (Sample 6). Rock sample of vent 5.
14:19				Moving upslope. Altered rock, crabs, and mussels.
14:20				White alteration and elemental sulfur. Concentration of mussels, crabs.
14:21				Altered rock outcrop / crust with overhang of tubeworms.
14:22				Suspended sediment clearing.
14:28				Suspended sediment clearing.
14:35				Moving upslope.
14:36				White altered rock / sediment, mussels and crabs.
14:37	1115	48.261	10.094	Rock / sediment with crabs and mussels.
14:37				Line of white alteration / crust along slope.
14:38				Altered rock / sediment with crabs.
14:38				Line of white alteration / crust along slope.

Time	Z	Lat.	Long	Dive Log PV-613 Monowai - Observations
14:39				Line of white alteration / crust along slope.
14:40	1101	48.271	10.094	Rock boulder covered in mussels and crabs.
14:40				Line of white alteration / crust along slope.
14:41				High densities of mussels with surrounding sediment, tube worms.
14:43	1089	48.282	10.129	Live tube worms.
14:44				Moving upslope, sediment, rock, crabs, and mussels.
14:45				Altered rock, tube worms, crabs, and shrimp.
14:46	1092			Turning to move downslope to Marker 8.
14:56	1165	48.209	10.151	Back on bottom, altered rock, mussels, crabs.
14:59				Moving over sediment substrate with altered rock, crabs, mussels.
15:00	155	48.231	10.107	Poor visibility, sediment, mussels, crabs.
15:01				White alteration on seafloor, fragments of elemental sulfur.
15:03				Disturbed sediment in water column.
15:05				Start gas tight sampling of Vent 6.
15:06				Vent 6 is a line of altered crust with shimmering water venting at base.
15:07	1165	48.233	10.073	**PV-613-7-GT-Red** (Sample 7). Gas tight sampling. Temperature 57.4°C.
15:17				**PV-613-8-MS** (Sample 8). Major fluids sampling of Vent 6. Sample failed.
15:25	1165			**PV-613-9-GT-Silver** (Sample 9). Gas tight sampling. Temperature 53.6°C
15:34				Temperature probe 57.4°C.
15:35				**PV-613-10a-SS** (Sample 10). Start of suction sampling. Suction sample of shrimp / ?filamentous mats
15:38				**PV-613-10b-SS** (Sample 10 cont.). Continue suction sampling. Suction sample of shrimp / ?filamentous mats. Temperature 53.6°C
15:42				**PV-613-11-R** (Sample 11). Fist sized rock sample from vent orifice, with white surficial alteration.
15:42				**PV-613-12-R** (Sample 12). Small altered rock sample from vent orifice.
15:45	1162	48.239	10.046	Temperature probe 53.6°C of vent 1 m along slope.
15:53	1165	48.238	10.070	Leaving bottom from Marker 8. **End Dive PV-613**

8.3 PV-614 Monowai Dive Log

Location: Monowai Volcano, southwest caldera area
Latitude: *Begin* 25°48.296 S, **Longitude:** 177° 09.996 W
Mission Date: April 09, 2005
Bottom Time: 4 hours 59 minutes (4.983 hours)
Maximum Depth (m): ~1166
Observer: David A. Butterfield
Pilot 1: Terry Kerby

Objectives:
(1) Sample fluids at HURL marker 8.
(2) Sample fluids at ridge crest.
(3) Continue to investigate along contour of HURL marker 8.

Observations, findings, etc: (Also see Appended Dive Log)
The dive began SE of HURL marker 8. Marker 8, on the south caldera wall, was located at 10:59 (1165m). A 44º C vent fluid sample was taken at marker 8. The search for additional vents moved upslope, and further hydrothermal fluid sampling was conducted at 12:53 (1157m), 14:01 (1143m) and 14:33 (1140m). The dive ended further upslope of marker 8 after another venting area was discovered at 15:41 (1079m). The sub left bottom at 15:56 (1028m).

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-614 Monowai - Observations
	1034	**25°S**	**177°W**	Passed through very intense particle plume near 1034 meters.
9:57	1211			On bottom. Altimeter not working, digicourse compass displayed 400°; low visibility; sedimented bottom with shells, rat-tail fish, dead crab; long-legged shrimp.
10:00	1211	48.296	9.968	Range 220m bearing 300 to marker 8 from surface.
10:14				Driving NW, pass by rocky outcrops with large Venus fly trap anemones; thick sediment on steep slope, evidence of sliding/slumping.
10:16	1195			Passing over scarp/ridge trending SW-NE.
10:17	1188			Heading 250 on digicompass; water is clearer than at start.
10:20	1171			
10:27				Crabs covering rocky pahoehoe-like outcrops with some gastropods. No sign of venting yet.
10:28	1160			Debris, crab pieces, shells flowing down a channel from above; no sign of venting yet, smooth sediment.
10:29	1161			Crossing another scarp.
10:32	1160			Zooming in on shrimp with very long antennae.
10:35	1165			Starting to see live mussels on sediment surface in small clumps on the bottom. Some light reflective shells among the dark mussels, staining? Some tubeworm debris; live crabs.
10:38				Still moving generally NW along contour; ambient water temp 3.7°C.
10:40	1165			Target is 100 meters, bearing 320; continue to see many mussels.
10:43:15	1165			First sign of altered sediment, whitish; dropping down to get a fix.
10:45	1165	48.26	10.04	Position at first hydrothermally altered sediment patch.
10:50:00	1165			Resuming transit to NW (forgot to zoom back out).
10:51				See visible venting, lots of crabs, very active; shrimp of different variety; eel-like vent fish; small blob of yellowish sulfur deposit below rock.
10:54				Sheet-like deposits of sulfur (not on video).
10:55	1165			Stopping to check out a potential sampling site, but pass it up after looking, will try to find a better spot.
10:57	1165	48.237	10.071	See marker 8; lots of shimmering water.

Time	Z	Lat	Long	Dive Log PV-614 Monowai - Observations
11:05	1165			We had a short tour of the area within about 10 meters of marker 8 and selected a spot to settle and try out the fluid sampler. Warm fluids were flowing out of a crack lined with white and yellow sulfur surrounded by gray sediment, and some sediment was down in the crack as well. The sampler was working fine, but shortly after we put the intake into the vent, communication stopped, and it took me 5 minutes to determine that the comm cable inside the sub was causing the problem, which went away and did not re-occur during the dive. Temperature at this first site was at least 45° C, but we had some trouble maintaining that temperature during the sampling as slight movements in the sub position due to currents would cause the intake to move and the temperature to drop. Terry continued to adjust the intake location while I monitored temperature during sampling.
11:25	1166.2	48.237	10.071	**PV-614-1-HFS8** (Sample 1). Taking bag 8, 11:25-11:30 sampler intake down in crack, Tavg 44.2C; intake is excavating a channel as the sub moves slightly in the current. Unfiltered bag water sample near marker 8. T=44°C. Vol=602 ml.
11:34	1166.2	48.237	10.071	**PV-614-2-HFS11** (Sample 2) Bag 11 taken 11:32-11:38. Filtered bag water sample, gff. Tavg=43C. Vol=620 ml.
11:39	1166			Terry says crabs are feeding from the sediment. We zoom in on one crab. HFS intake comes out of crack for about 30s.
11:44:20	1166	48.237	10.071	**PV-614-4-GT-yellow** (Sample 4). Pushed on GT-yellow trigger, but probably not far enough. T=32° C at firing. **PV-614-3-HFS6** (Sample 3).Took piston 6 at 11:41-11:45. Unfiltered piston water sample. Tavg=35°C. Vol=650 ml.
11:45:40	1166			Yellow GT fired and held for 2 sec, T=32°c at firing.
11:50				Moved the intake nozzle around to avoid sucking up sediment and get a higher temperature reading. Close-up of vent crack.
11:52		48.237	10.071	**PV-614-5-HFS3** (Sample 5). Sterivex DNA filter #3. Tavg=45°C. Vol=1451 ml. Pumped until 12:07.
11:55				Changing videotape; end of tape 1.
11:58				Sediment discharging from HFS exhaust - adjust intake again. The ambient water seems very clear now. Camera moved from intake to wider view in front of sub, crabs and shrimp.
12:02				Discussion about molten sulfur vs precipitation of sulfur from water. Deposits here seem pretty clearly to be the latter. [We will see great examples of molten sulfur at Macauley]
12:08		48.237	10.071	**PV-614-7-HFS4** (Sample 7). Sterivex DNA filter #4. Tavg=46°C. Vol=1706 ml. Star 1208, pumped until 12:20. HFS 3 and 4 represent a duplicate/combined sample.
12:05		48.237	10.071	**PV-614-6-GT-blue** (Sample 6). Triggering blue gas-tight, heard it go. T1 very stable 46.0° C when triggered.
12:13				Turned on HMI light. Video has been flickering back and forth between color and black and white all during the dive. Marker 8 is behind us maybe 5 meters to the S/SE from where we are sampling. Temperature becomes very stable at 46.0° C while taking second DNA filter.
12:21				Intake removed from this first sampling spot. We excavated a larger opening in the original crack.
12:27				Intake nozzle stowed after dropping. Getting ready to move to another site.
12:30				One large crab has a claw stuck inside of a mussel, and a mob of other crabs are attacking to get some. This did not end up on the video, but lots of other fighting crabs did.
12:43				Starting to move. Passing animals, sulfur encrustations, occasional loose pieces of sulfur. Occasional anemones. Bleached empty shells.
12:46	1156			Rocky outcrop with white staining and diffuse flow coming up around part of the base. Stop to look around here. Different camera view at 12:48.
12:51			stopped	The vent effluent is clear, but has a lot of white floc in it.
12:53	1157			HFS intake is in the starboard manipulator, trying to get it into position for sampling. HFS log doesn't start until 13:01. Got 37, 42, 44, 46, 47, 49.8 max
12:56	1157	48.242	10.083	Position given by *KOK.*
13:01	1157			Lots of white floc shaken loose by intake probe. Can't see the tip beneath an overhanging rock on the camera, but Terry says he can see it in a hole. There are lots of shrimp covering the white mat on top of the rock.
13:09	1157	48.242	10.083	**PV-614-8-HFS14** (Sample 8). Filtered bag water sample, 0.22 micron. Tavg=25.6. Vol=314 ml. Pump slows down as sample taken.
13:12	1157			Not pumping very fast, and lots of sediment coming out, so may be plugged up. Take the nozzle out at 13:13:45 to clear it out. Tip covered with stuff, cleared off, pump back on and back in vent.
13:17	1157	48.242	10.083	**PV-614-9-HFS17** (Sample 9). Filtered bag water sample, gff. Tavg=26°C. Note: mistake added 150 ml from site at 1140 m, so sample mixed.

Time	Z	Lat	Long	Dive Log PV-614 Monowai - Observations
13:22	1157	48.242	10.083	**PV-614-10-HFS20** (Sample 10). Unfiltered piston water sample. Tavg=32°C. Tmax=36.7C. Vol=700 ml.
13:28	1157			Removing intake nozzle and stowing it for transit. 5or more shrimp immediately start grazing in the excavated channel left by the intake line rubbing in the sediment. This vent seems to be very attractive to shrimp, and has lots of white mat and floc.
13:32	1157			Lifting off and moving up slope, going over several sites of white staining. Find what seems like a long outcropping layer of venting at 1151 meters. Huge numbers of mussels, crabs, some scattered tube worms that may be sliding down from above. At 13:34:50, see another seam of venting, then above that find a tangled clump of tube worms on a rocky outcrop at 1143 meters.
13:36	1143			Having a look around the rocky outcrop covered by mussels, with tube worms on part of the upper portion.
13:38	1143			Good shot of wrestling crabs.
13:44	1143			Intake nozzle in low-T vent, white-stained mussels with visible flow.
13:49	1143	48.246	10.098	**PV-614-11-HFS1** (Sample 11). Piston water sample with 0.22 micron filter. Tavg=6°C. Vol=700 ml. Moving intake nozzle around. Knocked one of the mussels out of the clump and it fell down below. Vent fish and crabs seemed to jump on it immediately.
13:58	1143			End of tape 2. Tape 3 start at 1359.
13:59	1143	48.246	10.098	**PV-614-12-HFS5** (Sample 12). Unfiltered piston water sample. Tavg=8.9°C. Vol=703 ml [Still sampling in mussel site.]
14:02	1143	48.246	10.098	**PV-614-13-HFS7** (Sample 13). Sterivex DNA filter. Tavg=8.6°C. Vol=1351 ml. Nozzle has moved around within about a 10-inch diameter between mussels and broken rock. Crab has climbed inside the fluid sampler.
14:09	1143			Close-up video of tube worms and crabs, panning around to look at the area around the mussel vent sampling site. Good video of mussels, crabs, shrimp, fish, anemone.
14:12	1143			Close-up of what appears to be a mussel with a crab leg clamped in its shell?
14:13	1143	48.246	10.098	White mat close-up, porous altered rock/sulfur/mat with shrimp. Stopped the last sample here (filter 7, 1351 ml). Took pistons 1 and 5 here.
14:16	1143			Shot of sampler in overhead camera.
14:18				Starting to move.
14:20				Stop to stow intake nozzle, now ready to move.
14:33	1140			Close to the last sampling site, found a hole about 10 cm diameter, venting clear hot water. Had intended to go farther, but this looks like a very good sample spot, so will try it.
14:42	1140	48.251	10.087	**PV-614-14-HFS19** (Sample 14). Unfiltered bag water sample, in the hole. Tavg=52°C. Vol=633 ml. While watching the intake in the "hole" vent, several crabs get pushed into or fall into the hot water and get blown out. This vent is clearly too hot for the crabs.
14:48:05		48.251	10.087	**PV-614-16-GT-green** (Sample 16) Green gas-tight triggered. **PV-614-15-GT-white** (Sample 15). White gas-tight triggered right after, then green re-triggered. All on video. Temp was 52.2°C, T2 was 37° C.
14:56	1140	48.251	10.087	**PV-614-17-HFS18** (Sample 17). Filtered bag with gff. Tavg=51.5°C. Vol=603 ml. **PV-614-18-HFS17** (Sample 18). Error: added 150 ml to 700 ml already taken. **PV-614-19-HFS16** (Sample 19). Filtered bag water sample with 0.22 micron. Tavg=51.8°C. Vol=640 ml.
14:59	1140			Moving camera around to look at the crab activity above the vent. Some good video in the next few minutes. Crab wrestling, vent fish hovering around the periphery, occasional burst of white floc from the vent. The flow goes over the rock, making white mat, and has a lot of shrimp grazing on it.
15:11	1140	48.251	10.087	**PV-614-20-HFS15** (Sample 20) Start 1504. Sterivex DNA. Tavg=53.9°C. Vol=1829 ml. Still sampling the "hole" vent. It seems the current has just shifted to go north, after going to the south for all the earlier part of the dive.
15:16	1140			Removing the intake nozzle from "hole" vent. White floc coming out of the hole.
15:20	1131			Lifting off the bottom. Water is not as clear now as it was, and must be carrying cloudy water from the south, or possibly forming fine sulfur particles from the vent effluent. Moving up slope. Passing another horizontal seam of white-stained venting on sediment slope at 1131m.
15:23	1119			Another seam of venting at 1119m.
15:25	1114			Spot a bright yellow small sulfur chimney about 15 cm tall with venting coming out of it.
15:29	1114			After stopping for a couple minutes to get some photos and video of the sulfur chimney, we continue up the slope.
15:31	1106			Stopped for a moment to call up to *KOK*, moving up slope. Mussel coverage of rocky outcrops is thicker up here.

Time	Z	Lat	Long	Dive Log PV-614 Monowai - Observations
15:34	1096			White-stained opening in rock near mussel field. Looks like a good vent, but we are running out of time, so continue up. Venting is nearly continuous up here.
15:38	1079	48.288	10.14	Large hole with venting, tube worms on rock above. We have a few minutes to get a temperature and maybe a sample.
15:44	1079			**PV-614-21-HFS22** (Sample 21). Piston water sample. Tavg=25.4°C. Tmax=26.8°C. Vol=322 ml. [Running sampler, took piston 26??]
15:48	1079			We are moving to find a spot to dump ballast weight and start ascent. Still see venting patches along our track.
15:52	1040			Billowing clouds of white in the water. This is near the depth where we saw very intense water column plume (1034m) during the descent. The whole slope has active venting. We see something from a few meters off that could be a chimney.
15:54	1028	48.35	10.155	Reached the top of the hill, seeing vents all the way up. Lots of cloudy water here.
15:59	1028			Leaving bottom out of sight now, dropping weight. Water is still intensely cloudy here.

8.4 PV-615 Monowai Dive Log

Location: Monowai Volcano, southwest caldera area
Latitude: *Begin* 25° 48.213'S**, Longitude:** 177° 10.005'W
Mission Date: April 10, 2005
Bottom Time: 5 hours 34 minutes (5.566 hours)
Maximum Depth (m): 1228
Observer 1: Bill Chadwick
Observer 2: Malcolm Clark
Pilot: Terry Kerby

Objectives:
(1) Sample vent fluids at the top of Mussel Ridge.
(2) Sample hydrothermal animals and possible sulfides on the top of Mussel Ridge.
(3) Conduct an Imagenex sonar survey over Mussel Ridge.

Observations, findings, etc: (Also see Appended Dive Log)
Started dive near Marker 8 on the NE slope of the volcanic ridge that the previous 3 dives have visited. Headed up slope to top of the ridge, collecting samples along the way. The Imagenex scanning sonar was on the sub for this dive, but we could not establish communication with it, and so no sonar data were collected. Instead we explored the cone located NW of Mussel Ridge and found another distinct biological community on the southern flank.

Limitations, failures, or operational problems noted:
On this dive the video recorder was only recording in black and white due to a loose connection. Also the Fornari digital still camera was not turned on until very late in the dive, so the only digital still for most of the dive are from the handheld camera. Finally the CTD data was not written to a file at the end of the dive, so there is no digital record of sub depth during the dive. Imagenex sonar system did not operate.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-615 Monowai – Observations
9:27	0	**25°S**	**177°W**	*Pisces* in the water at surface.
10:16	1228	48.213	10.005	On bottom. ~150 m south of drop target in muddy sediments. Stirred up a bunch of sediment. Waiting for it to settle. Small gastropods all over slope.
10:22				Going to head upslope, then contour to Marker 8.
10:37	1165			Very cloudy water at first, but now its clear water. Contouring to the northwest. Range to Marker 8 is 90m. Rattail fishes frequent, *Coelorinchus innotabilis* and *Coryphaenoides* sp.
10:44	1166			White deposits on the slope plus shrimp and crabs. This is the first signs of venting. Seeing sulfur crusts.
10:48	1165	48.230	10.070	At Marker 8. The current is to the south.
10:51	1165			Continued NW from Marker 8 at same depth to see the extent of the venting. It diminished rapidly just past Marker 8 (10m or so).
10:52	1165			Turning around to drive back SE toward Marker 8.
10:53	1168			Back at Marker 8. Venting area is only 20-40 m wide (E-W) around Marker 8.
10:54				Turning to head upslope toward top of ridge.
10:56	1153			Sediment on slope looks darker. Lots of sulfur crusts and venting areas, mostly around rocky outcrops. Lots of *Paralomis* crabs.
11:04	1143	48.255	10.110	At rocky outcrop with sulfur, tubeworms, etc. Sampling.
11:12	1143	48.255	10.110	**PV-615-1-MIN** (Sample 1). Sulfur crusts from a large outcrop sampled with the sediment corer.
11:15	1143	48.255	10.110	**PV-615-2-B** (Sample 2). Biology grab sample of tubeworms, mussels, crabs, anemones, etc.
11:26	1143			Sampling done. Heading upslope toward top of ridge. Waypoint 2 at the top of the ridge is at a range of 240m and a bearing of 218.
11:39	1095			All rocky outcrops have venting and biota. Visibility suddenly bad (cloudy).
11:42	1078			Just saw depression a few meters across with very cloudy white milky fluid coming out of it. Very different than anything else we have seen!
11:43	1072			Pillows.
11:47	1069			Video of small live tubeworms (can see the red tips).

Time	Z	Lat	Long	Dive Log PV-615 Monowai – Observations
11:59	1037			On bottom covered in a sheet of mussels as far as we can see. No obvious shimmering water, but we put the temperature probe down in the sediments and got a temperature of 9.8°C. Probe is about 1 foot long and was pushed all the way down into the sediments. Ambient temperature is 4.1°C.
12:05				Good visibility. Some outcrops appearing now after interval of seeing none.
12:10	1025	48.367	10.173	On bottom at small vent at top of ridge near Waypoint 2. Looks like a good fluid sampling site.
12:17				End video tape 1. Start video tape 2.
12:19	1025	48.367	10.173	At very top of ridge. On bottom for water sample. Max temp with temperature probe is 13.2°C (ambient=4.2).
12:26	1025	48.367	10.173	Tried to use White Major Sampler, but it didn't trigger. Pushed trigger in, but it wouldn't release.
12:32	1025	48.367	10.173	**PV-615-3-MS-Blue** (Sample 3). Fluid sample (MS Blue). Vent fluid from top of ridge. T=13.2°C.
12:43	1025	48.367	10.173	**PV-615-4-GT-Black** (Sample 4). Tripped Black Gas Tight. Vent fluid from top of ridge, T=13.2°C.
12:48	1025	48.367	10.173	**PV-615-5-GT-Red** (Sample 5). Tripped Red Gas Tight. We weren't sure that it tripped because we couldn't hear it, but it turns out that it had. Tried to actuate it several times to be sure. Vent fluid from top of ridge, T=13.2°C.
12:57	1025	48.367	10.173	Stowed all sampling bottles in basket. Short break for lunch.
13:11	1025			Driving to NW to look for possible sulfide stumps seen on the first dive. Couldn't find anything that looked like sulfide.
13:34	1038	48.323	10.149	**PV-615-6-R/B** (Sample 6). Rock from outcrop with mussels on it sticking up from the surroundings at the top of the ridge. This is like the ones seen on the first dive that were thought to possibly be sulfide, but they are clearly lava under the mussels. One mussel was attached to the rock.
13:40				Heading to start of Imagenex Line 1. Range and bearing is 295m at 252 deg.
13:46				Time on CTD computer is 33 seconds slow compared to the "mission time" on the other in-sub computer. Also the depth read-out on the CTD is 7 meters shallower than the other depth sensors.
13:54				Range and bearing to Line 1 is 100m at 269 deg.
13:59				Range and bearing to Line 1 is 49m at 270 deg.
14:03				Range and bearing to Line 1 is 25m at 260 deg.
14:04				Clock on Imagenex laptop is 2 sec slow compared to "mission time" in the sub. Sub in position at NW end of Line 1, about 20-30 m above the bottom.
14:05				Started file of sub heading at 14:05. Range and bearing to end of Line 1 is 408m at 129 deg. We are at the start of line 1, but having trouble getting the laptop to communicate with the Imagenex sonar.
14:17	1144	48.320	10.341	After many attempts to communicate with the sonar, we are giving up. Cannot communicate with the sonar. Sub is now on the bottom. The sub is also running low on power.
14:25				Decided to head for Waypoint 4 at the top of the cone NW of Mussel Ridge, which has not yet been visited. Range and bearing to WP4 is 457 m at 316 deg.
14:27				End video tape 2. Start video tape 3.
14:31				Encounter with large jellyfish. It was right in front of the pilot's view port, so got some great video and handheld pictures.
14:36	1157			Leaving jellyfish. Continuing on a heading of 316 deg toward the top of the NW cone.
14:38	1163			In sedimented flat between Mussel Ridge and the NW cone. Going up slope of NW cone.
14:40	1134			Sandy slope. Some mussel shell debris in narrow drainages.
14:42	1108			Steep slope. Not many outcrops. Scattered rattails.
14:44	1087			First signs of vent animals: mussels. More surface crusts and yellowish deposits.
14:45	1078			Came into a dense biological community. Rock outcrops covered with stalked barnacles, which we have not seen before. Crabs are large *Chaceon*, which were infrequent on Mussel Ridge.
14:46				Area of mostly mussels with small tubeworms, crabs (*Paralomis* on mussels), and gastropods. Can see shimmering water and discoloration on the slope. More barnacles.
14:47	1062			Cloudy water. Rocky outcrops. Temperature measurement in small rock pile with small live tubeworms showed 11.7°C (ambient is 4.1°C).
14:54	1054			Moving upslope again. Scattered fauna.
14:55	1039			Range and bearing to WP4 is 194m at 339 deg.
14:56	1039			Stopped at the top of this ridge to get a position. Very different fauna here than on Mussel Ridge.
14:57	1039	48.242	10.515	Position at top of ridge located south of the top of the NW cone. Still in dense biological community.
15:02	1061			Topped over the ridge heading N, and went down 20 m. In the bottom of a saddle. Going back upslope again.

Time	Z	Lat	Long	Dive Log PV-615 Monowai – Observations
15:05	1052			Muddy slope, suddenly no biota. Now not much shell debris coming down from upslope.
15:08	1019			Nothing on pillow rock outcrops except large anemones.
15:10	1004			Very large pillows (2-3 m across). Very small ? stalked barnacles on them.
15:12	1004			There is orange bacterial staining around the base of the pillows. Looks very fluffy and is probably evidence of low-level active venting.
15:15	984			Big crabs of a different species (*Chaceon*) than we have seen on Mussel Ridge.
15:16	978			Starting to see shell debris.
15:18	977	48.130	10.530	We are at Waypoint 4 at the top of the NW cone. Set down for a minute, then continued north.
15:22	979			Talus on N slope.
15:24	983			Small pockets of white mat. Rock strewn slope. Must be a little venting. A few shells on slope.
15:27	990			Mostly pillows and large anemones.
15:29	990			Orange staining and fluffy bacterial mat on the bottom of pillows again. We are in about the same place as we were when we saw them before. We went over the cone summit then contoured back around.
15:32	990	48.130	10.530	Temperature measurement of 11.0°C (ambient = 4.2°). Temperature probe is at the base of a pillow with orange mat. There is no other biota visible here. We are right near WP4.
15:37	990	48.130	10.530	**PV-615-7-SS1** (Sample 7). Suction sample into bottle 1. Yellow-orange fluffy bacterial mat collected from small vents at the base of a large pillow. T=11.0C.
15:44	989	48.130	10.530	**PV-615-8-R** (Sample 8). Rock sample of lava with yellow iron oxide stain taken at same site as suction sample (at the top of the cone).
15:49	989			Dropped weights. **End of dive PV-615.**

8.5 PV-616 Macauley Dive Log

Location: Macauley Volcano, E/SE caldera cone area
Latitude: *Begin* 30° 12.516'S**, Longitude:** 178° 27.057'W
Mission Date: April 12, 2005
Bottom Time: 6 hours 59 minutes (6.983 hours)
Observer: Gary J. Massoth
Pilot 1: Terry Kerby
Pilot 2: Colin Wollerman

Objectives:
(1) Explore upper slope and summit pit crater for fault structures, light rock, fluid discharge, and biota.
(2) Sample hydrothermal fluids and macro/micro fauna.
(3) Conduct a video survey of the summit pit and mark future fluid sampling sites.
(4) Sample hydrothermal fluids, macro- and micro-fauna, and deposits.

Observations, findings, etc: (Also see Appended Dive Log)
Started dive at 521 meters on the north slope of Macauley caldera cone. Proceeded upslope observing sparse biology to about 325 meters. At that depth we saw crust coating basalt pillow outcrops, and then broken 'plates' throughout the area. Between this depth and 300 m become totally underlain by dense biology (mussels on and in ash sediments, starfish) and still a metallic crust. We ascended to the cone crater rim at about 280 m and proceeded counter clockwise to the pinnacle peak of the cone at 248 m. Descended then 89 m to the base of explosion pit, which is 80 m in diameter at the top and 30 m diameter a5 the base, which is a flat, ash and sulfur covered floor. 129º C fluids were sampled, but measure maximum temperatures of 155º C were recorded nearby on the base of the pit floor. Video surveys were conducted on all ascents, which captured video of a huge, mass accumulation of elemental sulfur as a diked (ash conglomerate?) wall and sulfur chimneys. Very little biology was observed inside the pit rim. Biology was mostly confined to the outer cone slope, within a 290º-350º degree sector, as demonstrated by circum navigation of the cone at 290 m depth, with the densest biology on observed on the north slope. NAVIGATION GAP: 1224-1337.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-616 Macauley – Observations
		30°S	**178°W**	Landing Target at 500 m depth.
08:12		12.6	27.46	Board *Pisces V*.
08:20				*Pisces* in water. Depth 497m (3 "Maytags").
08:23				"Clear to Dive".
08:25				"Tower Awash".
08:45	521	12.516	27.056	On bottom, ~190 m northeast of drop target on basalt talus and grey ash-like sediment with yellow sediments beneath in places. Small shark swims by. Ambient T is 8.7° C.
08:48				Sharks swims by again, same position.
08:52				Start southward transit up north face of cone. Stop to pump water because we're heavy.
08:55				Restart transit S.
08:56				See many small fry. Terry comments on carallium hard coral.
08:58				Some outcrops in view. Pillow fragments. The slope is very smooth. Quite heavily dusted with pumice-like ash on even small talus - about 70% cover.
09:01				Mostly finely sorted small talus. Terry sees small trilobite crustacean (Craig Young has seen in Atlantic but not here).
09:04	520			Heading 053 upslope at classic angle of repose. Gorgonian coral spotted (branched, white).
09:06				Basalt looks fairly fresh, and larger than below. Clean pillow fragments (less dust).
09:07				See first starfish, otherwise barren of biology.
09:09				Fine, sorted drain channel being travelled.
09:10	472			Tunicate seen by Terry - also whip corals.
09:11				Macurid fish seen by Terry. Interesting fish, different from anything Terry has seen. It has a high fin (anagonia-like with a weird hump plus spine).
09:13				In place pillows. Decorator crab (small).

Time	Z	Lat	Long	Dive Log PV-616 Macauley – Observations
09:14				See first FeO (iron oxide) staining, plus white deposit.
09:15				Big-eyed, (almost transparent)-basalt-camouflaged fish.
09:17	446			See more scallop-like white shells. Spot iridescent-green snake-like eel. It has shimmering pulses of green color that ripple back over its body. The 'glowing eel'.
09:21				Good close-up of green eel. Stay tuned for more good stuff.
09:25				Terry sees an anemone. Bottom yellow-ish.
09:26	428			The slope is still very smooth. Large percentage of sand with finely sorted basaltic fragments and light shells (mostly broken).
09:27				Small galatheid crab.
09:28				221 heading. See another small green thing.
09:29	406			Scorpaenid fish (scorpion fish), urchin and open mussel.
09:31				Spined scallop with hermit crab. Sediments are scoured, with, ripples normal to the slope.
09:33				Large in-place pillows which are worked over on the outer edges.
09:38				Unknown fish with spines, variegated color.
09:40	356			Terry sees a large shrimp. The water clarity is high.
09:45	345	12.679	26.991	**PV-616-1-MIN** (Sample 1). Fe crust is plate-like, pervasive, broken, like old, thick mat. Scoop sample was taken off this crust at base of a basalt pillow. It looks like the crust 'flowed' around the pillow.
09:55				Renew uphill trek. Crust is pervasive. It looks like Fe-rich fluid leaked out and solidified.
09:56				Terry sees another iridescent green snake thing.
09:58				Coming into thick dead bio-deposits, still with think Fe crust everywhere.
10:00	325	12.715	26.998	**PV-616-2-MIN/R** (Sample 2) Mineral sample of crust coating (Iron oxide/silica 'flow coating') basalt rock. Sample placed in marker, rear box.
10:06				Underway again; lots of wasted 'razor clams' (Mussels); then live beds, partly buried in the slope. Great shots of biology. =13.2° C, ambient, T=13.4 in sediments by the clams.
10:15				Resume uphill climb. Milky water. Still in thick biology.
10:16				Butaguchi (?) fish.
10:17	300			Starfish on clams on crust on sediments. Huge bundle of starfish seen on a bacteria-marked vent. No schlieren (masses or streaks in an igneous rock).
10:24	292	12.735	26.980	**PV-616-3-BIO/MIN** (Sample 3) Sample of starfish with mussels - and possible FeO sediments. This outcrop is heavily encrusted in FeO. T = 13.8° C.
10:28: 51				On the rim of a pit crater, at the top of the transect, up from the south side of the cone. Biology drops off in density. See venting and filamentous bacteria on the mussels here. The whole area looks like it exuded iron at one time.
10:30				Heading 330 to 284 meters. The peak of the cone is to the southwest. It looks like there is an ash covering. Ambient T is 13.5° C. Probe in sediments temperature is 21° C.
10:34	284	12.763	26.998	**PV-616-4-SS1-BIO** (Sample 4) Slurp sample (bucket #1) of filamentous stuff (microbial mat?) on clams. Good close-up at the end of sampling. We see for first time that the bottom is covered with flat fish that dart around. They seem to be feeding on the ubiquitous surface coating of white waving bacteria. Still on the rim. Good shots of flat fish. No visible schlieren yet.
10:47				Moving to the southeast on the rim. End of Tape 1.
10:48				Terry sees a Moray Eel; looking into a pit with very little biology. The altimeter reads 20 MAB.
10:50				Terry thinks we are outside the pit on the outer slope. There is little biology on the seafloor, but metal coating on angular basalt is still prevalent.
10:52	280			Still looking for the pit.
10:53	293			Milky, poor visibility. Small white clam shells (abandoned).
10:55				Conclude on western outer slope of cone.
10:57	317	12.824	27.060	Stopped for position: We are on the WNW outer rim - on dead, white, imbedded clam shells, sitting on heavy ash cover. Decide to head due east to the cone summit.
11:03				Large piece of pillow basalt with Mn or Fe-Si crust on top surface. It appears to be sitting out of place on this ash and small talus slope.
11:07	313	12.847	27.042	**PV-616-5-MIN/R** (Sample 5) Crust on loose boulder. The crust is Mn or Fe-Si.

Time	Z	Lat	Long	Dive Log PV-616 Macauley – Observations
11:24				Moving to the peak. Some areas are 90% ash covered. No biology, like on north slope. See a grouper following us. These rocks appear to have a different, more Mn-like, coating compared to the Fe-Si crust first observed on the north slope.
11:26	300			060/110 range and bearing to summit peak target.
11:28				Smokey. See more Fe-staining.
11:29				020/80 range and bearing: Ash-covered slope with occasional large basalt pillow erratics.
11:30	257			Emerging into a milky layer. Heading northwest.
11:31				Climbing steeper section. Very milky water here. Dead mussel shells again.
11:32	248	12.853	26.93	**PV-616-6-BIO** (Sample 6) Biology sample of large gastropod on the pinnacle. We are at the basalt pinnacle peak of the cone: Only large gastropods are on the pinnacle basalt. Strong bio-zonation. The current is out of the north.
11:42				Over pit heading 347 degrees, altitude is 9 m. Very milky as we drove INTO the plume from the pinnacle. Now, 20 m away, we are dropping down a cliff with 8 m altitude now. The wall here is covered with mussels. The sheer wall of the explosion pit is impressive as we descend. We see sulfur chimneys go by port (Alt = 20m) as we spin around to check out the dimensions of the hole. Terry continues to move out from all.
11:48	279			Alt = 35 m (a hole) and getting even more milky. See Kahala fish darting about *Pisces V*. It's very aggressive. Comments on the wall: smooth with coating and very sheer as descend) The video is black. No biology in sight.
11:51				Stopped on a ledge to get rid of some water. PV is still too heavy for this descent. Grouper in view. White deposits on rock and oxide coating adjacent to that. See many flatfish on the ledge surface. Looks like a large blast hole.
11:55	310			Still descending into a hole which is 80 meters across at this point. Sonar images were captured.
11:59				Kahalas are darting about. Scorpaenid at the base of a rock is coated with anemones and starfish. Good video. Coating on rocks which we want to sample at some point.
12:01	320			60 meters diameter hole now. Still 20 meters altitude and starting down again. Sulfur crust/coating on all of wall. Terry notes a strong current going up out of the hole.
12:07				Spotted a 0.7 meter long salp. Also shrimp. The hole is 40 meters across now. Terry again comments on the flow coming up out of the hole, which is impeding our descent. See lots of sulfur as we approach the bottom. Ash floor.
12:10	335			Pit floor is **89 meters** below the pinnacle: T=12.8° C, which is lower than at the top.
12:12	337	12.778	26.953	See rare venting coming from behind a loose rock on the pit floor. Outcrops of sulfur on the walls. We're sitting over darker (Fe-rich?) crust layer several inches thick. Temperature-probe in flow that we can't get at to sample is 154.5° C.
1224-1337				NAVIGATION GAP: 1224-1337.
12:24				Can see that the sulfur was molten and dripping down the cliff face. Great video of sulfur extrusion plus layer beneath of darker stuff.
12:27	337	12.778	26.953	**PV-616-7-MIN/BIO** (Sample 7). Scoop Sample #2 of elemental sulfur plus a crab plus brown-red layer of lower plate or sheet crust - which is probably Fe/Si - (confirmed by video and Terry's comments). Looks like crabs are living in the sulfur crusts. After the scoop sample Terry tries to slurp a flat fish on bio-box lid (didn't get it).
				Moving from sampling site, see schlieren all over the base of the pit, which has wave furrows about 6-8 cm wave-length (estimated, not measured). Outcrops of sulfur dot the bottom. Flatfish swarm when we start to move. Move to crack at base of rock outcrop with elemental sulfur coating. It's the best flow we have seen to date. Crab and flat fish are right at the vent.
12:43	**336**	**12.773**	**26.968**	**Marker #9 deployed** on the north wall at the base of the pit. Marker #9 is on the ledge above the vent. **PV-616-8-MS/GT** (Sample 8)**.** Fluid sample (Blue MS), White gas tight (failed) at Mkr-9, Tmax=128.6°C buried in the sediments within a crack where water samples were taken. **MS White failed** to withdraw, but did within the hour still in the pit = pit background water. **MS Blue fired as did GS Green and GT White**. When taking T the water flow changed from clear to milky for some time.
12:51				While still taking temperature readings the video runs out. We missed about one hour of the dive (mostly taking water samples and rearranging the basket, but also the first rise part way up the wall).
13:51	337			Video 3 begins. Marker 9 is in sight at the base of the pit after re-descending to redo video survey of the wall.

Time	Z	Lat	Long	Dive Log PV-616 Macauley – Observations
13:56	337			**PV-616-9-MIN** (Sample 9.) of extruded (worm-like) blob of elemental sulfur placed in the biobox. Taken from the pit floor with flat fish all about. The elemental sulfur sample consists of elongated pieces plus a more round blob.
13:57				Excellent video of the sulfur for PR.
14:00				Moving to get another shot of Marker #9. See more blobs of sulfur now on the floor. Wonder if it just came out!
14:02				Area of most intense diffuse discharge (Tmax ~ 90° C) just 4 meters east of Mkr #9, also at the base of the wall. White altered rock, also source of milky plume. Red (Fe) and white staining on the pillows at the base.
14:05				Heading to the south end of the pit then coming back to the north to come up the north wall face.
14:06	327			10 meters up wall as position to rise.
14:09				Conglomerate stack; talus slope and large chunks of sulfur block are adjacent.
14:10				Sheer wall with dike features cross-cutting. Some dikes (look like ash) cross-cut older dikes. Dikes are about 4" or more in thickness. 14:10:53 excellent video of dikes on sulfur wall. Terry sees very yellow, fresh splotches of sulfur coming thru the wall in several places. Wall overhangs in several places.
14:16	296			See draping Fe-Si crusts for the first time as we ascend (now 40 meters up from the pit floor). Terry sees sulfur chimney structures.
14:18				Stopped at sulfur chimney but it breaks off at the basket. It is light in weight and ash-colour underneath. No sample.
14:20	276			Nearing top of the pit. See live mussels, which become thick all of a sudden at 272 meters, 44 meters above the pit floor.
14:22	270	12.808	26.924	**PV-616-10-BIO** (Sample 10). Sample large batch of live mussels from a clump, which we just knocked off into biobox. So many! Lots of bacterial mat on the on the mussels. Position approximate.
14:28	260			Still climbing and heading east. We're near the rim. Pit is about 80 meters deep on this wall.
1431	257	12.808	26.924	80 meters above the pit floor! 80 meters across. On the rim. Clams at this site have worm-cast like coatings on them. Bacteria?
14:40	274	12.762	26.904	On the north rim. Starting clockwise circumnavigation of cone on the 290 meter contour.
14:45				On the circum trail, see mostly ash and fine talus mixed with white clam-waste debris.
14:52	291	12.8	26.851	Near fissure or ridge structure on the east slope. As we go around we see very sparse biology, which is nothing like what we saw that was maxed at this depth on north face of cone. We're opposite the inside wall where the venting occurred and where the sulfur abundance was great (est?).
15:12				Lots of bio-debris comes into view again.
15:13				Bio-debris. Pillows have Fe-Si crust coating again.
15:14	292	12.769	27.037	**PV-616-11-BIO** (Sample 11). Beginning of live mussels that have a heavy coating of filamentous bacteria. Tmax=7.4° C in the mussels. The sample was a single mussel with filamentous bacteria from the outer slope.
15:15				Huge grouper swims in front of the camera.
15:18				Good shot of the temperature-probe in the mussels, down to rock. Terry sees schlieren.
15:25				As we leave the mussel sample site we see it was isolated, but then get back into dense biology within the minute. Crust is again abundant, as saw when we first came into this band from below.
15:28	287			Crossing dense bio-debris and life that we first saw on approach to the cone.
15:31	289	12.739	26.95	Passed out of high biology zone, back to ash and small basalt talus as turn northeast. Sitting in small 'razor clam'-like shells on ash as wait for a position.
15:39	289			Cleared to leave the bottom. Where the basket has dredged the bottom we can see structure vertically within, like bioturbation/discard.
15:44	290	12.745	26.93	Leave the bottom.
15:45				Video off as leave the bottom.
15:57	0			*Pisces V* on the surface (13 min. ascent).
16:07				*Pisces V* secure on deck.

8.6 PV-617 Macauley Dive Log

Location: Macauley Volcano, E/SE caldera cone area
Latitude: *Begin* 30°12.619'S, **Longitude:** 178°27.064'W
Mission Date: April 14, 2005
Bottom time: 6 hours 39 minutes (6.65 hours)
Maximum Depth (m): 438
Observer 1: Cornel de Ronde
Pilot 1: Terry Kirby
Pilot 2: Steve Price

Objectives:
(1) Reconnoiter cone western flank and move upslope to the summit crater; map geological and hydrothermal-related features.
(2) Measure fluid temperatures; take representative video and stills, especially of 'hydraulic' veins in the crater wall.
(3) Sample vent fluids, rocks (especially silica chimneys, Fe-oxide crusts, and any of the veins mentioned in [2 above], mineralization and animals (especially the 'flat' fish).

Observations, findings, etc: (Also see Appended Dive Log)
Started dive on ~northwest slope and traversed up slope. Collected numerous animals (mussels, gastropods and starfish) on the slope above ~365 meters. Also collected non-vent related animals (urchin and cup coral) and piece of old Fe-oxide crust. Inside the main crater, sampled diffuse vent fluids ~8 meters east of Marker #9 (30.1°C) and also re-sampled vent fluids at Marker #9 (103.8°C). Collected two different pieces of layered volcaniclastic rock, one with Fe-oxide coating and both with abundant elemental sulphur binding the rock matrix. Reconnoitered crater at ~365 meters (crater ~80 x 40 m) depth and again at 290 meters depth (rim not continuous at this depth). Finished by moving to the northern rim of the crater

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-617 Macauley - Observations
		30°S	**178°W**	
8:50	438	12.619	27.064	On the bottom. Sandy (ash) bottom. Reef (?) shark off the port side.
				PV-617-1-B (Sample 1). Sampled cup coral in area of talus covered slopes; winnowed sediments.
8:57				Talus of ~weathered/oxidized lava
9:51				Sub moving upslope ~SE. Talus is typically <20 cm; some ~1 m.
9:14:36				White fan coral.
9:15:22				Brilliant orange coffin fish.
9:16:30				Nice close-up of coffin fish without time stamp on.
9:19:00				First sign of altered ash (brown colour).
9:19:18				First sign of dead clam shells (white) and some black mussels.
9:20:42				See second sighting of larger coffin fish (9:21:48 good video).
9:22:54				Nice coral?
9:24:56				Dark red sea urchin.
9:27:08				Large, several meter sized boulders of lava as talus.
9:29:07	360			**PV-617-2-B** (Sample 2). Large dark red urchin (9:29:16 good camera close up with no time stamp).
9:34:48				Massive lava in this area. Not sure if in-situ?
9:35:29	345	12.696	27.007	**PV-617-3R** (Sample 3). Massive reddish-brown Fe-oxide crust encrusting lava blocks; several cm thick from the northwest slope (9:41:00 close up).
9:44:12				Fe crust still very extensive upslope.
9:45:30	316	none	none	**PV-617-4-B** (Sample 4). Sample consisted of 3 long brown mussels, a small piece of Fe-oxide crust, 1 gastropod, 2 clams. First occurrence of extensive bed of alive and dead long, brown, mussels, calms and gastropods.
10:01:19	315	none	none	**PV-617-B-5** (Sample 5). Yellow starfish, 1 gastropod, 1 mussel. Starfish looked different than one seen on previous dive.

Time	Z	Lat	Long	Dive Log PV-617 Macauley - Observations
10:06:10				Slopes covered by blocky lava here; less ash.
10:08:10				Large bed of live mussels, partially buried.
10:08:33				Nice close-up shots (no time stamp) of common red starfish.
10:10:29				More good video of starfish (red and yellow) on top of mussels
10:14:08				Abundant red star fish on mussels
10:14:32				Still very extensive field of mussels, all alive
10:15:00	284	12.757	26.986	Top of crater rim; mussels and starfish right to top of rim on outside flank of volcano; see starfish starting above 315 m.
10:16:20				First notice flat fish among the mussels.
10:25:10				Moving off down into summit crater; see mostly ash but some mussels (commonly dead) and starfish; lots of flat fish.
10:27:40				"White out" with heavy turbidity.
10:34:00				Mapped crater wall with sonar - recorded several images.
10:36:10	337			Sat down on pit floor, near deepest part; then moved slightly further down slope where diffuse venting coming out at bottom of crater wall and through sediments (T=129.5°C); crabs.
10:51:00				Diffuse venting in volcanic sediments (129.5°C); small crabs.
10:54:10				Abundant flat fish cover sediment surfaces; molten S.
10:55:10				Close-up of flat fish.
10:57:35				**PV-617-6-R** (Sample 6). Collected piece of layered ash/volcaniclastic with matrix dominated by elemental S at bottom of small pit.
11:02:00				See lots of flat fish neat diffuse venting.
11:04:18	338			**PV-617-7-SS-B** (Sample 7). Starting to setup for suctioning flat fish; sucked several fish into jars #2 and 3.
11:15:55				Moving off from deepest part of small pit.
11:17:29				Mostly dead mussels on crater floor.
11:22:00	335			Moved slightly to north (?); see lots of diffuse venting (153.7°C).
11:24:35				Moving off to Marker #9; lots of turbidity in the water column.
11:30:16				Arrive Marker #9 area; diffuse venting; S encrusted ash layers.
11:42:45				Close-up of venting at Marker #9.
11:44:00	336			**PV-617-8-R** (Sample 8). Sampled Fe-coated volcaniclastic rock with 'box-work' texture on surface (126°C).
11:51:00				Moving away from Marker #9.
11:52:20	335			**PV-617-9-MS-white** (Sample 9). Moved to new sampling site of diffuse venting. Fluid sample (MS White) T=30.1°C). Fe-oxide coating of volcaniclastics in area.
12:08:10	335			**PV-617-10-GT-blue** (Sample 10). Sampled gastight (blue) at same place as above.
12:14:50				Measuring temperature.
12:20:10				Moving away from this site.
12:22:50				Measured temp nearby diffuse venting (T=88.5°C).
12:26:42				Moving away; see altered talus on pit walls; lots of S; Fe staining; lots of turbidity in the water column.
12:38:30				Molten S; Fe-alteration; volcaniclastics.
12:40:30	332			**PV-617-11-B** (Sample 11). Collected black squat mussels (x3) in a cluster. Moving clockwise around pit from Marker #9.
12:45:30				Fe-altered talus; S, sediments, crabs and flat fish.
12:47:42				Good example of 'molten' S atop Fe-altered volcaniclastics; lots of crabs and flat fish.
12:50:00	337			~15 m from previous spot. See incredible shots of molten S 'dripping' vertically down rock face.
12:52:58				Close-up shot of large predator fish.
12:53:30				More video of the S wall; crabs; close-ups of dripping S (12:53:47).
12:59:44	336	12.784	26.948	Whole wall of S; ~3.5-4.0 m across and ~1.5 m tall (good video).
13:08:20				Good video scan of whole s wall; see was molten in past.
13:09:05				Close-ups of draping S layers that make up wall; flat fish, crabs.

Time	Z	Lat	Long	Dive Log PV-617 Macauley - Observations
13:12:19				Leaving S wall; close-up of rim.
13:15:15				Talus boulders on crater wall coated by Fe, S and flat fish.
13:26:36	336	Mkr9		Back at Marker #9.
13:31:25	336	Mkr9		**PV-617-12-MS-blue** (Sample 12). Fluid sample (MS blue). T=103.8°C.
13:39:00	336	Mkr9		**PV-617-13-GT-yellow** (Sample 13). Gas Tight sample (GT yellow). T=103.8°C.
13:59:25				View of crater wall; ash, Fe-oxidized talus; locally S-coated.
14:03:05				Pinnacles' of ash/volcaniclastics along crater wall; dead mussels.
14:05:47	313			First good shots of the 'hydraulic'(?) veins on north wall of pit.
14:08:26				Good shot of one of the major black veins in the north wall.
14:10:20				Traverse upslope steep part of hydrothermally altered crater wall; massive volcaniclastics/ash units; rare mussels and starfish.
14:13:30				Further around wall of crater pit- vertical profile; S alteration talus.
14:17:35				More pinnacles of volcaniclastics.
14:19:55				Massive ash units with lithics and pumice clasts; upclose shot of undercut unit.
14:20:50	260	12.779	26.896	**PV-617-14-SS** (Sample 14). Jars #4 and 5. Black squat mussels covered by white stringy bacterial mat sampled. (14:21:44 nice close-ups of mussels and bacteria)
14:28:02				Close-up shots of large Grouper fish.
14:28:58				Good close-up of mussels, white bacteria, and Fe-oxide crust.
14:29:57				Some sort of eel (top LHS) curling up into a ring.
14:46:58				Still traversing around walls of crater; see large boulders of altered volcanic talus made of mostly ash units; crater rim is ~237 m.
14:47:45				More steep ash slopes.
14:50:19				More pinnacles carved out of the ash units.
14:54:40	290	12.798	26.981	Spectacular layered ash units. Some fine-grained, others contain blocks of pumice and smaller lithics (?). Sandy ash-covered slope beyond rim of pit covered in flat fish and some S staining.
14:57:20				Extensive flat fish covering sediment.
15:01:20				Left bottom.
15:04:32				Mussels and starfish above rim of crater; extensive mussels there after, above rim of crater.
15:08:15				Fe-staining above crater rim.
15:09:50				Massive ash fall units.
15:11:15				Massive S and Fe coated ash units; locally see pinnacles.
15:13:20				Moving to NE slope above crater rim; see mussels at 15:14:37.
15:19:20	282	12.758	26.907	Leave the pit from the north side.
15:20:14				At the wall.
15:21:30				Mussels everywhere.
15:23:00				Set down to manipulate the basket.
15:29:30				Leaving the bottom. End of dive.

8.7 PV-618 Giggenbach Dive Log

Location: Giggenbach Volcano, summit area
Latitude: *Begin* 30°02.240'S, **Longitude:** 178°43.226'W
Mission Date: April 15, 2000
Bottom Time: 7 hours 10 minutes (7.167 hours)
Maximum Depth (m): 276
Observer: Matthew Stott
Pilot 1: Terry Kirby
Pilot 2: Max Cremer

Objectives:
(1) Reconnoiter volcano summit crater(s) and cone(s); map geological and hydrothermal-related features.
(2) Measure fluid temperatures - take representative video and stills.
(3) Sample vent fluids, rocks, mineralization and animals.

Observations, findings, etc: (Also see Appended Dive Log)
Diffuse and focused low temperature venting was found along a NE/SW line bisecting the main cone. Phase separation of fluids was observed at 2 sites (Mkr #10 & Mkr #12); the most vigorous field (Mkr 12) contained both diffuse and focused venting at 205°C. The Mkr #12 field was made up of an extensive wall (~30m x >50m (LxH)) of white sulfur (and presumably microbial biofilm) and vigorous venting. Geologically this field had a mixed morphology exhibiting a pumice scree slope and ash terraced features (E & W edges respectively). The central cone comprised mainly of new talus and was dominated by fish, soft corals and extensive purple algal carpeting near the summit. Some shimmering water was observed. However, strong surface surges and a malfunctioning compass meant that no further exploration was possible. Large numbers of chimney structures were found at Mkr #10 (primarily composed of siliceous material with some sulphide (perhaps pyrite) material. Of note at both markers, but in particular in the vicinity of Mkr #12, were outcrops of mussels covered in a thick white microbial biofilm. The outcrop of mussels near Mkr #12 was perhaps 1 acre in size. Fun was had by all.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-618 Giggenbach - Observations
		30°S	178°W	
8:44	0			*Pisces* in the water at surface
8:54	276	2.240	43.226	On bottom. Pumicey sediments. Cloudy, but clearing. 50m NE of WP1.
9:03				Heading east towards WP2. Approx 20 degree slope.
9:10	260			Occasional lava bombs, separate elemental sulphur globules with occasional gastropods in pumice sediments.
9:18	254			**PV-618-1-R** (Sample 1). Pumice "ejecta" with hypha and algae from area of small rubble field.
9:30	189	2.249	43.058	Increased basalt rubble. Continued east. Broken sheet flows.
9:38	167	2.297	42.994	Diffuse hydrothermal vent found. Red matting, algal or Mn coating on top of matting. Shimmering water, ~25x40m, but very diffuse. Several orifices. Possible venting site 50m to the north. Not visited.
9:49	164			**PV-618-2-R** (Sample 2). Shelf sample. **PV-618-5-SS1** (Sample 5) Suction sample of red bacterial mat with algal/Mn top.
10:11	164			**PV-618-3-MS-blue** (Sample 3). Fluid sample (MS Blue).
10:14	164			**PV-618-4-GT-green** (Sample 4). Green gas tight sampler. Continuing on to WP2 (E).
10:29	170			Multiple pit craters and fault features.
10:44	189			**PV-618-6-R** (Sample 6). Highly altered basalt. Diffuse venting. Rock sample with white bacterial matting. T=24°C.
10:55	189			(west of WP2) - Venting rock shelf with fingers of orange iron hydroxy precipitate. Source temp 57C but mixing with seawater rapidly so temperature drops to ambient quickly.
11:06	191	2.289	42.864	Venting with phase separation. Plenty of mussels with white matting. Temp at phase separation 99.1°C.

Time	Z	Lat	Long	Dive Log PV-618 Giggenbach - Observations
11:25	191			**PV-618-7-B** (Sample 7). White chimney's and mussel clumps. 3 mussels with thick bacterial mat coating sampled at HURL marker 10. Venting with phase separation T=99.1°C.
11:29	191			HURL marker 10 deployed.
11:42	186			(Upslope Mkr 10) - Half dozen sulphide/silica chimneys spotted.
11:51	186			**PV-618-8-R** (Sample 8). Chimney piece sampled (sulfide?).
11:57	186			Leaving crater and heading for cone summit.
12:01	150			Sharp distinction between sandy bottom and angular talus of cone > 45 slope. Large blocks going to smaller as we gain height in slope. No sessile fauna. Only fish.
12:08	110			Increasing numbers of fish & purple algae on rocks.
12:13	95			**PV-618-9-R** (Sample 9). Talus with algae coating sampled. Several grey reef shark and schools of mau mau in the area.
	83	2.024	42.694	Near summit. Shimmering water noted. Appears to be no point source. Schools of fish everywhere.
12:26				Large vertical column of basalt. East side of the summit.
13:11	160	2.024	42.651	Large hydrothermal field. Diffuse venting with large outcrops of mussels.
				Medium sized talus with venting around. Temperature in soil 85.3C.
13:28	143			**PV-618-10-B** (Sample 10). White, mat-encrusted mussels sampled (4).
13:33	168			Dead mussel field and volcaniclastic rock (?).
13:40	158			Bottom of mussel field.
13:49	143			Top of mussel field.
14:17	158	2.024	42.651	**PV-618-11-MS-white** (Sample 11).Fluid sampled (MS white) at bottom of mussel field. **PV-618 -12-GT-white** (Sample 12).Gas tight (white) in same area. T=70.4°C.
14:55	161			**PV-618-13-B** (Sample 13). Sinter-like sponge sampled. 10m east of previous sampling point.
15:05	163	2.023	42.627	Major venting (good video). Large field, massive venting phase separation.
15:09	163			HURL marker 12 deployed.
15:16	163			**PV-618-14-R** (Sample 14). Sediment scoop of hard sulphur crust just below major 205°C vent. Scoop #1: Gas formation appears to be 3 inches above vent opening.
15:25	163			Vent temperature: 205.0°C.
15:41	163			**PV-618-15-R** (Sample 15). Scoop of glassy black sand near Mkr 12. **PV-618-16-R** (Sample 16). Pumice sampling in thermocouple holder.
15:43	163			Survey field (eastern end). Sedimented walls all along. Continual bubbling from vents.
15:53	166	1.994	42.612	Large overhangs of sedimented walls. Length of field >30m (western end). Massive sedimentation layers (with and without white S layering).
16:04	161			Leaving bottom

8.8 PV-619 Giggenbach Dive Log

Location: Giggenbach Volcano, summit area
Latitude: *Begin* 30° 01.962'S, **Longitude:** 178° 42.406'W
Mission Date: April 16, 2005
Bottom Time: 5 hours 35 minutes (5.583 hours)
Maximum Depth (m): ~183
Observer: David A. Butterfield
Pilot: Terry Kerby

Objectives:
(1) Sample hydrothermal fluid and gas at Giggenbach volcano.

Observations, findings, etc: (Also see Appended Dive Log)
The main objective of the dive was to sample a range of vent fluids from Giggenbach caldera, including the marker 12 area in pit and marker 10 to the SW. The dive was delayed due to communication problems with the fluid sampler on deck. Underwater cables were re-connected and problem went away. The comm. problem returned during descent, but was resolved prior to landing at 134 meters depth. We drove a vector to marker 12 area and found the pit. We selected the vent next to marker 12 and set up with the fluid sampler. We took 3 pistons, two bags, and 3 gas-tight samples in the boiling vent. We then moved down slope to take more samples, lost the grip on the intake nozzle, drifted down to the bottom of the pit, and then could not get the sampler working again. We surveyed the pit thoroughly, took a gas scoop sample at the boiling vent by marker 12, then gradually climbed up to the east and ended the dive.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat.	Long	Dive Log PV-619 Giggenbach - Observations
		30°S	**178°W**	
				Plan: launch and drop near marker 12 vent area. Sample boiling fluids and gas in this general area. If time and power permit, sample diffuse venting near marker 10.
8:00				In sub to check out HFS and launch. Initial check looked ok, but then lost comms. Checked inside connectors, no problem found. System came back on but went out again on second approach to launch site. Secured power, Colin re-made underwater cable connections, cleaned comm. connector, and system came back on. Started third approach to launch site about 08:55
8:55				Air temperature 21°C. Surface water temperature 22°C. Bottom temperature at 145 meters is 16°C.
9:38	145	1.962	42.406	Arrived on bottom. Marker 12 area vector range 300 meters at 255 degrees. Landing site has lots of various small fish, purplish bacterial mat on 5-20cm size pumice. Took hand-held photos. Current seems to be coming from direction 320 degrees from our compass. We drive W/SW from this point and see only pumice with bacterial mat coating and small fish along the way.
09:55	119	2.004	42.54	We have started to see yellow staining on the seafloor, sign of sulfur and hydrothermal alteration. We continue to follow the vector toward marker 12.
10:27	168	2.004	42.66	Terry has recognized the area of the pit near marker 12. We see mussels, white staining, and signs of hydrothermal discharge.
10:35	164	2.004	42.648	**PV-619-1-HFS6** (Sample 1). **PV-619-2-HFS5** (Sample 2). **PV-619-3-GT-Blue** (Sample 3). **PV-619-4-GT-Yellow** (Sample 4). **PV-619-5-HFS22** (Sample 5). **PV-619-6-GT-Black** (Sample 6). **PV-619-7-HFS18** (Sample 7). **PV-619-8-HFS9** (Sample 8). Upon arrival at marker 12, we set up to take samples with HFS. Temperature climbed quickly and stabilized at 203° to 204°C at our depth of 163.5 meters. Took 3 piston samples, 2 bag samples and 3 gas-tights from this vent. Details of these are in the sample log. Sampling continued from 10:56 to 11:28. The vent was too hot to pump directly through filters, so didn't take any here. After getting 8 samples, wanted to look for another sampling site, and potentially do a vertical transect of the area of boiling. Note: the depth in the *Pisces* dive log is incorrect for this time period.

Time	Z	Lat.	Long	Dive Log PV-619 Giggenbach - Observations
11:54	168.9	Below Mkr-12		We set up to do more sampling with HFS, and measured temperature up to 198.2° C and still rising, when the sub moved and we lost the grip on the sampler intake before we were ready to take a sample. In the process of trying to recover the intake nozzle, we drifted down the hill all the way to the bottom of the pit before we could get hold of it again.
12:00	183.7	2.004	42.63	**PV-619-9-Gas** (Sample 9). Gas in scoop with pressure relief; collected above boiling vents at Mkr 12. Start: 1415 Stop: 1419. Bottom of the pit below marker 12. There was a site of good diffuse venting at the bottom, coming up around the base of a large boulder that had fallen into the pit. Unfortunately, I could not get the sampler to operate again after the tumble down the slope. I tried power down/up at least 8 times over the rest of the dive, and it would not come back. Tried Gary's computer, but that was not the problem. Must be something to do with the cabling or sampler. The sampler was dead for the rest of the dive, so we could not continue water sampling. We have only the gas "scoop" sample capability remaining. At the bottom of the pit, there was diffuse venting but no boiling, a very large boulder and lots of debris, including mussel shells. Any venting in this area would have to come up through continuously accumulating debris from above. Note: when I got to the trouble-shooting of the sampler, we first eliminated cable issues, and then I opened the case to find it was flooded with seawater due to a damaged o-ring. It must have flooded during dive 614 at Monowai. I spent 30 hours washing the entire case and contents, replacing the PC104 computer, flush pump controller board, cleaning and drying the pump/valve controller board, and reassembling. There were just enough spare parts to make the sampler work again. It was fully tested on deck with the deck power supply before the ship arrived in port at Tauranga.
12:48	171			During this time we make a clockwise circuit around the pit near a depth of 171 meters. Very near the bottom of the pit, we see flat fish and take some photos. These are larger and rounder than the flat fish sampled at Macauley.
13:09				We see a reddish layered deposit with a near vertical face. According to the sub compass (which did not seem to be accurate during this dive) the trend of the wall face was 055 degrees, dipping at an angle of about 10 degrees below horizontal to the east. The navigation track does show us driving nearly due east along this wall at the north end of the pit. I was intermittently trying to get the sampler to come back on during the period from 12:30 to 13:30.
13:40	129	2.041	42.588	At the top rim of the pit, there is intense venting over an area about 2x4meters. Enough to push the submarine up and register a temperature of over 18.5°C on the sub external temperature probes compared to 16° C ambient temperature at this depth.
14:15	163.5	Mkr-12		Over approximately 5 minutes, we collect gas bubbles into the modified scoop sampler. It was filled approximately ½ full with gas. After taking this sample, we were obliged NOT to descend more than 10 meters or so in order to avoid compressing the scoop sampler and causing either contamination by seawater or possible cracking/implosion of the plastic. The suggestion came down from the surface to explore due north, but we found that direction to be deeper, so we drove along at approximately the 130m contour. Our compass direction was telling us we were heading NE, but the navigation track shows that we were moving E/SE. We continued nearly straight going gradually up, and ended the dive near where we had started, in a very similar environment with no sign of hydrothermal activity.
15:10	110	2.178	42.384	Final position. Upon ascent, we watched the gas sample. At 70 meters, it started to vent gas bubbles, and continued to vent gas until we reached the surface. The HFS started to vent gas out of the exhaust tube and intake at about 15 meters and blew out a significant amount of gas in large bursts. Could not see gas directly coming out of the piston samplers, and no apparent bag explosions. Piston samples were approximately ½ gas and ½ liquid. Bag samples had less gas. We scooped up lots of rock over the course of the dive, almost all of it pumice from the pit. Most of it was gone by the time we were on deck.

8.9 PV-620 Giggenbach Dive Log

Location: Giggenbach Volcano, summit area
Latitude: *Begin* 30°02.265'S, **Longitude:** 178°42.774'W
Mission Date: April 17, 2005
Bottom Time: 6 hours 30 minutes (6.5 hours)
Maximum Depth (m): 178
Observer 1: Cornel de Ronde
Observer 2: Ron Greene
Pilot: Terry Kirby

Objectives:
(1) Traverse southern slope of volcano, heading upslope towards crater at summit.
(2) Map geological and hydrothermal-related features in the southern crater and head north to main crater.
(3) Map geological and hydrothermal-related features in the main crater with emphasis on field of silica-rich chimneys and reconnoiter northwest part of the crater, take representative video and stills.
(4) Move ~northeast around base of summit cone at ~165 m ('venting depth') and reconnoiter small northeast crater just south of Marker #12 crater, then finish dive on small cone further to northeast.
(5) Sample vent fluid, rocks, mineralization (especially chimneys) and animals.

Observations, findings, etc: (Also see Appended Dive Log)
Started dive on southern slope of main summit cone, landing much further north than anticipated. Worked around NW slope of the cone (fresh basaltic talus), then headed ~S down NW margin of main depression where lower (~180 m) slopes were covered in bacterial mat (sampled). Moved ~SE and eventually found silica chimneys are getting lost navigating around numerous holes that mark the boundary of the eastern side of the depression. Sampled silica chimney, moved to Marker #10 and sampled fluids and sediments. Then moved ~NE to Marker #12. In a smaller depression sampled rock, boiling vent fluids (203 °C at 156 m) and gases. Much fewer animals than at Macauley.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-620 Giggenbach - Observations
		30°S	178°W	
10:57	178	2.265	42.774	On bottom. No time stamp. Floor covered in sediment with small, up to 30 cm talus that is locally Fe-oxide coated.
~11:08:19	177			Grouper swims past camera (time estimated from bottom time).
~11:11:31	177			See strange snake eel that stands on end then goes down hole; great video.
~11:16:12	175			Edge of basaltic cone talus slope; blocks ~30 cm; some < 1 m.
~11:19:24	175			Continue to see basaltic talus. Camera had been zoomed in during transit over talus to this point, now zoomed out.
~11:20:18	175			Large grouper following us around.
~11:21:35	175			Only real example of lava flow seen; massive with jointing.
~11:36:00	176	2.111	42.910	Get range and bearing of Mkr-12 and see have to go back south; then see more sandy bottom. Some whip corals.
~11:49:57	178			First sight of extensive bacterial mat covering NW slope of main, summit depression.
~11:52:07	178	2.205	42.954	**PV-620-1-SS-jar#1** (Sample 1). Suction sample into jar 1 of massive orange/yellow bacterial mat. T=33.3° C, from small diffuse vent with white bacterial floc coming out.
11:53:14	178			Time stamp on for first time in dive.
11:53:26	178			Good video of vent spewing out bacterial floc; revolting!
12:06:05				Leaving bottom after collecting bacterial floc. Traverse SE down NW slope of depression ~180 m and see extensive bacterial mat.
12:12:44				More bacterial mat. Adjacent sandy slopes show ripples.
12:17:19				Moving ~SE still around 180 m and see small outcrop of Fe-silica crusts (?) with some dead mussels shells. Substrate mostly sand.
12:21:11				More Fe-silica crusts.

Time	Z	Lat	Long	Dive Log PV-620 Giggenbach - Observations
12:21:50				Extensive area of white, probable bacteria, on mostly sandy substrate with minor talus and Fe-silica crusts (?).
12:25:10				See white filamentous bacteria encrusting walls of steep pit off SE margin of main summit depression.
12:27:15				Exploring one of at least 3 steep pits off SE margin of depression.
12:29:04				Another glimpse of steep, bacteria-covered walls of pit.
12:30:33				More shots of pit wall; ash units, locally altered, lots of bacteria.
12:39:10				Ash units forming walls of pit; water very turbid.
12:40:29				See layered structure of ash units as we lateral around steep walls of one of these pits.
12:43:07				More bacteria-encrusted, steep ash pit walls. Walls of pit closed in on sub quickly; got down to depth of at least 205 m. Suspect venting occurring at base of pit. Ambient temperature rose 0.5°C.
12:45:38				Partially eroded, ash units that form steep walls to pit. White bacterial mat.
12:49:11				Finally back out of pits area and on top sedimented depression immediately W of pits, marking eastern-most margin of main depression. Rippled sediment.
12:50:26	186			See bacterial mat and Fe-silica crust on sediment surface.
12:57:19				Sandy bottom with blocks of ash units poking through.
13:09:05	186			Leaving bottom and heading ~N to find silica chimneys.
13:10:47				Rippled, sandy bottom on E side of main depression.
13:18:32				First sign of alteration/bacteria associated with silica chimney site.
13:19:00	185	2.251	42.836	Top of slope where see several indurate, silica chimneys.
13:23:46				First sight of silica chimneys atop an altered ash unit.
13:24:02				Chimney in foreground that looks like a pyramid is the one eventually we sampled; is ~ 1 m tall and mostly silica.
13:25:39	183			Shot of top of silica chimney; attempted to sample with robotic arm (13:26:25) but proved too hard; then rammed with front of basket (13:34:05) which broke off piece ~15 cm long.
13:38:01				**PV-620-2-MIN** (Sample 2). Top of ~1 m tall silica chimney; indurated. Retrieved chimney that was knocked off, downslope.
13:44:40				View of tallest silica chimney in this field (~2.5 m). Attempted to sample by ramming with basket, but chimney broke off about 1.5 m down and all fell to ground.
13:51:00				Moved off to try and find Mkr-10. Sandy bottom with minor talus.
14:01:45				Near Mkr-10 see lots of white bacteria covering bottom. Landed at Mkr-10.
14:04:44	191	Mkr10	Mkr10	See white filamentous bacteria growing off mussels; Mkr-10 small pile of volcanic sand/ash that has diffuse venting. Liquid coming from sediment mounds; gas bubbles out of small holes.
14:10:35	191			**PV-620-3-MS-white** (Sample 3).Fluid sample (MS white). **PV-620-4-GT-white** (Sample 4). Gas tight sample (white). Moved forward slightly and used T probe to break crust of small sediment mounds where liquid discharging; T=164.5°C (gas bubble discharge ~99°C measured previous dive).
14:35:16				**PV-620-5-MIN** (Sample 5). Sediment scoop of ash/bacteria at Mkr-10 T=164.5°C. Used sediment scoop to sample sediment mounds where fluid discharging and which had white filamentous bacteria growing on it.
14:42:50				Moved ~N away from Mkr-10. See numerous patches of white bacterial matter and additional silica chimneys (e.g., 14:44:28, 14:45:19, 14:45:41, 14:45:56). Chimneys appear to be striking ~NE toward crest of a bowl where chimneys line the rim.
14:47:29				More silica-rich chimneys; mostly <1 m tall. Some white bacteria; most recent chimneys are more yellow in colour (dead ones have a dark brown exterior).
14:48:17				More chimneys (and at 14:48:30).
14:48:51	178			Nice video of old chimneys <1m and more recent Fe-silica deposits (yellow); making a 'Y' outcrop pattern. Video stamp off at 14:48:55.
14:54:19				Another dead silica chimney.
14:54:52				As move ~N to NE, see pinnacles of Fe-oxide coated, weathered and eroded ash units. We're moving ~SE up slope of large 'cone'.

Time	Z	Lat	Long	Dive Log PV-620 Giggenbach - Observations
15:01:50				Mostly sandy bottom; some talus of ash units (?); minor patches of white bacterial material in places.
15:07:25	140	2.227	42.652	Getting position on way to Mkr-12; make way more to N.
15:16:36				Mostly sandy bottom; some talus of ash units (?). Minor patches of white bacterial material in places.
15:22:11				Shot of a grouper.
15:27:31				See some gastropods on bottom - not sure if alive?
15:31:39				Dominantly ash with some minor S + Fe-oxide crusts.
15:32:19				At NE depression where Mkr-12 is. See layered ash units rim of the depression. Black squat mussels sitting on top of one unit at rim, covered with white bacteria.
15:37:20	163			**PV-620-6-R** (Sample 6). Sulfur-coated volcaniclastic rock from Mkr-12. T=205°C. Shifted Mkr-12. This is the most S seen on dive and freshest looking S. It binds the matrix to ash units here. ~1.5 m downslope from boiling vent.
15:39:52	163	Mkr12	Mk12	Boiling vent (205°C) @Mkr-12 (time stamp off).
15:41:10				Overhanging ash units upslope above Mkr-12; steep talus slope mark the walls of this depression/pit; lots of S staining
15:48:00	156			**PV-620-7-MS-blue** (Sample 7).Fluid sample (MS blue). **PV-620-8-GT** (Sample 8). Gas tight sample. Sampled upslope of Mkr-12; at different boiling vent. T=203°C.
16:04:00	156			**PV-620-9-B-SS** (Sample 9). Suction sampled small crabs seen around vent into jars #2, 3, 4.
16:17:47	165			**PV-620-10-bubbler** (Sample 10). Sampled gas bubbles in inverted sediment scoop from boiling vent below #620-7. Samples taken downslope from previous boiling vent (but along from Mkr-12).
16:19:47	165			See bubbles filling up top part of scoop.
16:27:30				Leaving bottom of pit where Mkr-12 located.

8.10 PV-621 "W" Dive Log

Location: Volcano "W" East, summit area
Latitude: *Begin* 31°51.891'S, **Longitude** 179° 11.245'W
Mission Date: April 18, 2005
Bottom Time: 5 hours 59 minutes (5.983 hours)
Maximum Depth (m): 1299
Observer: Ian Wright
Pilot 1: Terry Kirby
Pilot 2: Colin Wollerman

Objectives:
(1) Explore the northern rim and wall of the southern caldera (Volcano W).
(2) Explore the southern rim and wall of the northern caldera (Volcano W).
(3) Explore and sample hydrothermal vents on the central resurgent cone of the northern caldera.

Observations, findings, etc: (Also see Appended Dive Log)
The northern wall of the southern caldera comprises precipitous slopes with pillow lavas, pillow tubes, and localised sheet flows with minimal sediment cover and epifaunal encrustation. The upper part of the wall also has columnar cooling joints. On the upper part of the wall localised bacterial mats occur, with dead mussel shells, and live worm tubes. At separate sites bacterial mats with diffuse venting at 8.9° C and tube worms were collected. The crest of the caldera rim is covered with ?dead bacterial mats. The southern wall of the northern caldera comprises rugged volcanic topography. The lower slopes of the central resurgent cone comprise blocky talus and some in situ lavas. The upper flanks are covered in bacterial floc, which includes diffuse venting and small Fe finger chimneys. Bacterial floc was recovered from a diffuse vent with 28.0° C venting at a depth 1047 m. The crest of the cone comprises a ~16 m wide and 15 m deep pit. Diffuse low temperature venting also occurs inside the pit with temperatures of 10.0°C. Major fluids were sampled from this pit.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-621 "W" - Observations
9:22		**31°S**	**179°W**	Seafloor sighted. Complex lavas flows and blocks.
				Landed on base of northern wall, southern caldera.
9:24	1299	51.891	11.245	On bottom. Steep volcanic wall with sediment cover.
9:27				Trimming sub buoyancy.
9:31	1306	48.312	9.790	Moving upslope. Fish.
9:32	1286	48.338	9.811	Pillow lavas and blocky talus.
9:34				Elongate pillow lavas and pillow breccias, little biology.
9:36				Moving along western flank of lava tongue protruding from wall.
9:41				Complex lava flows + talus.
9:44				Pillow talus.
9:45	1293			Sheet flows with ropey flows at margins.
9:47				Ropey lava flows with anemone and flatfish.
9:50				Rock sampling; **PV-621-1-1R** (Sample 1).
9:55				Moving upslope. Complex ropey lava flows.
9:56				Minor sediment cover of lava flows. Bioturbation trails.
9:58				More subdued topography; flows with partial sediment cover.
9:59				Broken pillow talus and complex lavas.
10:00	1270			Sediment scree slope.
10:01				Pillow talus and cobble scree.
10:02				Pillow talus.
10:04				Pillow talus with minor sediment.
10:05				Massive lava outcrops.
10:05				280 m south waypoint 4.

Time	Z	Lat	Long	Dive Log PV-621 "W" - Observations
10:06				Complex lava flows.
10:07				Still climbing caldera wall.
10:09				Sediment / scree.
10:10				Pillow talus.
10:11				Massive lava outcrops; still climbing wall.
10:13				Complex ropey lavas.
10:17	1195	51.752	11.172	Position on rim of southern caldera.
10:22				Increasingly more sediment cover over volcanic talus.
10:24				Moving through water column to find local highs.
10:25				Back on bottom. Poor visibility.
10:26	1169	48.432	9.924	Massive lavas; sea pen.
10:29				Massive lavas with minor scree cover.
10:31				Sediment covered volcanic blocks.
10:32				Lava spires.
10:43				In water column. Poor visibility.
10:46				Pillow talus including altered blocks and mussel fragments.
10:51				Altered talus; mussels shells and live tube worms.
10:55				Sampling tube worms; **PV- 621-2-B1** (Sample 2).
11:02				Altered talus; mussels shells.
11:03				Fe-staining, alteration.
11:06	1155	51.645	11.293	
11:07				Volcaniclastic sediment.
11:10				Moving through water-column.
11:20	1188	51.634	11.306	Back on seafloor. Volcaniclastic sediment.
11:25				Poor visibility.
11:26				Moving through water column.
11:31				*Pisces* back on bottom. Complex lavas and pillow breccias.
11:06				*Pisces* back on sedimented seafloor.
11:33				Steep outcrops with ropey lavas.
11:34				Pillow tubes.
11:34				Pillow tubes with cascading lava bud sediment cover.
11:36				Climbing massive flow outcrop.
11:38	1129			Volcanic breccias with possible xenolith blocks.
11:39				Still climbing volcanic breccias outcrop.
11:40				Volcanic breccias forming a spire.
11:43				Poor visibility / moving through water column.
11:44				Back on bottom. massive lavas.
11:46				Large pillow lavas.
11:48	1116	51.519	11.215	Position: upper northern wall; southern caldera.
11:58				Moving upslope.
11:59				Poor visibility.
12:00				Massive lavas.
12:01				Cooling / columnar jointing in massive flow.
12:05				Pillow breccias.
12:06				Radial and columnar cooling joints in large flows.
12:07				Columnar jointing in massive flow.
12:08				Bacterial mat beneath pillow lava on wall.
12:10	1052	51.478	11.172	Position.
12:12				Temperature probe 8.9°C.

Time	Z	Lat	Long	Dive Log PV-621 "W" - Observations
12:15				Suction sampling bacterial mat; **PV-621-3-SS-3** (Sample 3).
12:18				Moving upslope on caldera wall.
12:21				Massive flows with ?columnar cooling joints.
12:22				Large pillow lavas with minor bacterial mat.
12:23				Large angler fish.
12:27	1013			Rock sampling; **PV-621-4-R2** (Sample 4). 40 m upslope from previous position.
12:32				Moving upslope.
12:33	1000			Old bacterial mats / Fe crusts partially broken up.
12:35				Poor visibility.
12:38				Rippled sediment.
12:39				Poor visibility.
12:42	1028	51.388	11.258	Position; on southern rim of northern caldera.
12:47				Moving NNE through water column.
13:07				Back on bottom. Broken pillow lavas; rat-tails.
13:08	1158	51.161	11.144	Position on northern caldera floor.
13:15				Poor visibility. Rugged lava flows.
13:16				Complex lavas; crab.
13:20				Lava flows; crab + swimming "sausage".
13:22				Poor visibility.
13:24				Broken flows and talus; rat-tails.
13:26				Back on bottom.
13:27				Massive outcrops, talus, rat-tails.
13:28	1178			Steep slope, volcanic outcrops, octopus.
13:29	1159			Mix of outcrops and covering talus, rat-tails.
13:30				Moving across floor of northern caldera towards cone.
13:32				Rugged topography; ropey lavas and blocks; little biology.
13:34				Pillow tubes, but mostly broken pillows and blocks.
13:36				Sedimented slope with some outcrops.
13:39				High of the seafloor. Poor visibility.
13:43	1178			Rugged lava flows. Crossing a ridge orientated ?NE-SW.
13:40				Moving along southwest base of central cone.
13:41				Poor visibility.
13:42				Cobble talus + ?sandy volcaniclastics.
13:45				Cobble talus + ?sandy volcaniclastics.
13:46				*Pisces V* on seafloor.
13:47	1165	50.853	10.943	Position 10. Lower eastern slope of central cone.
13:49				Moving upslope on eastern flank of cone.
13:50				Cobble / block talus + sediment; rat-tails.
13:53				Poor visibility.
13:54				Increasing cobbles / blocks less sediment.
13:55	1101			?Bacterial floc on seafloor + lava blocks.
13:56	1081			Increasing floc on seafloor + broken mussel shells.
13:57				Floc in the water-column.
13:58	1063			Sheets of floc and ?Fe-iron crust displaced downslope.
13:59				Sheets of floc + ? Fe "finger chimneys".
14:00				*Pisces V* touches down; dispersed floc.
14:01	1047	50.855	11.044	Position 10; upper eastern slope of cone.
14:02				Bacterial floc + diffuse shimmering water; 28.0°C.
				Suction sampling;**PV-621-5-SS2 & 3** (Sample 5).

Time	Z	Lat	Long	Dive Log PV-621 "W" - Observations
14:09				Moving upslope.
14:11				Recovering lost temp probe.
14:12				Sediment scoop of floc and underlying black sand.
	1039			**PV-621-6-MIN1** (Sample 6), 8 m upslope of previous site.
14:18				Moving upslope. Bacterial floc + Fe crust.
14:20	1033			At cone crest at the edge of crater pit.
14:22				Moving into crater pit. Pit 16-20 m in diameter.
14:23				Pit walls and floor blocky lavas covered with floc.
14:23				Poor visibility.
14:25	1047	50.872	11.066	Centre of pit. Position
14:28				Diffuse venting 5 m from pit centre; base of outcrop.
14:30				Temperature probe of vent; 10.0°C.
14:33				Suction sampling vent; **PV-621-7-SS-4** (Sample 7).
14:40				Major fluids sampling; **PV-621-8-MS-white** (Sample 8).
14:46				Leaving pit crater.
14:50				Moving upslope. Floc covered outcrop and talus.
14:52				Back on crater pit rim. Floc covered talus.
14:53	1031	50.873	11.102	Marker 13 deployed on crater pit rim.
				Rock sampled; **PV-621-9-R3** (Sample 9).
14:58				Moving to do anticlockwise circuit of outer cone flank.
15:00				Poor visibility.
15:01				Blocky rubble and talus.
15:02				Bacterial floc in water column.
15:03				Floc covered volcanic talus.
15:04				Talus / blocky - cobble scree slope.
15:05				Bacterial floc in the water column.
15:08				Floc covered scree.
15:09				Localized lava outcrops.
15:10				Bacterial floc and ?Fe crusts.
15:15				Floc dispersed in water column.
15:19				Floc covering blocky talus.
15:23	1044	50.873	11.102	Leaving bottom from Marker 13.

8.11 PV-622 Rumble V Dive Log

Location: Rumble V Volcano, summit area
Latitude: *Begin* 36° 9.015'S**, Longitude:** 178° 12.002'E
Mission Date: April 21, 2005
Bottom Time: 2 hours 40 minutes (2.666 hours)
Maximum Depth (m): 796
Observer: Malcolm Clark
Pilot 1: Terry Kerby
Pilot 2: Steve Price

Objectives:
(1) Explore Rumble V cone.
(2) Sample hydrothermal rocks, minerals, fluids, animals and deposits.
(3) Undertake mapping to locate best vent sites for later fluid sampling.

Observations, findings, etc: (Also see Appended Dive Log)
Started dive at 795m on the southern slope and explored northwards up the slope cutting across strong structural flows of pillow lava. A high diversity of deep invertebrate and fish fauna was seen. We were advised 2.5 hours into the dive that weather at the surface was deteriorating, and the dive might be shortened. Consequently we headed straight for the best vent target, known mussel beds to the east of the summit. Large expanses of dead mussels were seen, and at 11:30 a live bed was seen at 486m. Sampling was carried out hurriedly there before having to abort the dive because of the topside wind and sea conditions.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-622 Rumble V – Observations
		36°S	178°E	
8:20	0			*Pisces* in the water at surface.
8:45	500			As descend are being pushed to east. Thrust to the west to maintain landing site.
9:07	794	9.015	12.002	Descend through school of bluenose to the bottom. Land in area of broken pillow lava. T=7.5°C.
9:20	794			Start moving to the north. Corals, gorgonians and urchins are frequent. Bottom is ropey pillow lavas.
9:27	794	9.010	12.000	**PV-622-1-B** (Sample 1). Collect a specimen of *Dermechinus* (a sea urchin), which tend to dominate the seascape like cacti.
9:40	796	9.010	12.000	**PV-622-2-R** (Sample 2). Sample a sample of the pillow surface, although it crumbles and only small pieces are recovered. Stop near a deepwater lobster *Projasus parkeri*.
9:44	794			*Projasus* and brittle star
9:50				Corals, crabs, cidarid and echinoid urchins, rattails, morid cods (?*Tripterophycis gilchristi*). Fairly clean basaltic pillow lava, gastropods, brittle stars.
9:57	780			Moving up vertical pillow wall, branching corals.
10:00	770			Deepwater stargazer.
10:08				Softer sediment in amongst pillows, long-nosed *Coelorinchus ?supernasutus* rattail.
10:12				Talus slope, scattered corals, rattails, lobster.
10:15				Back to pillow ridge, urchins, corals.
10:16	726			Drop into shallow crater/hole, dead/broken shells.
10:17				Silver roughy, echinoids, corals again.
10:20	715			Following ridge on slope. Ropey lava, anemones.
10:27	700			Scorpaenid fish.
10:30	680			Ridge again, pillow lava/fragments, urchins, corals, fish.
10:35	660	8.536	11.898	At WP2, "garden" of urchins, corals, starfish, bluenose close-up.
				Off bottom transit to the north for a few minutes.
10:50				Talus slope, steep, looks unstable, not much biota, a few alfonsino, gastropods.
10:53				Prickly dogfish, *Oxynotus bruniensis.*

Time	Z	Lat	Long	Dive Log PV-622 Rumble V – Observations
10:55				Advised by *KOK* that weather deteriorating.
11:00	598			Talus slope, pillow fragments.
				Start of second DVD.
11:05				Moving across talus, scattered benthic fauna, anemones, brittle stars, echinoids.
11:07				Traveling 15-20m above bottom to get to WP3.
11:10				50 m bearing 110deg to WP3.
11:13	555	8.536	11.898	Rubble and bouldery-talus slope.
11:16				Expanse of dead mussel shells covering very large area.
11:19				Informed to abort dive at 11:45.
11:20				Some white staining over small area, still on dead mussel beds, blocky talus bottom.
11:22	510			Bluenose
11:23				Mussels peter out, steep talus slope
11:28	486	8.439	11.894	Live mussels found. Decide to sample before run out of time.
11:30	486	8.439	11.894	**PV-622-3-B** (Sample 3). Sample of *Gigantidas* mussels.
11:33	486	8.439	11.894	**PV-622-4-MS** (Sample 4). Fluid sample (MS) from above mussel bed. T=11.2° C T ambient=10.2° C.
11:36	486	8.439	11.894	**PV-622-5-MS** (Sample 5) Fluid sample (MS) from above mussel bed. T=11.2° C T ambient=10.2° C.
11:40				Move slightly to west, off the mussels to drop weights.
11:43	474	8.439	11.885	**PV-622-6-R** (Sample 6). Rock with encrusting mat.
11:47	474			Dropped weights. End of dive.

8.12 PV-623 Clark Dive Log

Location: Clark Volcano, summit area
Latitude: *Begin* 36° 26.835'S, **Longitude:** 177° 50.651'E
Mission Date: April 07, 2005
Bottom Time: 6 hours 5 minutes (6.083 hours)
Maximum Depth (m): 1072
Observer: Alex Malahoff
Pilot 1: Terry Kerby
Pilot 2: Max Cremer

Objective:
(1) Explore and image the summit of Clark volcano.
(2) Collect biology, microbiology, chemical and geologic samples.

Observations, findings, etc: (Also see Appended Dive Log)
The dive began east of the summit and traversed up to the summit. The major discovery was of a field of sulfide chimneys on the northern summit ridge just south of the northern summit. The vent field (~100 m in diameter) consists of lots of diffuse venting and several chimneys are about. Mkr-14 was placed at the "Twin Towers" vent site, which consisted of two large chimneys. A temperature of 221° C was measured near the base of the largest one. The southern summit was not hydrothermally active. Lots of broken corals and displaced rocks attested to recent dredging/trawling activity on the southern summit.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-623 Clark – Observations
		36°S	177°E	
9:13:00	1072	26.835	50.651	On Bottom.
				Ballasting, see pahoehoe lava.
				Need range to WP1; not much current, silt cloud hanging.
9:17:00				Bearing 301, range 40 m.
9:20:00				Ballasting, see pahoehoe lava.
9:22:00				On Bottom, ballasting.
9:24:00				Red fish: Orange Roughy?
9:30:00				Start moving; observing hydrothermal alteration. Mention Orange Roughys.
9:32:00				Seeing yellow alteration.
9:33:00				They're seeing lots of Orange Roughy; Using the port camera, not so good.
9:35:00				Not giving any depth or headings into microphone.
9:35:00	1050			Light dusting of sediments on what looks like pillow lava tubes but camera isn't so great.
9:35:48				Nice view of flows as sub travels over bottom. Looks like series of flows that have broken off fronts.
9:37:10	1033			More talus with sediment pockets between; have been seeing some yellow staining.
9:38:00	1028			Going up steeper slope, more talus.
9:39:00	1012			Going up wall of lava outcrops. Think I see some truncated pillows.
9:39:50	1014			At base of massive lava columns, from mass-wasting.
9:40:00	998			Moving up vertical lava wall with dike or lava column sticking out as vertical column.
				Sponges, other sessile stuff; they claim they see Mn coating on rocks.
9:42:00	993			Stopping to look at mineralization.
9:44:45	995			Settled down, stopped on bottom.
9:45:00	994	26.893	50.533	**PV-623-1-B** (Sample 1). Sponge.
9:50:00	994	26.893	50.533	**PV-623-2-R** (Sample 2). Sampled lava with iron oxide crust. Almost same spot as previous sample.
9:53:16	995			Moving away from sample station upslope.

Time	Z	Lat	Long	Dive Log PV-623 Clark – Observations
9:54:00	992			Seeing small hydroids on rocks? Sub is hovering in same spot.
9:55:20	992			Have turned to right and settled down to get video of yellow stuff.
9:56:30				Turn and head upslope again at 329.
9:56:45	986			Going upslope, seeing yellow staining but nothing obviously active.
9:57:30	982			Going upslope over old talus? Some light staining.
9:58:20	975			Nice view of outcrop of sheet flow-like lava.
9:59:00	973			Going up slope of sheet flows with some hydrothermal staining.
9:59:20	971			Arrived at base of outcrop of truncated pillow lavas; appears to be ridge left from mass-wasting
10:01:30	961			Seeing orange roughy fish on slope of basalt talus with sediment intermixed.
10:02:30	955			Seeing steeper slope ahead.
10:03:30	950			See wall of lava-cut across it obliquely ~1 m high.
				Going along side of channel in slope. Lavas are breccia with sediment infilling.
9:04:30	941			Across channel still on breccia with sediment fill.
10:05:00	933			Come over some edges of flows, small scarps.
10:05:50	933			Looking at wall of pillow (?) outcrops with staining in veins between. Stopping to look at vertical wall of outcrop.
10:07:45	933			Settling in to sample small active vent on wall of lava. Fluids leaking through the massive flows.
10:08:00	930			Nice video close-up of hydroids (?) in venting.
10:09:30				Moving to better spot.
10:10:00	930			At new spot, very close to first spot.
10:17:00				**PV-623-3-SS** (Sample 3). Suction microbial mat (white films) and other organisms mat venting on wall. Sample into jars 1 and 2.
10:23:30	930			
				Very diffuse venting area on outcrop wall.
10:23:30				Start moving upslope again.
10:23:56	922			Massive sheet like flows here.
10:24:19	913			Going over stained bottom, mostly talus and slabby lava.
10:25:30				Lot of small patches of active venting, some sponges, roughy.
				Talus with hydrothermal alteration and small deposits.
10:27:00	892			See active site of diffuse venting - stained area probably mat.
10:27:45	896			At active site stopped on bottom. Small chimney.
10:28:00	895	n/a	n/a	**PV-623-4-MIN** (Sample 4). Sediment scoop of sulfides and ash T=92.6°C.
10:29:00	895			Stopped - considering what to sample.
10:32:45	895			Nice video close-up of bacteria and venting.
				Nice close-up of venting.
10:34:00	896			Sucking up scaleworm and bacteria
10:34:00	895	n/a	n/a	**PV-623-5-SS** (Sample 5). Suction sample scaleworm and bacterial mat into jars 3, 4 and 5 near vent.
10:49:00	893			Moving away from site upslope towards summit.
10:50:45	890			Bearing 288.
10:51:00	884	n/a	n/a	**PV-623-6-B** (Sample 6). Long-neck barnacles sampled. T=15° C. Tmax=106° C.
				Seeing lots of white mat now fractures in rocks on this slope.
10:51:45	884			Stop at Barnacle site.
10:57:30				Start moving upslope again. See small sulfide chimney right away and stop.
11:00:00	883	n/a	n/a	**PV-623-7-R** (Sample 7). Sampled small venting chimney (T=?).
	883			Getting good video of chimney at 10:59.
11:02:30	882			Measured temperature. Sampled small chimney (sample 7), moved slightly.
11:03:30				Moving upslope to large chimney; pattern of white filled fractures.
11:04:30	879			Arrived at group of several small chimneys that are white and venting clear fluids.

Time	Z	Lat	Long	Dive Log PV-623 Clark – Observations
				Stopped considering what to sample; nice video BUT THEY DID NOT TAKE OFF THE TIME CODE TO GET GOOD SHOTS.
11:07:45				Maneuvering around to try to sample chimney
11:08:00	879	26.831	50.375	**PV-623-8-R** (Sample 8). Piece broken off large (6 m tall) chimney. T=185.2°C.
11:08:42	880			Nice close-up of venting from chimneys.
				Measured temperature; 185 C.
				Put out Mkr 14 right on chimneys. Can see that chimneys are lined up but not clear what the orientation is.
11:17:00				End Tape 1.
				Taking water samples.
11:21:00	879	26.831	50.375	**PV-623-9-MS-blue** (Sample 9). Sampled vent fluid (MS blue). T=185.2°C. **PV-623-10-GT-white** (Sample 10).Gas tight sample (white). T=185.2°C
11:47:00				Begin Tape 2 - Apparently they are missing time period 11:17 to 11:47.
11:49:00	866			Chimney video survey.
11:50:10				Chimney coming into view.
11:51:15	869			Video survey.
11:52:15	870			Going up and down Twin Towers chimney getting GOOD VIDEO.
				Until about 11:54. In sight of Mkr 14 at large chimney.
11:54:00	872	26.850	50.366	**PV-623-11-R** (Sample 11). Small rock samples at base of Twin Towers chimney.
12:00:00				
12:04:00	872	26.850	50.366	**PV-623-12-MS-white** (Sample 12). Sampled vent fluid (MS white). T=221.1°C. **PV-622-13-GT-black** (Sample 13) Gas tight sample (black). T=221.1° C.
12:04:00	872	26.850	50.366	**PV-623-14-SS** (Sample 14). Suctioned bacterial material near vent.
12:21:00	872			Trying to get gas tight sample at base of large chimney.
12:27:00	872			**PV-623-15-B** (Sample 15). Yellow Deudrophilla (coral) plus urchin.
12:28:45				Going to summit bearing 330 deg.
12:29:20				Moved a few meters 12:28:35 - 12:29:20.
12:30:00				Still messing around near chimneys.
12:32:15				Heiko shoulder not operating; still near chimneys trying to sample.
12:34:00	871			Start moving towards summit of Clark Volcano.
12:35:00	875			Moving towards summit, hard to see bottom on video.
12:36:45	881			See bottom, looks like hydrothermally stained area, basalts? With Mn?
12:37:45	875			Looks like basalt columns here.
12:38:30	876			Going over Mn and Yellow- stained basalt looks.
12:39:30	865			Climbing towards summit; drop-off to left. Looked like small crater.
12:40:30	855			Old talus; coming up towards summit stained rock.
12:41:10	853			Coming to summit; essentially there.
12:41:45	853			Working way towards the summit.
12:42:30	851			Talus or brecciated flow, lot of corals here.
12:43:20	847			All talus or breccia with some corals, staining, fish.
12:45:00	846			Same, pretty much lots of lava blocks and breccia.
12:47:00	846			At summit of Clark Volcano; stopping for position.
13:00:00				Start moving again.
13:01:30	845			Start moving SE.
13:02:35	844			Moving SE. Still lot of broken up lavas on top. Could be partly from dredging the top.
13:05:00	852			Can't see bottom right now, dropping off.
13:08:30	871			See bottom again; covered with anemones and corals, looks like intact basalt lava; lots of yellow coral; also some iron deposits; seeing broken coral….
13:10:00				See large broken slab on surface as if it's been torn up by dredge; stopping to take picture.
13:12:10	866			Turning around to continue.

Time	Z	Lat	Long	Dive Log PV-623 Clark – Observations
13:14:10	876			Are looking at Mkr. 14 by small vent again.
13:15:45				Moving Mkr 14 to Twin Towers.
13:15:00	880			Can see Twin Towers ahead. Need to figure out what course they're on.
				As they're moving slope drops off to left so appears that towers are lined up perpendicular to slope.
				Note large mound at base of Twin Towers.
13:17:00	872			Moved Marker 14 to base of large chimney.
13:18:00				As they swung around there was distinct pillow lava with corals on it.
				SOME NICE VIDEO OF TWIN TOWERS.
13:23:30				Going to move S-SE; backing off and turning to port.
13:25:00	874			Driving over lava with corals and white staining in fractures.
13:26:15	881			See some more small chimneys on slope to left; white staining in mosaic of fractures.
13:27:10	882			Seeing very distinct line of vents (small chimneys) perpendicular to slope dead ahead.
13:27:30	887			Right at chimney line - they're on the right now.
				DVD has glitch in it; goes from 13:2730.
13:27:45				Change direction, turning to port after passed by chimney line.
13:28:10	891			Slope on left; going north.
13:28:30				Just saw crab. Appears that they reversed course and are heading back north now.
				White staining; anemones?
13:29:30	891			On slope (up to left), in dark lavas with small sediment pockets.
13:29:40				Turning to starboard to head south again.
11:30:00				Turning south again.
11:30:15	897			Going south again?
13:31:20	899			Changed course to right (south). Doesn't look like there's anything hydrothermal here, just lava blocks and sediment.
13:32:30	898			Going along slope; slopes up to starboard; not much hydrothermal activity.
13:33:00	889			In basalt breccia, not much hydrothermal here; covered with Mn crust.
13:33:40	887			Seeing bacterial mat again; seeing small oxide chimneys coming from lava.
13:34:30	879			Wall to left. Out of oxide chimneys.
13:35:00	879			Some warm water coming out of small yellow chimney.
				Stopped for a minute.
				Floc coming out of seafloor cavities.
13:37:00	879			Stopped to take temperature.
				~55 deg C water coming from out of hole (where chimney got washed away when submarine set down).
				Taking mat sample (suction sampler) from 55 deg vent; GREENISH filamentous material
13:38	879			**PV-622-16-SS7** (Sample 16). Suctioned nontronite with green material (filamentous bacteria?). Tmax=56° C. (80m N of w.p. #3)
13:38	879			**PV-622-17-R** (Sample 17). Sample of nontronite crust with green material. (80m N of w.p. #3)
13:38	879			**PV-622-18-MIN** (Sample 18). Scooped green and red nontronite crusts. (80m N of w.p. #3)
13:47:00	879			Still at sample station END DIVE TAPE # 2.
13:48:00				Still at sample station BEGIN DIVE TAPE # 3.
13:54:00				Video of what appears to be greenish altered rock sample.
14:01:00				Starting to move off station.
14:02:00				On course heading south.
14:03:00				Going over lava, some oxides. Now seeing more anemones in one spot.
14:03:30	886			Seeing edge with yellow deposits; stopping briefly.
14:08:30	886			Starting to move off again.

Time	Z	Lat	Long	Dive Log PV-623 Clark – Observations
14:10:00				Lava with some yellow deposits.
14:11:00	888			Seeing corals, gorgonians; stopping to look.
14:14:00				**PV-623-21-B** (Sample 22). Sampling soft, pink gorgonian corals. (Sample number out of order).
14:16:00				Going forward again over rocks with corals, anemones etc. Lot more sessile life here.
				Heading south; running out of power on 24 v batteries.
14:19:30	890			Got off into space, then came back onto bottom. Lots of sessiles here; no hydrothermal.
				Lavas (breccia) with sponges, corals, other.
14:21:30				Lot of dead broken coral on bottom; probably from trawling or dredging.
14:22:00	874			Huge Paragorgia in sight broken off very recently; stopping to look and take pictures.
14:28:00				Just moving back on course after looking at huge broken Paragorgia.
14:28:45				Taking a quick look at an orange precious coral; lots of anemones around.
14:33:00	870	27.001	50.384	**PV-623-19-B** (Sample 19). Sampled Red Corallium Regalia (coral).
14:36:45				Going to continue to SW.
14:37:00				Begin moving SW again; seeing more broken corals etc.
14:38:00	860			Seeing broken corals all over the place; some still intact though.
14:39:00	854			Come on another Paragorgia with large chunk taken off, but still appears to be rooted and alive.
14:39:07				Fresh rock broken by trawling or dredging.
14:39:30	854			Looks like ridge of brecciated basalt.
14:40:30				Lots of small yellow and white corals. Now see large crab; lots of anemones as well.
14:42:00	842			Same type of terrain; lots of corals, some broken.
14:43:20	846			Similar terrain.
14:43:25	847			Turning left.
14:44:45				Turned to go up to high spot.
14:46:00				Going east towards southern summit of Clark Volcano.
14:47:00	843			At summit, parking to get position; turning right to get set up.
14:47:30	844			Completely stopped.
14:58:00				Move off spot, maneuvering. Going to start Moving SW some.
14:59:00				Start moving SW.
				Seem to be going off into deeper water.
15:02:30	852			Slowing up, turning? Lose bottom.
15:03:00				Coming about to ??
15:03:00				Have turned and now sub is settling down onto bottom.
15:04:00	853			Stopped now.
15:04:45				Now moving forward again.
				More dead corals.
15:05:20	849			Are settling down again.
15:10:30				Moving a few meters to get sample.
15:11:30				Nice picture of Orange Roughy hanging there.
15:12:15				Maneuvering around.
15:13:45				Stopped again.
15:15:00	848	27.067	50.350	**PV-623-20-R** (Sample 20). Mn-coated lava with anemone.
15:17:36				END DIVE 623

8.13 PV-624 Rumble V Dive Log

Location: Rumble V Volcano, summit area
Latitude: *Begin* 36° 08.546'S**, Longitude:** 178° 12.169'E
Mission Date: April 30, 2005
Bottom Time: 6 hours 32 minutes (6.533 hours)
Maximum Depth (m): 651
Observer: Ashley Rowden
Pilot 1: Terry Kerby
Pilot 2: Colin Wollerman

Objectives:
(1) Explore Rumble V cone.
(2) Sample hydrothermal rocks, minerals, fluids, animals and deposits.

Observations, findings, etc: (Also see Appended Dive Log)
Landed someway SE of proposed landing point (WP1) at 08:52 at 651 meters water depth. Moved towards WP1 over dark sediment with occasional small patches of yellow. Benthic fauna was generally sparse, although there was an area of large sea pens and small white urchins on a low ridge. After reaching the vicinity of WP1, changed direction to move upslope towards the summit of the cone. Encountered on route, first dead *Gigantidas gladius* (mussel) shells, and then an area of diffuse venting characterized by live *G. gladius* and predator red seastar *Rumbleaster*. Placed Marker 15 here at 452 meters (is the same vent site as discovered on dive PV-622). Continued to move upslope (NW) and mussel bed started to run out at 430 meters. At 413 meters we encountered small white patches where shimmering venting was occurring. Moved towards the summit in hope of finding more active venting. At the summit (approx 370m) we saw a number of large - 2+m high - pinnacles (old chimneys?) from the bases of which venting is taking place, marked by white/yellow slashes on the pinnacle sides. Unfortunately, the pinnacles are strewn with old fishing lines (like a cobweb). The entanglement hazard was sufficient to make sampling these vents too dangerous to even consider. Moved downslope towards the northwest. At 379 meters we found white patches and shimmering venting from cracks beneath the rocks, cracks coated in white (bacteria?) and yellow (sulphur?). Vent fauna was characterized by alvinocarid shrimp (*Alvinocaris niwa*?) nearest to the vent, and then 50 centimeters away G. gladius, small white anemones, and a gastropod (brown banded) whelk-like predator. Sampled vent fluids. Temp=39.7° C. This vent site also had fishing lines present. We moved downslope (southwards) encountering small patches of mussels and the red seastar. Once we reached the 452 meter contour, Marker 16 was placed (to act as future guide upslope to venting just beneath summit). Began to circumnavigate (anticlockwise) the cone along the 452m contour (below fishing line hazards but at depth which diffuse venting occurs - judging by occurrence of mussels at Marker 15) to explore the reminder of the cone. Encountered a yellow/brown patch of bacteria and crust, sampled some of this material and fluid where it was coming out of the cracks (Temp=22°C). We passed Marker 15 (and noted that the mussel bed in that area is about 20 meters wide). Thereafter the substrate was of dark sediment (talus), which is densely populated, with small white anemones (indicative of diffuse venting?) but not much other benthic fauna. On the north side of the cone we came across another mussel bed - but here there were no *Rumbleaster*, rather the main predator appears to be a gastropod (*Fusitriton*?), also there are numerous small orange seastars. The mussel bed is similar in dimensions to the one at Marker 15. Also on the north side of the cone we encountered a fresh looking band (20m) of lava pillows. The pillows have anemones on them, including a large white/purple species. Numerous fish (roughy and alfonsino?) were also associated with the pillows. On the remainder of the track along the 45 2 meter contour the pattern is repeated: dark sediment sparse fauna (though in some places masses of small white anemones) with patches of yellow/brown bacteria/crust, sometimes smaller white patches. Arrived back at Marker 16 at 15:24 to complete the dive. Left the bottom at 15:31.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV 624 Rumble V - Observations
		36°S	**178°E**	
8:52	651	8.546	12.169	On bottom - landed SE of WP1 - dark sediment - move off to NE.
9:00	650			Rattail (*Coelorinchus aspercephalus*?).

Time	Z	Lat	Long	Dive Log PV 624 Rumble V - Observations
9:03				Begin to see sea pens (1m tall) 2m or so separation. Dark sediment. Fish (juv roughy, rattail), hermit crabs.
9:08				Bellowfish (*Centriscops obliquus?*).
9:11	596			Begin to see signs of sediment alteration - yellow patches of bacteria?
9:13				Short arm seastar, *Munidopsis*, urchin, anemones.
9:14	583			Patch of alteration, yellow bacteria? crust, strikes upslope.
9:15				Move off contour. Yellow patch back to dark sediment (which does still have very small patches of yellow), some sea pens, rattails, gastropods (on small rocks), hermits, scorpian fish.
9:16	561			Strike of yellow crust upslope at 285 deg. Seastar, hermit crabs nearby.
9:19				Small (3-5 cm) white regular urchins, other spp. of urchin too, gastropod (*Fustriton?*), hermit, bluenose (*Hyperglyphe antarctica*).
9:20	549			Temp taken (12° C) in small yellow patch.
9:23				Lots of small, white urchins on a ridge running NW 293 deg (like "Milky Way"). Moving up ridge line. *Dermechinus*, seastar, hermits, *Munidopsis*. Dark sediment with patches of yellow.
9:27				Cross trail of yellow - looks unnatural - our old sled tracks? Breaking through crust.
9:30	519			4 x large *Anthomastus.*
9:34	511			Moving upslope over dark sediment still with small white urchins, but with some crusts in parallel arrangement at 311 deg.
9:35				School of bluenose.
9:37	502			Altered bottom, patches of yellow and crust edges. Anemones on rocks, ophiuroids, rattails where away from yellow patches.
9:40	497	8.380	12.000	Stop to get position, are just north of WP1.
9:51	497	8.380	12.000	**PV-624-1B** (Sample 1). Gastropods (*Fusitriton*?) feeding on dead crab, 6 large (30cm) polychaetes are moving in to feed. Sampled large polychaete feeding on dead crab.
9:53				Move upslope, see altered bottom, quite large patches.
9:55				Start encountering talus field, anemones, stylasterids, anthomastus, small white urchins. Moving off to west.
9:58	473			Start to encounter dead *Gigantidas gladius* shells on surface. Small orange seastar.
10:04	457			Mix of dead and some live *G. gladius* (some dead insitu), other dead tend to align up/down slope (think this is area identified by TAN0107 photo survey).
10:09	452	8.432	11.863	MKR-15 placed. Essentially last position of dive 622.
10:12				Move upslope over mostly live mussels, though still plenty of dead. White fluff? On some surface Hydroids?
10:14	436			Start to encounter *Rumbleaster* feeding on mussels, masses of small white anemones over surface of mussels.
10:22	430			Still moving up slope, now live mussels more common than dead, gastropods, *Rumbleaste.*
10:25				Stargazer (mottled).
10:28	413			White patches on ridge edge - shimmering, masses of small anemones cover almost all surface of ridge. Small gastropod, same as sampled on previous dive (brown band). Move then up ridge towards summit hoping for more obvious venting.
10:30				Encounter pinnacles (old chimneys?) at peak - these have many ropes across them like a cobweb. Pinnacles covered with anemones. Among pinnacles are white patches of white deposits - presumably venting.
10:34	376			See white cracks in pins where venting taking places. Dead *G. gladius*, not possible to see if live mussels in white area because sub moving to avoid entanglement.
10:38				3 Hapuku.
10:40	380	8.362	11.744	Landed just NW of pinnacle summit to get position. Surface covered with small white anemones.
				Tape 1 ends.
10:55				A collection of small venting sites seen.

Time	Z	Lat	Long	Dive Log PV 624 Rumble V - Observations
10:57	379	8.362	11.744	**PV-624-2-B** (Sample 2). Sampled *Gigantidas gladius* mussels. T=39.7C. Less than 10m from previous position. Active vent. T=39.7 C. 100's of alvinocarid shrimp at centre of vent where there is white, and some yellow colour too. Then sharp boundary where no shrimp but *G. gladius mussels* occur.
11:05	379	8.362	11.744	**PV-624-3-SS1** (Sample 3). Suction of vent shrimps (?*Alvinocaris niwa*).
11:06	379	8.362	11.744	**PV-624-4-SS2** (Sample 4). Suction of vent shrimps (?*Alvinocaris niwa*).
11:07	379	8.362	11.744	**PV-624-5-R** (Sample 5). Sampled white/yellow rock from vent.
11:12	379	8.362	11.744	**PV-624-6-MS-yellow** (Sample 6). Fluid sample (MS yellow).
11:15	379	8.362	11.744	**PV-624-7-GT-yellow** (Sample 7). Gas tight sample (GT yellow).
11:24	384	8.362	11.744	Move off downslope SW, encounter diffuse venting, large white patch.
11:34	390	8.378	11.733	**PV-624-8-MIN** (Sample 8). White sediment, gastropod, small white limpets in scoop sample. T=25.7° C. Lots of small white limpets on surface of white patch. Sample captures gastropod seen feeding earlier on mussels, also limpet sampled.
11:40	390	8.378	11.733	**PV-624-9-R-B** (Sample 9). Sampled rock with white covering and small white limpets.
11.46				Small patches of young? *G. gladius* on white patch. Also shrimp and brown banded gastropod.
11:57				Larger patches of young mussels seen.
11:58	399			Talus with mussels and *Rumbleaster.*
12:05	414	8.394	11.733	In shallow depression with yellow/brown crusts, small white anemones.
12:09	414	8.394	11.733	**PV-624-10-MIN** (Sample 10). Scoop of red/yellow crust and an anemone.
12:12	414	8.394	11.733	**PV-624-11-R** (Sample 11). Sampled brown rock with anemone.
12:14	414	8.394	11.733	**PV-624-12-SS** (Sample 12). Suction sample of crustal material and small orange seastar taken.
12:16	414	8.394	11.733	**PV-624-13-SS** (Sample 13). Suction sample of crustal material and small orange seastar taken.
12:18				Move down slope in S to get to 452 m contour - depth where previously found mussels.
12:28	452	8.445	11.729	Tallus, gastropod, small, white anemones. Put out MKR-16, then begin to circumnavigate the volcano at 452 m contour going anti-clockwise (Marker is immediately downslope of vents).
12:31	452	8.445	11.729	**PV-624-14-B-R** (Sample 14). Sampled 2 brown/black rocks, hydroids, small anemone at Mkr 16.
12:42	453	8.449	11.723	Encounter patch of altered substrate, mottled colour, and tiny yellowish filamentous chimneys. No obvious macrofauna. Temp=21° C.
12:49	453	9.449	11.723	**PV-624-15-SS** (Sample 15). Suction sample of small yellow/white chimneys (4 cm), filamentous bacteria and brown crust.
12:54	454	10.449	11.723	Just to side of small chimney area encounter small patch of brown with shimmering vent at crack at base of rock with white filamentous material on edge of crack.
				End of Tape 2.
13:03	454	10.449	11.723	Temp 22°C.
13:09	454	10.449	11.723	**PV-624-16-MS-blue** (Sample 16). Fluid (MS blue) sample at vent. T=22.0°C.
				Move off eastwards along 452m contour.
13:17	451			Talus, some dead mussel shells, some white patches.
13:20				White patches, dead *G. gladius*, dark fluffy covering on rocks.
13:23	451			See MKR-15 - *G. gladius* mostly live (seems this bed is about 20 m across, vertical extent unknown?), small orange seastars.
13:25	451			Continue to circum cone northeastwards along contour 452 m, mussel bed ends just after MKR-15.
13:27				Dead *G. gladius*, small orange seastar, gastropods sparsely distributed on extensive dark sediment some small rocks, bluenose.
13:32	452			Lots of small white anemones in dark substrate otherwise quite 'barren' of fauna.
13:36	452			Some sort of morwong?
13:38	452			See large gastropod covered in anemones, similar looking anemones in substrate all around.
13:40	452	8.293	11.784	**PV-624-17-B** (Sample 17). Sampled large, turban-shaped gastropod.

Time	Z	Lat	Long	Dive Log PV 624 Rumble V - Observations
13:44				Yellow patch encountered.
13:46	452			Find bed of live *G. gladius* mussel on the north side of cone (think this might line up with bed found on TAN0107), gastropods.
13:51	448	8.288	11.75	**PV-624-18-B** (Sample 18). Sampled clump of large *Gigantidas gladius* in area of diffuse venting. T=12.6° C.
13:58				Mussel bed continues - must be in diffuse venting, densely packed mussels, gastropod (*Fusitriton*?) as predator here? Small orange seastar, NO *Rumbleaster.*
				Move off bed after few 10s of metres - but no time on video to mark edge. NO TIME STAMP FROM 1358 – 1414.
				Pillow lava with large (10cm) white anemones with purple tentacles [still no time stamp on video].
14:06	453	8.293	11.707	**PV-624-19-B-R** (Sample 19). Sampled lava pillow rock fragment, large white/purple anemones, gastropod (*Fustriton*?).
14:18	453	8.293	11.707	Pillow lavas fresh looking, few metres high and extending up slope. Can't see how far extend down slope. Small anemones as well (good close up shots), urchins, lots of fish associated with this feature - roughys and alfonsino? And one morwong? moving among cracks (good footage of latter).
14:20	453			Move off pillow lavas - so only 10 or so metres wide.
14:25	453			Paler sediment patches just off lava then back to dark sediment and dead *G. gladius.* White urchins within long thin spines.
14:28				Barren substrate with isolated rocks on which groups of anemones (yellow/white) gather. Some gastropods (*Fusitriton*?).
14:29	453			Paler sediment, orange crust.
14:32	453	8.275	11.707	**PV-624-20-SS** (Sample 20). Suction sample brown crust, small orange starfish. Now at NW position on cone.
14:37				Rock with 10s of *Dermechinus* urchins and nearby stone with very yellow anemones, also small, orange seastars and gastropods, bluenose.
14:41				Move off SW over dark sediment.
14:43	452			Crusty sediment, biscuits of crust, then back to dark sediment with the odd dead mussel shell, quite a lot of *Munidopsis* all facing the same direction (angled downslope).
14:45				Dark sediment continues, large ophiuoids (bit like snake legs), urchins with fine spines, orange seastar, small white urchins too, hermits with anemones.
14:48				Fish with modified pelvic fins that look like a number of 'feelers'.
14:53	433	8.343	11.594	**PV-624-21-B** (Sample 21). Sampled large spiny crab (not well - missing two legs).Spiny crab has stalk barnacles on carapace. Now at Western side of cone.
				End of Tape 3.
14:58		8.343	11.594	Bluenose.
15:00	449			Moving off SE on contour 452 m.
15:03				Encounter altered surface, yellow, brown crusts, bit jelly looking in places.
15:05				Mussel debris, rattails, sm. white urchins.
15:06				Back to brownish crusts.
15:07	452			Yellow/brown patch of bumpy surface - bacteria over tallus? At least 10 m in all directions around position. Few dead mussel shells, presumably washed down slope, couple of small live urchins.
15:10	452	8.424	11.696	**PV-624-22-SS** (Sample 22). Suction sampled yellow 'bumps' of bacteria from substrate in area of diffuse venting. T=27.5° C.
15.17				Moving off eastwards towards MKR-16.
15:19	452			Dark sediment with few dead mussel shells, small white urchins, small orange seastars, gastropods (*Fustriton*?).
15:24	452			Return to MKR-16 - Circum cone complete. End of dive

8.14 PV-625 Healy Dive Log

Location: Healy Volcano, SE caldera cones area
Latitude: *Begin* 34° 59.544'S**, Longitude:** 179° 00.742'E
Mission Date: May 1, 2005
Bottom Time: 6 hours 28 minutes (6.466 hours)
Maximum Depth (m): 1483
Observer 1: Gary J. Massoth
Pilot 1: Terry Kerby
Pilot 2: Steve Price

Objectives:
(1) Explore 4 cones trending SW 1430 meters from landing point to locate source of 1405 ±50 meter depth plume.
(2) Sample hydrothermal fluids, macro- and micro-fauna, and deposits.

Observations, findings, etc: (Also see Appended Dive Log)
Started dive at 1389 meters in the saddle between the east and west summit pits of NW (#1) cone. Observed ubiquitous covering of FeOOH-Si deposits overlying black 'basaltic-looking' sand/ash. No lava outcrops or talus was in view. Proceeded to E pit (<50 meters diameter, 13 meters deep) where a thicker (half-meter or greater) blanket of FeOOH-type sediments was punctuated by up to meter-high chimneys of the same material. Also, many intricate smaller chimneys of varying morphologies were observed, many with intact flow orifices. Although the temperature probe registered up to 15.9º C compared to 4º C ambient temperature, no schlieren was observed here, or at the larger W pit (30 m by 60 m oval, 19 m deep), which was relatively devoid of the chimney structures. The full extent of the outer slope of this cone was coated in FeOOH with occasional outbreaks of coarse-grained black sands and even rarer basalt outcrops. Hundreds of 'flocaberries' up to several centimeters in diameter were observed cascading down this slope, with accumulations in low pockets. The slope of the adjacent pit (#2) was bare, black sand to within a few meters of the summit where the FeOOH sediments again became thick. Schlieren marked a 20-meter band of diffuse discharge on the NW rim (Mkr 19). A circumnavigation of this rim located a second, small region of discharge on the WNW rim sector. No venting was observed within the 4-m deep, 40-m diameter. pit - other than on the inner upper NW wall adjacent to Mkr 19, which was too diffuse to sample, with overlying FeOOH deposits approaching 1 meter in depth. Where vent fluids were collected from the outer rim region at Mkr 19, the fluid temperature was 33.9º C. The next cone (#3) was similar, although smaller in dimension. Here, venting through FeOOH sediments was again observed, at temperatures up to 28.4º C. The fourth cone in this sequence was not explored due to time constraints. The FeOOH sediments in most areas were dark orange overlain by a lighter yellow filamentous-looking covering. A large squid was observed enroute to pit #3 but no sessile macro fauna. Fish were observed, but rare. The consistent venting depths (1373±10 m) plus the persistent plume visible near the cone summits provide strong evidence that these sites are the source of the plume mapped by CTD tows during previous expeditions.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-625 Healy - Observations
		34°S	**179°E**	
		59.345	00.898	Landing Target at 1460 m depth.
08:14				Dive, Dive, Dive (on deck go-ahead, depth 1382 m).
08:20				*Pisces V* in water.
08:24				"Clear to Dive".
08:25				"Tower Awash".
09:23	1389	59.544	00.742	On bottom, ~500 m SW of drop target on Fe00H-Si ppt. almost completely covering coarse black basalt sand. Natural collapse of old and weathered thin (< 1 cm thick) Fe crust exposes black sands in spotty pattern. Sonar and position info indicate we are in between two peaks on a saddle atop the first cone (#1) target. We plan to look at eastern peak first, then western, larger peak. Ambient T is 3.9º C.
09:39	1389	59.544	00.742	**PV-625-1-MIN** (Sample 1). Scoop #5, <1 cm thick FeOOH-Si crust and black sand (ash).

Time	Z	Lat	Long	Dive Log PV-625 Healy - Observations
09:46	1389			Start ~180 m trek to east up 45º slope of eastern cone. Note soon that we are getting deeper rather than shallower, going into a pit, not up a peak. Also note that visibility is clearly decreased and within a definite hydrothermal plume as pass 1406 meters. Same large pieces of orange-colored floc in water column.
09:52	1413			4 MAB, peak 30 meters ahead.
09:57	1430			First sighting of 'flocaberries' FeOOH floc rounded, rolling and collecting in depressions.
10:03	1440	59.642	00.837	In line with ripples running E-W (064º). Very thin FeOOH covering black sands. Some talus debris. Decide to head WNW back to main peak (330 m/310º). No sessile biology, see one small black fish and large aristoma shrimp. As start going up hill FeOOH becomes dominant.
10:11	1391			º322 heading over 95% black sand; as rise move into sharp gradient of thick FeOOH cover, much thicker, create storm when land.
10:19	1391	59.563	00.831	**PV-625-2-SS** (Sample 2). Suction sample of 25-30 cm thick FeOOH-Si old and weathered crust (T=15.9ºC in sediments). At first exposure as climb cone.
10:26				Base of steep, rocky slope with some talus in view but mostly a full covering of thick FeOOH sediments. Starting to see some small nontronite chimneys. Old crust, cracked in view. Good view of chimneys and sediments. Note that the small chimneys have flow holes at top.
10:29				Single shrimp on top of FeOOH sediments.
10:32	1374			200 m/280º to cone summit. On ridge of pit crater with sharp drop-off to pit (13 m deep, 50 m diameter).
10:37	1389			At Iron City. Fine sculptured chimneys, all different morphologies, finger-diameter on large basal structure.
10:45	1394	59.524	00.778	At bottom of pit: 50 m diameter, 20 m deep. Many lattice-like nontronite chimneys. Realize still on eastern edge of W cone, need to continue to the west to explore this cone more fully.
10:50				1 meter tall nontronite chimney. Decide to drive thru to see if solid or all fluff. Landed in deep fluff. Chimney all fluff.
10:54				Chimney Village within the first and smaller of two joined pits on west cone summit. Work around the pit in video survey, temp is 4.9º C at bottom, 5.5º C at rim. GOOD VIDEO HIGHLIGHT.
11:03				At base of pit, wave forms (E-W) on black sand, much different than adjacent pit, here pretty much devoid of FeOOH sediments.
11:09	1356			Transition from black sand to light coating of FeOOH; 230º/50 meters to WP2 and see we are entering yet another pit: 60 m by 30 m oval 19 m deep, rimmed by FeOOH sediments.
11:16	1375			At base of pit covered by Fe floc.
11:23				On ridge rim of pit and climbing NW to summit, totally covered in FeOOH. Small back flow holes punctuate the flat sediment cover. END TAPE 1.
11:28	1345	59.508	00.639	At summit of W cone (#1); totally devoid of macrofauna (Terry comments he saw a hydrolagus). In visible plume at summit. FeOOH covered (some lighter FeOOH floc) along full rim. 650 m/210º to WP3 (Cone #2).
11:42				Underway for WP3 after brief stop for lunch.
11:51				On down slope of Cone #1, steep with hundreds of flocaberries running downhill - an impressive Fe flux. Full outer slope is Fe sed covered. GOOD VIDEO HIGHLIGHT (see close-up of rolling berries!)
11:57				At base of cone see still a THICK blanket of FeOOH suggesting a huge flux here of Fe.
11:59				Attempt to settle onto bottom but sink in Fe sediments up to bumper bar without bottoming out. The entire basal area of the cone is fluxing and collecting Fe. GOOD VIDEO.
12:04	1461			300 m/210º to WP3. Observe turbidity flow from our trail roiling downhill to our port.
12:08	1483	59.692	00.509	GOOD VIDEO of basket driving thru the Fe sediments at base between the cones. This could be the source of the deeper plume.
12:15	1483	59.692	00.509	**PV-625-3-SS** (Sample 3) Suction sample of FeOOH-Si sediments mid-way between cones 1 & 2 (T=8.7°C).
12:22				As start climbing the second cone transition from Fe sediments to winnowed black sands with wave crests running up/down slope. See white shells, small gastropods? Shrimp seen, sand is barren of all life or floc. Many small rat tail fish seen congregating. Slope is ash covered and smooth without any lava rock.

Time	Z	Lat	Long	Dive Log PV-625 Healy - Observations
12:30				As approach the very summit enter more turbid water and also transition into FeOOH sediments with some rock outcrops. Almost immediately enter a large chimney field of nontronite spires, some on the meter-scale, others smaller and thin. Most of this area has clear shimmering water coming thru the Fe-Si chimneys.
12:31	1373	59.784	00.435	On summit pit crater rim with chimneys and shimmering water. Tmax = 33.9ºC emerging thru thick blanket of FeOOH sediments. Position is 60 meters from WP 3, as we are on the NE rim of the summit pit.
12:41	1373	59.784	00.435	**PV-625-5-MS Yellow** (Sample 5). Fluid sample (MS Yellow). T=33.9ºC in sediments. NE rim of Cone #2. Taken in max flow stream, just above black sediments.
12:53				Marker 19 deployed.
12:54	1373	59.784	00.435	**PV-625-4-MIN-Sc#4** (Sample 4). Scoop sample #4, FeOOH-Si that hot water was flowing thru (Mkr #19).
13:03	1373			Starting to move clockwise around rim.
13:06	1366			Single shrimp in water over pit ridge. Large sections of crust collapsed in on itself. See many chimneys in pit. No venting locally. Rim is narrow and steep sided, especially on inside. Sheer wall in places. Heading 283º.
13:10				Some schlieren from small chimneys.
13:13	1373	59.816	00.408	Stop at FeOOH chimneys with fluted, holed, and dark fibrous material. GREAT video. Temp = 21.3ºC coming thru the fibrous mat.
13:19	1373	59.816	00.408	**PV-625-6-MIN-Sc** (Sample 6). Scoop #1 of fibrous FeOOH-Si chimney matter.
13:25	1373	59.816	00.408	**PV-625-7-SS** (Sample 7). Suction sample of fibrous FeOOH-Si matter. Same fibrous, stringy, tamale paper-like material as scooped. END TAPE #2.
13:27				Tape #3 started at same site as above. Close to being back to Mkr 19, now on NW part of rim. Mkr 19 on N rim.
13:30				Entire rim floc structure collapses on basket and reveals bare black sand base with rock embedded.
13:34				GOOD VIDEO of exposed sand/rock section. Fluid flow is thru the entire sand pile, diffuse and sand reacted?
13:41	1372	59.816	0.408	**PV-625-8-R** (Sample 8). Rock (basaltic, vesicular) from within black sediments beneath FeOOH-Si matter. Temp in sand pile where rock came from is 22.5º C. (Rock fell out from exposed wall and was sampled).
13:47				Depart sampling site to continue around ridge to Mkr 19. Pit is 40 m in diameter and 14 m in depth.
13:51				Start to see small chimneys, and then see Mkr 19. Therefore, two areas of active discharge, both on the northern quadrant of the pit rim. See into pit, quite murky.
13:54	1373			Inside of Pit opposite Mkr 19. Thickly sedimented with FeOOH and active diffuse fluid flow. Exciting landing in deep sediments, above bumper bar.
13:56	1372			5 MAB and moving into pit.
13:59	1387			At base of pit. Many small finger chimney FeOOH spires, most with intact flow holes, but no apparent venting at base of pit.
14:02				See small rock outcrops as ascend north inside wall.
14:10	1373			Temp in FeOOH sediments: 35.8º C. Near Mkr 19, but inside part of wall.
14:24	1373	59.784	00.435	Collected three samples here at Mkr 19 outside rim (Samples 9,10,11). T=28.3º C. Sediments MUCH thinner (a veneer) compared to inside pit at same sector. All sampled in discrete flow site coming out of bared, coarse black sand.
14:30	1373	59.784	00.435	**PV-625-9-MS Blue** (Sample 9). Fluid sample (MS Blue). T=28.3º C in sediments at Mkr #19.
14:38	1373	59.784	00.435	**PV-625-10-GT Red** (Sample 10). Gas tight (Red). T=28.3º C in sediments at Mkr #19.
14:40	1373	59.784	00.435	**PV-625-11-GT Yellow** (Sample 11). Gas tight (Yellow). T=28.3º C in sediments at Mkr #19
14:47				Underway for WP4 (Cone#3) 360 m/209º.
14:51	1389			Land on many splendid small chimneys on steep slope of Cone #2 - chimneys as far as can see, contrary to upslope approach from N side.
15:00	1441			192 m/230º to WP4. Still see FeOOH sediments.
15:04				Climbing up black sand slope of 3rd cone, even more barren than coming up previous cone.

Time	Z	Lat	Long	Dive Log PV-625 Healy - Observations
15:05				Giant Squid (~> 1 m in length) sighted directly in front on slope of cone, feeding tentacle exposed, long and white. Shrimp. Ripples in sediments running 256º directly uphill. Wavelengths appear greater than on previous cone. Highly weathered outcrops occasionally seen.
15:15	1386			On NE rim of cone #3. Sediments with schlieren on top of ridge, thin layer starts right at top, about 1385 m. See fibrous deposit as on previous cone.
15:26	1384	59.952	00.313	Tmax = 28.4ºC. Three samples collected at this position (12,13,14).
15:28	1384	59.952	00.313	**PV-625-12-SS#4** (Sample 12). Suction sample #4 of white mat atop orange FeOOH-Si sediments.
15:29	1384	59.952	00.313	**PV-625-13-SS#5** (Sample 13). Suction sample #5 of white mat atop orange FeOOH-Si sediments.
15:301	1384	59.952	00.313	**PV-625-14-MS White** (Sample 14). Fluid sample (MS White) T=28.4ºC in sediments.
15:32				END OF TAPE #3, while MS sampling
15:51				Leave bottom.

8.15 PV-626 Brothers Dive Log

Location: Brothers Volcano, NW caldera wall site
Latitude: *Begin* 34° 51.778'S, **Longitude:** 179° 3.548'E
Mission Date: May 2, 2005
Bottom Time: 4 hrs 45 minutes (4.75 hours)
Maximum Depth (m): 1774
Observer: Bob Embley
Pilot 1: Terry Kerby
Pilot 2: Max Cremer

Objectives:
(1) Explore and map the northwest wall of the Brothers volcano, high temperature hydrothermal system and collect biology, microbiology, chemical and geologic samples.

Observations, findings, etc: (Also see Appended Dive Log)
Note: the CTD depth was reading up to 25 m shallower than the *Pisces V* depth gauge throughout the dive. This was using the "corrected" CTD depth used on previous dives (by adding 10 meters to the CTD).
The dive began on the lower part of the caldera wall at 1774 meters. The talus included many pieces of white, highly altered volcanic rock. Several samples of this were used as ballast and one was retained as a sample (PV-626-1-R). *Pisces* proceeded up the wall towards the vents. The second rock sample (PV-626-2-R) was an in-place piece of altered pillow lava from an outcrop of altered volcanics at a depth of 1729 meters. The first active hydrothermal activity was noted at 11:00 with the first occurrence of yellow-orange low temperature patches and small chimneys at a depth of 1691 meters. A suction sample of the oxide chimney was taken (PV-626-3-SS). After traversing a zone of active Fe venting the zone of high temperature sulfide chimneys was reached. The chimneys appeared to line up along an approximate E-W trend going directly upslope. *Pisces* descended to the maximum depth of the sulfide chimneys at about 1680 meters. A small inactive chimney (PV-626-4-Min) was taken here. The large chimney adjacent to the one sampled had a *Shinkai 6500* marker 4 next to its base. *Pisces* again ascended the slope and took water samples at two sites. The lower site was near the top of a chimney (PV-626-5-MS -blue) at 1644 m). The maximum temperature recorded was 260° C. The upper site was easier to sample and both a major (PV-626-6-MS-yellow) and a gas tight were taken (PV-626-7-GT-black). *Pisces* headed east to explore the eastern extent of the active area and came across another small chimney field at 13:45L in a water depth of 1647 meters. Samples of true crabs were taken here (PV-626-8-B and PV-626-9-SS). A traverse to the east encountered extensive areas of oxide venting between depths of 1620 and 1632 meters. A thruster problem limited the ability to maneuver in the rough terrain so the dive was terminated at 15:05.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
		34°S	**179°E**	
10:20:00	1781	51.778	3.548	Landed on bottom. Stirred up sediment cloud. Small outcrops and many large talus blocks. Many white altered rocks. Collect 3 of them for ballast, so they don't have to pump water out.
10:26:00				Near landing site.
10:33:00	1766			Picking up altered rocks for ballast.
10:33:00	1774	51.78'	3.59	**PV-626-1-R** (Sample 1). Picked up three white altered talus rocks for ballast (only kept one by end of the dive).
10:36:00	1753			Start upslope; steep - lots of mass-wasting, altered rocks.
10:36:30	1774			Hdg. 270; huge slab of white altered rocks.
10:37:00	1750			Slope steepens. Lots of broken white altered rocks.
10:38:10	1764			CTD (corrected with +10m) reads 1745 m!
	1755			CTD (Corr+10m) reads 1735!
10:38:00				Huge blocks of white altered rocks; mostly sand and gravel now. Steep slope, white rocks, pillows, talus, gravel streams, some outcrop.
10:40:20	1755			See feeding tentacles sticking out of sediment. CTD depth is 1726 m!
10:40:40	1749			Coming to vertical wall - 1728 is CTD depth (20 m shallower).

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
10:40:50	1728			Going up more vertical wall.
10:42:00	1749			1723 CTD depth.
10:42:30	1642			Stockwork?
10:42:50	1712			Stopping to look at alteration zone shallower than sub! Could be stockwork. 45 deg slope.
10:43:30	1736			198 deg heading. Some bacteria mat on rocks (probably not hydrothermal).
10:45:00				Seeing lots.
10:43:50				Moving up over stockwork zone.
10:45:30				Looking for sample site.
10:46:00				Stopping to look at sample site - spotted apparently.
10:46:45				At sample site. CTD depth is 1708 m
10:48:10	1729	51.79	3.50	**PV-626-2-R** (Sample 2). Wedge of altered basalt taken from intact pillow. CTD depth is 1708 m. Nice video of "buggered" pillow.
10:52:05				Putting sample into biobox.
10:55:00	1728			Sinking down slope a few meters.
10:55:25				Going up slope past sample location.
10:57:00				See in place outcrop sticking out from slope. Hesitating to look more closely. Could be hydrothermally cemented breccia.
10:58:15	1690			Looking at large structure, possibly cemented breccia.
10:59:00				Passed ridge of breccia sticking out, going right (north) along slope.
10:59:45				Stopping at active oxide chimneys; nice video.
11:01:05	1691			Moving up slope- seeing active oxide chimneys.
11:02:15	1715			1687 m CTD depth
11:03:45				Stopped to take a temperature at oxide chimney; 38.5° C coated with Mn.
11:04:45				Taking oxide slurp sample.
11:07:45	1715	51.778	3.52	**PV-626-3-SS** (Sample 3). Suction of yellow (oxide chimney (Jar #1). 1792 m CTD depth (corr. =10m). Moving off sample site. Mn coating oxide/silica.
11:09:15				Moving off sample site; Mn coating oxide/silica.
11:10:00				Still at sample spot (within a few m's). 1700 m NICE VIDEO OF SOME OF THESE OXIDE CHIMNEYS.
11:12:00				Going up slope over lots of large nontronite chimneys - poking through talus. These are actively venting diffuse fluids.
11:13:15				Hdg. 289 going upslope.
11:13:20	1679			Large nontronite chimney growing out of outcrop.
11:13:30				Big basalt pillar.
11:13:47				Nice video of large basalt pillar.
11:14:30				Looks like band of nontronite chimneys: band about 276 deg.
11:14:30				Stopping to look at band of active oxide chimneys in band about E-W. See pillow wall up ahead.
11:15:00	1673			Going up along band of chimneys.
	CTD			Chimneys growing right of talus and out of pillow outcrop.
11:15:30	1674			Looking for place to sample water in these active chimneys.
				NICE VIDEO OF CHIMNEYS.
				Wall looks basaltic and not very altered; perhaps some alteration.
				Sort of boundary.
				Between altered and unaltered rocks.
11:16:00				Maneuvering around looking at oxide field.
11:16:20	1696			At vertical outcrop of unaltered pillows. 1671 m CTD.
11:16:50				Looks like outcrops of dikes in vertical wall.
				Ridge has a westerly orientation. ~270.
				Really nice sequence of dikes dipping about 15 deg N.

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
11:18:30	1657			Going over wall.
				Beautiful exposure of dike complex (see cooling cracks perpendicular to dike's sides).
11:19:50				See beautiful spider-like creature go across video.
11:20:00	1646			Now seeing more rubble and more alteration again.
11:21:00	1668			Going up steep wall; 1650 CTD depth.
11:21:45				Near-vertical wall.
11:22:00	1639			Wall with dikes exposed.
11:23:00				Vertical wall - appears to be large spur, possibly dike.
11:23:30				Looks like two intersecting ridges; one E-W, other more N-S. -NEAT. Nice video of geology here.
11:24:15				More nontronite in between rocks. Seeing nontronite growing from spaces between rocks.
				Solid massive wall now.
11:25:00				Seeing smoke drifting around now.
11:25:45	1629			Very foggy, stopped to get a fix. 1616 m CTD.
11:27:00		51.77	3.445	Getting fix, very foggy; range and bearing to WP 2.
11:30:30				Moving ahead again to look for sulfide chimneys. Looking into space. 1643 m CTD. Dropped down off scarp to get to better see the sulfide chimneys.
11:37:10	1632			Heading (south?) along wall, seeing beautiful draped nontronite chimneys.
11:37:45	1666			Contouring westerly; 1642 m (CTD) on wall, now turning to east.
11:38:30	1658			Have come off wall going west; lots of nontronite.
11:39:10	1658			Turning to head back east? 1334 m CTD.
11:39:45	1659			Seeing large field of nontronite chimneys.
11:40:30				Looking at nontronite chimneys; much of it active. Looks like it was E-W. Nice video.
11:42:00				Lots of active nontronite chimneys on spur.
11:43:30				Out in space, can't see bottom.
11:44:15				Come across huge block standing up to form a spur.
11:46:30				More nontronite on steep wall.
11:47:20				Out in space.
11:48:05				Chimneys ahead.
				Chimneys going upslope in distinct bands. They are lined up in upslope direction.
				Stopped to get orientation.
11:49:30				1648 m - stopped.
				Nice video of chimney.
11:50:05	1662			Looking at chimney, stopped.
11:51:30		51.275	3.494	
11:52:30				See diffuse venting on sides of the chimney.
11:53:00				Seeing smokers below us as well; turning to go downslope.
11:53:30				Going downslope to get to base of chimneys; looking into space.
11:54:05				Still in space, but Terry sees *Shinkai* marker, has "0" on it - but can't read the number very well.
11:54:45				Starting to see more chimneys farther downslope.
11:55:20				Seeing chimney field. Some good video through here.
11:57:00				Backing downslope; 1634 CTD depth.
11:57:30				Coming around to starboard, not much to see right now.
11:59:30				Hdg. 270 - looking right up line.
11:59:45	1663			Seeing band going to west. 1639 m CTD (may not be good depth comparison).
12:01:15				Going downslope to the east to try and reach bottom of field.
12:02:00				Coming around to starboard to face west.
12:02:00	1666			See marker # 4 (*Shinkai*); can't see much on video.
12:03:25	1669			Still can't see much on video. 1645 m CTD.

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
12:04:10				Saw another spider-like floater.
12:04:20	1672			
12:05:00				Seeing chimneys now; begin nice video. These are oxide chimneys; facing south. So do nontronite chimneys go N-S?
12:05:50				Looking at bottom. Big slab of altered rock just right of nontronite chimneys.
12:06:20				On bottom to get position at nontronite chimneys.
	1680			At base of chimney field but sitting at nontronite area. Chimneys covered with manganese 1656 m CTD (24 m different).
12:09:45		51.786	3.492	Still sitting in same spot.
12:11:05				Nice video going up chimney; see other chimneys in background.
12:11:25				Nice view on video showing nontronite chimneys in foreground and sulfide chimneys in background (one has marker on it).
12:12:10				Seeing chimneys, one with marker 4. Beautiful video.
12:12:45				NICE VIDEO.
12:15:10	1679	51.39	3.49	**PV-626 4-MIN** (Sample 4). Small sulfide chimney at deepest end of chimney line. Just east of large chimney *Shinkai* sampled - Shinkai Mkr. #4.
12:19:45				Just finishing taking chimney sample END TAPE 1 of 3.
12:21:26				Still at chimney sample site.
12:22:00				Still at chimney sample site, discussing what to do.
12:23:20				Nice view of top of chimney with beehive structure.
12:25:00				Going up different chimney to get height. Bottom is at 1668, top is about 1663 (sub depth reading).
12:27:00				NICE VIDEO OF TOP. Now moving off to port.
				10 m off bottom.
	1661			Multi vent chimney, several meters up.
				Moving up chimney line.
12:30:00				See another one up ahead with beehive on it. Above it looking down.
12:30:15	1657			Top of chimney; venting on top, looking for a sample spot. 1633 CTD, so **CTD reads 24 meters shallower than the submarine depth**.
12:32:00				Accidentally knocked over top of chimney. Don't see anything else right here.
				See barnacles down below and ahead.
12:33:20				Seeing barnacles below, now enveloped in a silt cloud.
12:34:00	1655			Hdg. 281 deg.
12:34:30				In open space, not seeing bottom now.
12:38:20				See another chimney, turning; seeing lot of smoke in water.
12:39:00				Seeing chimney complex in video. NICE VIDEO.
12:39:25				Beautiful reddish-orange coloration on side of these chimneys! NICE VIDEO.
12:40:00				Coming up onto top of chimney; try to get sample. Lots of shrimp swarming around the chimney.
12:40:20				Maneuvering around chimney to get into sampling position.
12:43:20				In sampling position on top of chimney. Can see black smoke pouring out of top of chimney.
12:44:00				Taking temperature of vent; highest temperature was 265° C.
12:46:30		51.75	3.47	**PV-626-5-MS** (Sample 5). Fluid sample (MS Blue). 1621 m CTD depth. Fluid sample at top of large chimney. T=260° C. Difficult to tell how good sampler was in position. No GT because fear of dropping it.
12:47:45	1644	51.749	3.472	1621 m.
12:49:30				Nice video of top - water sampling.
12:54:40				Nice view with main camera looking down on to chimney with water streaming up the side of it.
13:00:00				Swung off the chimney, now looking at another chimney.
				Squat lobster.
13:02:00				Stopped on seafloor stowing major sampler. See some barnacles. 1629 m CTD depth.

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
13:03:30				Looking at barnacle colony.
13:04:10				Start moving again, to waypoint 3?
13:05:05				Barnacles on lower part of chimney; start moving to WP3.
13:05:40				Extensive barnacle colonies on wall, boulders or sulfides?
13:07:00				Old chimney stumps and seeing extensive barnacle colonies.
13:07:15				Moving upslope.
13:08:00	1615			1592 CTD depth.
13:09:00				Maneuver to find spot to sample water on another smoker.
				1593 CTD depth.
13:11:00	1616	51.75	3.43	**PV-626-6-MS** (Sample 6). Fluid sample (MS Yellow) Tmax=290°C Up on chimney sampling smoker.
13:29:30		51.75	3.43	**PV-626-7-GT.** Black Gas Tight sampler in vent fluid. Tmax=290°C. **Deployed Mkr 17.**
13:45:00				Another group of chimneys perched on steep wall.
13:45:10	1647			Looking at chimneys, going to get a fix. 1635 m CTD depth.
13:46		51.75	3.43	**PV-626-8-B** (Sample 8). Crab put into biobox, slightly crushed.
13:47		51.75	3.43	**PV-626-9-SS** (Sample 9). Crabs sucked into hose and held in holder. Small gastropods in Jars 2 and 3
13:47:00		51.699	3.582	Getting nice video of chimney with large scale worms on it.
13:48:00				Really nice VIDEO without the time on it.
13:58:00				Rising up.
13:59:00				Looking at large vertical wall. 16:09 CTD depth.
14:00:00				Wall covered with orange mat.
14:01:00				In plume. Can't see bottom anymore.
14:02:00	1620			On talus slope with orange mat.
14:03:00				Nontronite patches. Looks like giant grooves extending downslope.
14:05:31				WP 5, 170 m; Bearing 076 deg., in mid-water.
14:06:30				Seeing wall now, seeing nontronite, some of it is active, small chimneys. 1609 m CTD depth.
14:08:40				In thick plume now, went over ridge with nontronite. Seeing more now on the slope; heading generally E-SE.
14:09:17				See big blocky structure on wall to left, could be old sulfide.
				Now going into box canyon.
14:12:30	1628			1607 CTD depth; see big overhanging block.
14:14:00				Moving up the wall of blocky lava, doesn't look altered.
14:14:30				See patches of nontronite on this steep slope; lots of them appear to be actively venting. 1596 CTD depth.
14:15:20				See lots of patches of nontronite on a bench growing through sediment.
14:15:25	1612			1593 m.
14:15:50				Lots of patches of nontronite.
14:16:20				132 m at bearing 078 deg.
14:17:00				Going back into mid-water.
14:18:00				In mid-water.
14:23:30				Begin Tape 3 of 3. In mid-water.
14:26:00				See bottom again, getting fix. On 35 deg slope.
14:26:25				1592 CTD depth. Bottom is sedimented old talus; small nontronite chimneys?
14:26:30				Range 140 m; 093 deg bearing. Going to do contour-following now.
14:30:50				See bottom again, getting fix. On 35 deg slope.
14:31:00				See bottom again. Lots of small nontronite chimneys; looks like same slope as 14:26. 1603 m CTD depth.
14:31:45				Going upslope; in mid-water.
14:34:40				Lots of nontronite chimneys again on seafloor, pretty dense.

Time	Z	Lat	Long	Dive Log PV-626 - Brothers: Observations
				1595m CTD depth.
14:35:45				See headwall of very recent slide of sediments from this area. Very sharp contrast between exposed deeper stuff and overlying darker stuff.
14:36:00				Going upslope - can see bottom but pretty dark.
14:37:30				Looking at sedimented slope.
14:40:00				Lots of sediment, maybe some nontronite, but pretty far away.
				Have been moving S-SSE.
14:40:30				Looking at sedimented slope.
	1565			Trying to settle down for position, near gnarly outcrop.
14:54:45				Have backing down slope, thruster stuck so can't point... all the way up.
14:59:00	1632	51.637	3.634	Approaching cliff with nontronite on it. Getting position.
				1621m CTD depth.
15:01:45				Leaving ledge to go back downslope.
15:04:00				Going downslope backward (thruster can't rotate fully).
15:05:00				Have left bottom; END DIVE PV-626

8.16 PV-627 Healy Dive Log

Location: Healy Volcano, southern wall of caldera and south crater
Latitude: *Begin* 34° 59.637'S**, Longitude:** 178° 59.797'E
Mission Date: May 3, 2005
Bottom Time: 5 hours 11 minutes (5.183 hours)
Maximum Depth (m): 1527
Observer: Ian Wright
Pilot 1: Terry Kirby
Pilot 2: Colin Wollerman

Objectives:
(1) Explore the southern wall of the Healy caldera for hydrothermal venting.
(2) Map and sample the caldera wall.
(3) Explore crestal cone for hydrothermal venting floor.

Observations, findings, etc: (Also see Appended Dive Log)
The lower southern wall (below ~1350 m) of Healy Caldera comprises pumice talus with very rare encrusting epifauna. A single outcrop shows evidence of older hydrothermal alteration and breccia deposition. On the upper wall (above ~1350 m) pumice talus is increasingly winnowed and partially covered with rippled sand. Above 1300 m rippled sand is dominant. Above ~1150 m the flanks of the Healy cone are covered with Fe-crusts and small Fe chimneys. Diffuse venting is recorded at 1140 m with T=20.1° C. Along the eastern and southern Healy crater rim diffuse venting, with chimneys, crusts, and bacterial floc is pervasive. The northern and western rims are dominated by rippled sand. The upper crater wall consists of extensive areas of diffusively venting Fe chimneys, bacterial mat, and associated crusts. The lower crater wall has precipitous outcrops 10-20 m in height and mostly covered in Fe crust. The crater pit comprises old Fe-crusts and a few dead small Fe chimneys. There is no sign of active venting on the crater floor.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-627 Healy - Observations
		34°S	178°E	
9:46				Seafloor sighted; talus slopes.
9:48	1527	59.637	59.797	Landed on seafloor, base of southern wall; main Healy caldera.
9:48				On bottom. Pumice talus covered with veneer of silty Fe detritus.
9:50				Silt cloud dispersing.
9:58				Trimming sub buoyancy with ballast rocks.
10:04				Fine pumice talus with silty veneer; no epifauna.
10:07				Trimming sub buoyancy.
10:08				Bioturbation trails on silt veneer.
10:11	1505			Moving upslope due south.
10:12				Pumiceous talus ranging in size from sand to < 1 m blocks.
10:13				Holothurian.
10:14				Mix of coarse blocky pumice talus and fine lapilli.
10:15				Fish.
10:16				Pumiceous talus with no epifauna.
10:17	1477			Large blocks + ?in situ outcrop with small white staining.
10:18				Bioturbation mounds in pumiceous sand.
10:19				Extensive pumiceous talus.
10:20	1500			Pumice blocks with woody fabrics; blocks up to 5 m in length.
10:24				1-2 m high scarps orientated SW-NE.
10:27				Pumiceous talus.
10:29				Pumice "lapilli".
10:34				Pumiceous talus with no epifauna.

Time	Z	Lat	Long	Dive Log PV-627 Healy - Observations
10:36				?Old altered 15 cm thick crust overlying black breccia unit.
10:42	1410	59.834	59.618	**PV-627-1-MIN** (Sample 1). Sampling altered crust. Old, pale alteration ~15 cm thick crust overlying black breccia. Scoop # 1.
10:47		59.834	59.618	**PV-627-2-R** (Sample 2). Sampling basaltic(?) rock from black breccia.
10:51				Pumiceous talus.
10:53				Pumiceous talus with localised black sand veneer.
10:55	1336			Pumiceous talus + localised shell detritus.
10:58				Moving SE along slope.
11:04				Pumiceous talus but localised fines current-winnowed.
11:05	1330			Poor visibility.
11:07				Finer pumiceous talus; anemone.
11:08	1324			Still moving ESE.
11:09				Current swept pumice talus.
11:12	1321	59.952	59.848	Position; now moving WSW.
11:15				Gorgonian coral.
11:19				Now moving upslope in SW direction.
11:20				Rippled sediment; ripples strike 189° with flow W®E.
11:21				?In situ outcrop.
11:22				Rippled sediment surrounding displaced blocks.
11:24	1276			Rippled sediment overlying old Fe-crust / crust fragments.
11:25				"Hydroid" on rock.
11:27				Rippled black sand + blocks; Fe crust fragments.
11:30	1262			
11:34	1295	0.014	59.534	"Hyroid" on rock; dominant but sparse epibenthic fauna.
11:34	1295	0.014	59.534	**PV-627-3-B** (Sample 3). Hydroid (?) on rock sampled.
11:37				Gorgonian coral with anemone.
11:38	1256			Squid.
11:39				Rippled black sand with blocks; slight increase in epifauna.
11:41				Rippled black sand.
11:44	1232			
11:45				Rippled sands, sour around blocks; shell fragments in ripple troughs.
11:46	1219			Tape change.
11:48	1216			
11:51				Rippled black sand with crust fragments in troughs.
11:55				Sand veneer covers Fe crust.
11:59	1166	0.204	59.757	**PV-627-4-MIN,** (Sample 4). Older Fe crust on outer flank sampled in scoop # 4.
12:12				Moving again upslope on to Healy cone.
12:13	1156			Fe-crust broken into plate with more recent venting along cracks.
12:16	1152			Partially buried "nontronite" chimneys.
12:17				Increasing number and size of Fe-chimneys.
12:24	1140	0.243	59.507	Actively venting Fe chimney, T=20.1 °C.
12:27				**PV-627-5-SS** (Sample 5). Suction sample of Fe chimney and mat from diffuse active vent into jar #1. T=20.1°C.
12:29				Moving upslope of Healy cone.
12:30				Dispersed field of partially buried nontronite chimneys.
12:34	1118			Reached crater rim of Healy cone.
12:36	1119	0.272	59.445	Marker 18 deployed.
12:42				Actively venting Fe chimney, T=22.2° C.
12:46				Moving anti-clockwise around crater rim.
12:48				Lines of nontronite chimneys parallel with rim.

Time	Z	Lat	Long	Dive Log PV-627 Healy - Observations
12:50				Log of wood.
12:51	1118			Diffuse venting from nontronite, concentric with rim; bacterial mats.
12:54	1114			
12:56				Current swept nontronite chimneys, planed off; bacterial mat winnowed.
12:59				Moving to the west.
13:02				Rippled black sand with chimney remnants.
13:05	1105			Rippled sands.
13:08	1103			Poor visibility; rugged lava flows.
13:10	1104	0.329	59.203	**PV-627-6-B** (Sample 6). Hermit crab with anemone sampled.
13:15				Still moving around crater rim.
13:17				?Congre eel.
13:19				Rippled sands; altered Fe crust and nontronite / bacterial mats at rim edge.
13:24	1101			Rippled sands; moving east on southern rim.
13:25				Plates of disrupted alteration crusts overlying black sand.
13:28				Lines of nontronite chimneys with partial rippled sand cover.
13:40	1117			Extensive field of Fe chimneys and associated bacterial mat.
13:44				Fe alteration crusts and chimneys.
13:44	1125			Squid and sting-ray.
13:47	1121	0.480	59.450	Squid.
13:52				Current swept Fe-crusts and small chimneys on rim.
13:54	1119			
13:55	1121			Lines of small Fe chimneys and bacterial mat?
13:56				Holothurians arrayed on seafloor.
13:57	1121			**PV-627-7-SS** (Sample 7). Holothurian sampled into jar #2. [Position 50 m west of last position]
14:00				Balls of bacterial floc rolling downslope.
14:03				Small Fe chimneys and altered crust.
14:06				Now moving due north.
14:12				Disrupted and broken Fe crusts.
14:13	1105	0.426	59.318	Position on southern crater rim.
14:15				Moving into crater pit down south wall.
14:18				Upper part of wall comprises altered and mostly inactive Fe chimneys and crusts.
14:22				Precipitous slope on lower wall. Ropey flows and massive outcrop.
14:24				Squid.
14:24				Altered? Fe crust on outcrop.
14:26				Precipitous outcrop on lower wall.
14:28	1177			
14:32				Crab.
14:32	1179			Centre of crater; old altered Fe crust.
14:38	1179	0.350	59.380	**PV-627-8-MIN** (Sample 8). Sample of Fe crust from crater floor into scoop #5.
14:25	1047	0.350	59.380	Centre of pit; position.
14:45				Leaving crater pit for crater rim.
14:48				Altered crust sloughing off caldera walls.
14:49				Fe chimneys on upper wall.
14:50	1128			
14:51	1128			Diffuse venting from Fe chimneys.
14:52	1122			Small Fe chimneys with partial veneer of rippled sand.
14:52				Back on crater pit rim; floc covered talus.
14:54				Extensive area of diffuse venting; Fe chimneys and bacterial mat.
14:55				Back at Marker 18 on crater rim.

Time	Z	Lat	Long	Dive Log PV-627 Healy - Observations
14:57	1119			Low power and dive terminated early.
14:59				*Pisces V* leaving the bottom.

8.17 PV-628 Brothers Dive Log

Location: Brothers Volcano, NW caldera wall site
Latitude: *Begin* 34°51.690'S, **Longitude:** 179°03.679'E
Mission Date: May 8, 2005
Bottom Time: 1 hour 33 mins (1.55 hours)
Maximum Depth (m): 1,692
Observer: Cornel de Ronde
Pilot 1: Terry Kirby
Pilot 2: Steve Price

Objectives:
(1) Locate and sample the massive sulfide 'wall' discovered during the last *Shinkai* dive on the NW caldera wall.
(2) Sample with major and gas tight one vent.
(3) Sample mussels (especially) and tube worms.
(4) Move to rim of caldera, if time, and try and locate ancient, partially buried massive sulfide field seen during 1998 R/V *Sonne* camera tows.

Observations, findings, etc:
Landed ~400 m E of massive sulfide wall. Landing point was area of talus with abundant altered rocks and pieces of massive sulfide crust (sampled). Diffuse venting here ~23° C. Upslope by only ~10-15 m was new site of active black smoker chimneys up to 4 m tall. Several chimneys here and many dead ones that had fallen over. Did not sample due to lack to time (see below). Moved generally to W. Numerous vertical walls of massive lava, locally highly altered. Several 'shutes' of talus, commonly with highly altered rock. At one point saw very white sandy material (broken down altered dacite) that was covered with fine-grained pyrite such that it sparkled with the flood light on it. Further W discovered small field of chimneys, all dead, but up to 7 m tall. Sampled a small chimney. Did not locate the wall of massive sulfide as described by the Japanese, but feel we were close when dive ended.

Limitations, failures, or operational problems noted:
No dive was intended/planned for this day as was dedicated to recovery of hydrophone moorings. But latter were recovered much quicker than anticipated so a decision to dive was made. But this meant that the dive would be short, due to the late launch of the sub (in the water at 1:00 PM) and the depth to the bottom (~1,700 m). Sony camera did not appear to pan as quickly as on previous dives.

Time is local. Depth in meters. *Pisces-V* dive log **positions have NOT been adjusted** to agree with edited navigation files.

Time	Z	Lat	Long	Dive Log PV-628 Brothers - Observations
		34°S	**179°E**	
14:47	1692	51.690	03.679	**PV-628-1R** (Sample 1). Landing point; talus slope with lots of bacterial mat rolling down the hill, fluffy Fe-silica material. Talus is very altered rock and also some massive sulfide crust/chimney(?) material; sampled two altered rocks (one volcaniclastic, one lava) and large piece of massive sulfide crust; diffuse venting in bacterial mat (T = 23.4°C).
15:00	1692	51.690	03.684	Moving off upslope over bacterial mats.
15:01:07				See first glimpse of chimneys sitting on small ledge on lavas above talus. Largest one 5 m tall with several others behind.
15:01:59				Close-up of top of tallest chimney; is venting black smoke; see scale worms on exterior to chimney, in hot fluids; base of chimney is partially collapsed and wonder how chimney can stand up?; white bacteria near top, beehive part, of chimney.
15:03:14	1689			See close up of beehive type chimneys at base of large 5 m chimney; deployed Mkr#20
15:09:34				Close-up of some of the spindly, ~2 m tall, chimney in this group that outcrop behind tall one; white is bacterial mat(?); these chimneys also venting; pipe organ type chimneys.
15:11:38				Close-up on tallest of the spindly chimneys covered with shrimp.
15:12:13				View of large (wide) chimney structure furthest behind the tall chimney. It is venting. When attempting to set up to sample fluids, whole structure was pushed over by the Pisces.

Time	Z	Lat	Long	Dive Log PV-628 Brothers - Observations
15:13:23				Close-up of top of chimney structure; white bacteria with black sulfides(?) showing through. See more shrimps on exterior; knocked over at 15:13:28.
15:13:55				See massive, blocky, lava wall above chimney field; moving to W.
15:16:25				Massive lava; blocky; some flow many m high.
15:18:03				See some low-T bacterial mats; visibility hampered by smoke.
15:20:27				More bacterial mats/mounds.
15:23:18				Massive lavas.
15:25:28				Impressive overhand of lava flow.
15:25:46				Solitary white star fish on steep slope with sediment and lava flows.
15:27:00	1578	51.63	03.575	Got position above low T alteration zone to find massive sulfide wall.
15:29:45				Moving around slope of walls to W; blocky lavas and sediment slopes.
15:36:08	1581	51.616	03.520	Highly altered sediment (ground rock) with abundant sulfides (py).
15:42:06				Moving further W to massive sulfide wall; more blocky lavas.
15:42:40				Highly altered rock; white = bacteria or alteration?; intense alteration zone here.
15:45:11				Steep slope of altered lava; host to long-neck barnacles.
15:49:05				More slopes of mostly sediment here, but lavas underneath; shrimps.
15:52:34				Slope with sediment and lavas, covered in long-neck barnacles.
15:53:09				See crab amongst barnacles.
15:54:26				See overhang of lavas from wall where deployed Mkr#21.
15:55:21				Sitting down on ledge to test strength and see if can deploy Mkr; see
				Tall (7 m high) chimneys in background.
15:57:10	1571	51.657	03.428	Deploying Mkr#21 on ridge above chimneys.
16:00:00				Close-up view of overhang where marker deployed; dangerous!
16:01:11				See view of 7 m tall chimneys nearby.
16:05:25				Base of large chimneys; lava.
16:06:48	1577			**PV-628-2MIN** (Sample 2). Sampling of top of small dead chimney; good close-up of base of large chimney. (~10 m from Mkr#21)
16:09:51				Start of pan up chimney (inactive) in front of tall dead chimney.
16:11:26				Moving ~W up slope (wall) to drop weights and leave.
16:18:33				More blocky lava outcrop.
16:20:00				Leave bottom.

9.0 *Pisces V* DIVE MAPS

The high-resolution EM300 bathymetry data are proprietary, courtesy of New Zealand National Institute of Water and Atmospheric Research (NIWA). Data resolution is ~25 meters.

***Pisces-V* navigation tracks on the dive maps were created using the final edited navigation files (see navigation section 5.0).**

For higher resolution adobe illustrator files of the dive maps, or for the actual edited navigation files contact Susan Merle or Bob Embley. Text files or ArcGIS shape files are available.

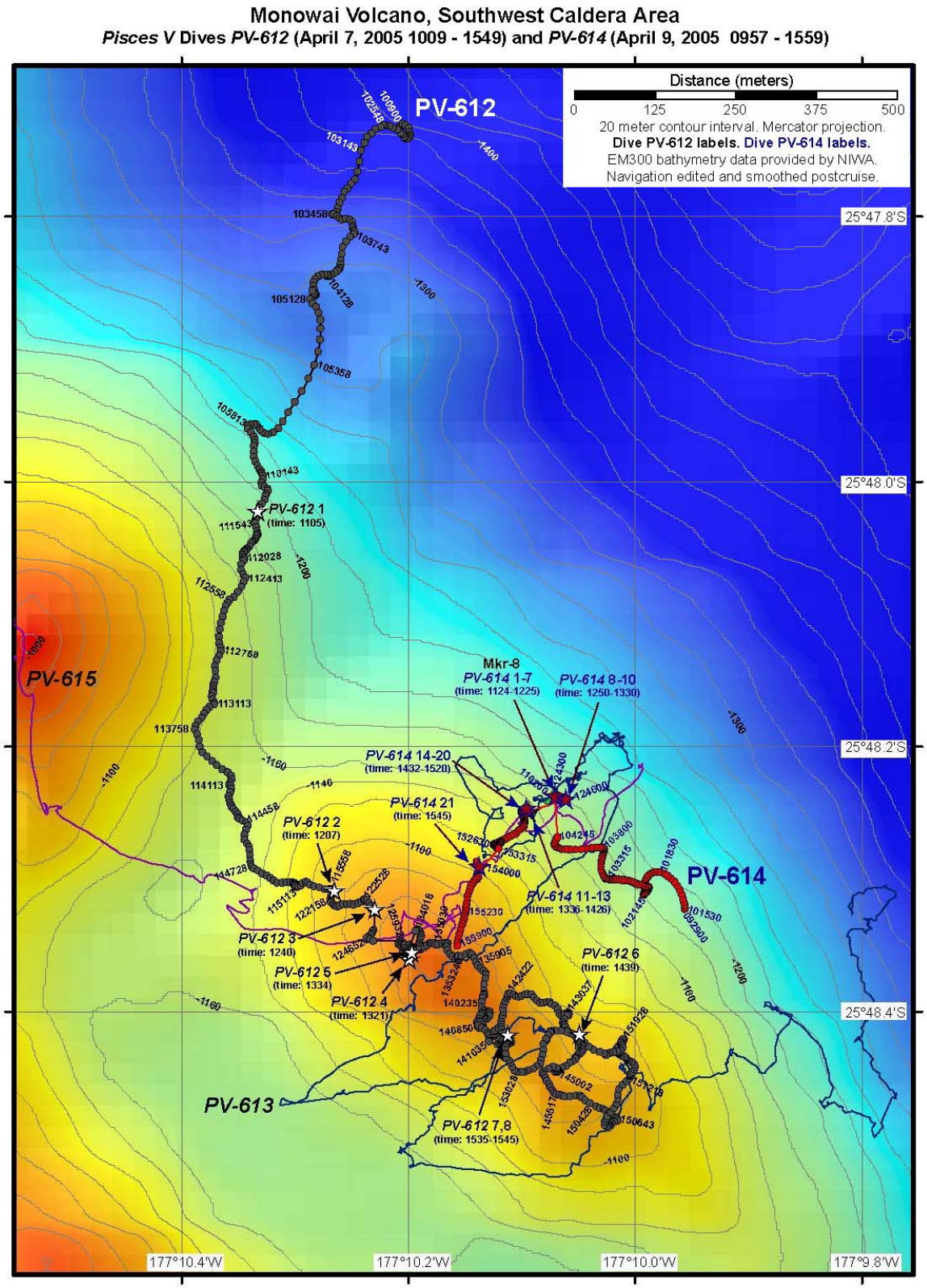

Figure 4: Dive map of *Pisces V* dives *PV-612* and *PV-614* at Monowai volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

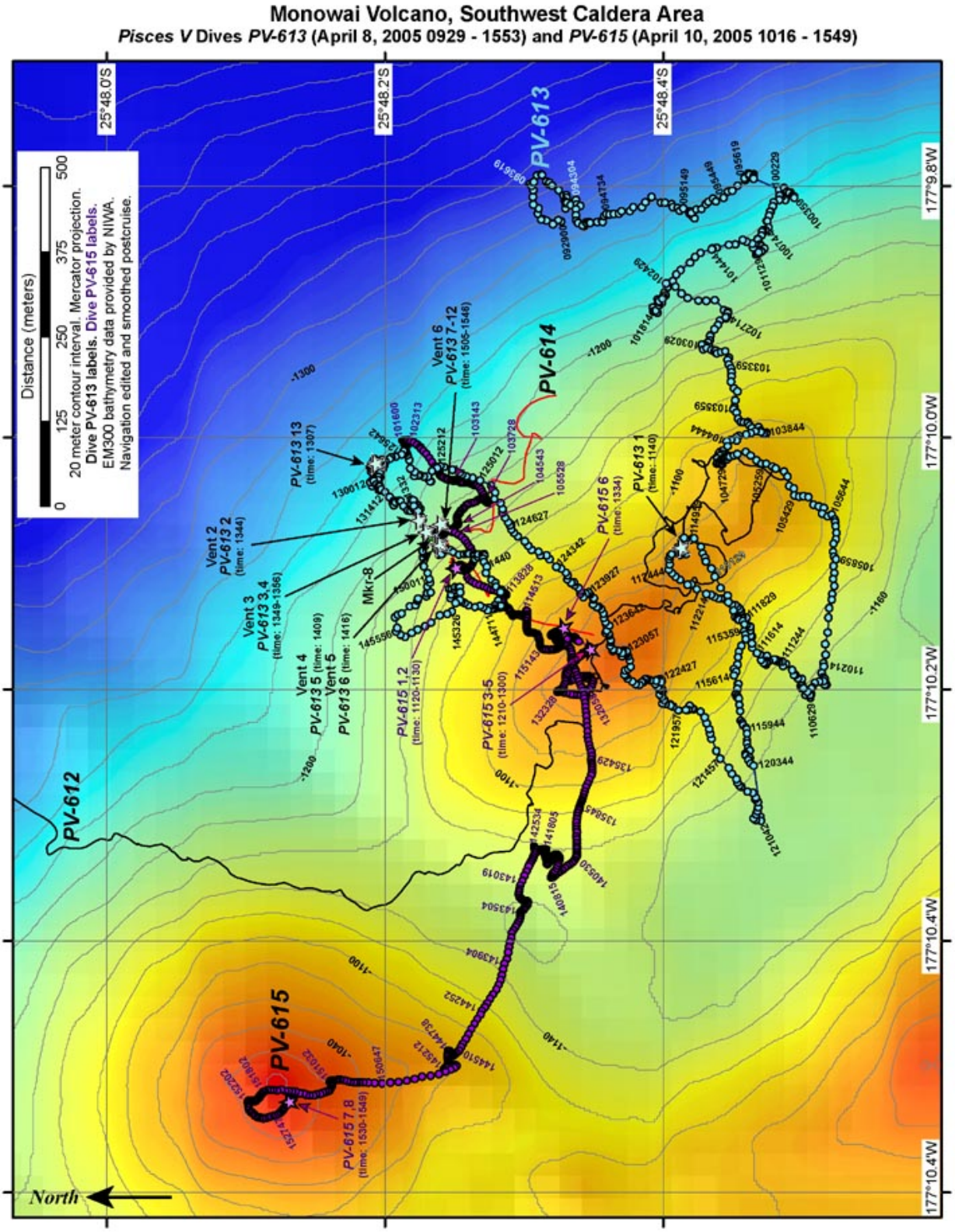

Figure 5: Dive map of *Pisces V* dives *PV-613* and *PV-615* at Monowai volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

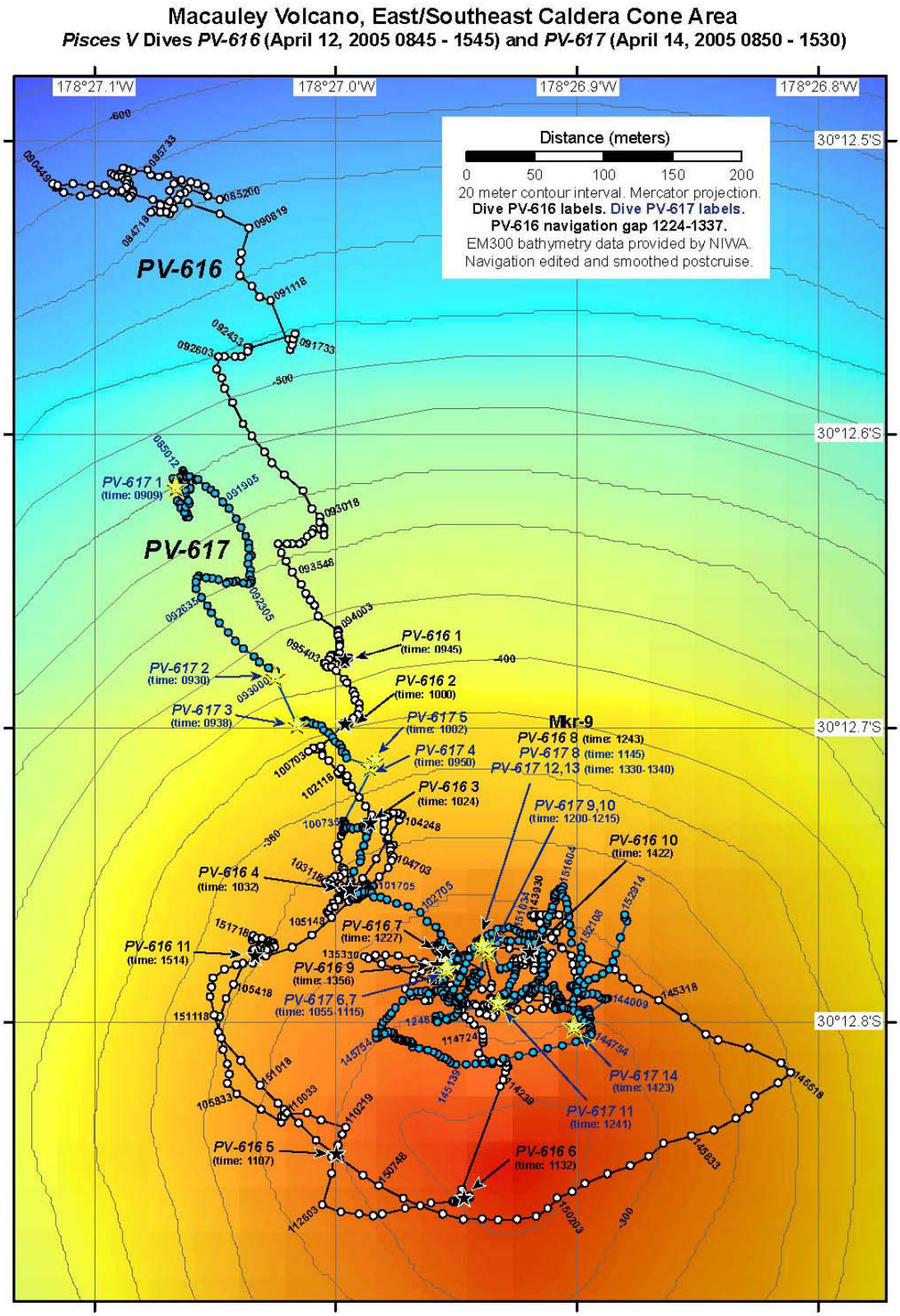

Figure 6: Dive map of *Pisces V* dives *PV-616* and *PV-617* at Macauley volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

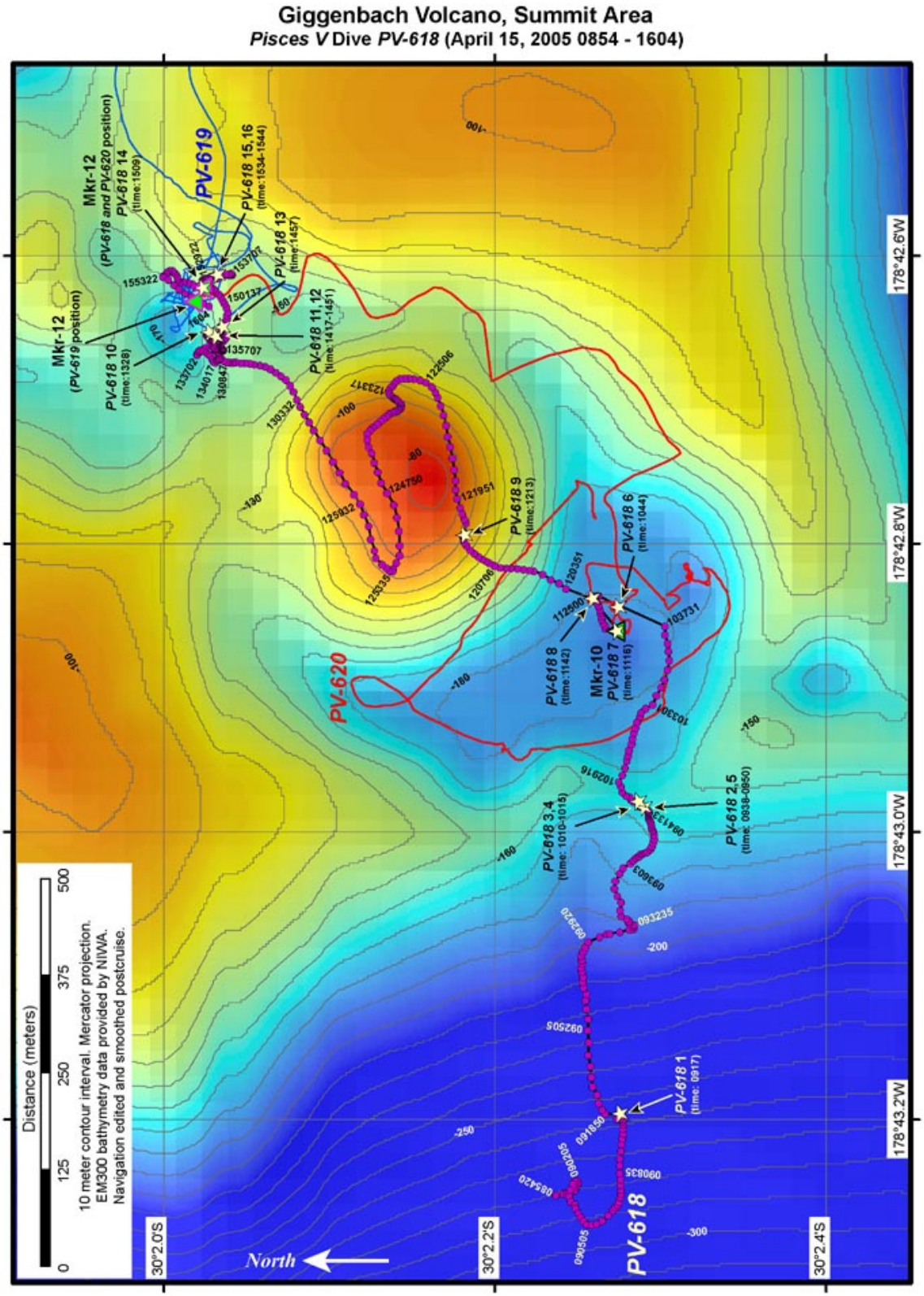

Figure 7: Dive map of *Pisces V* dive *PV-618* at Giggenbach volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

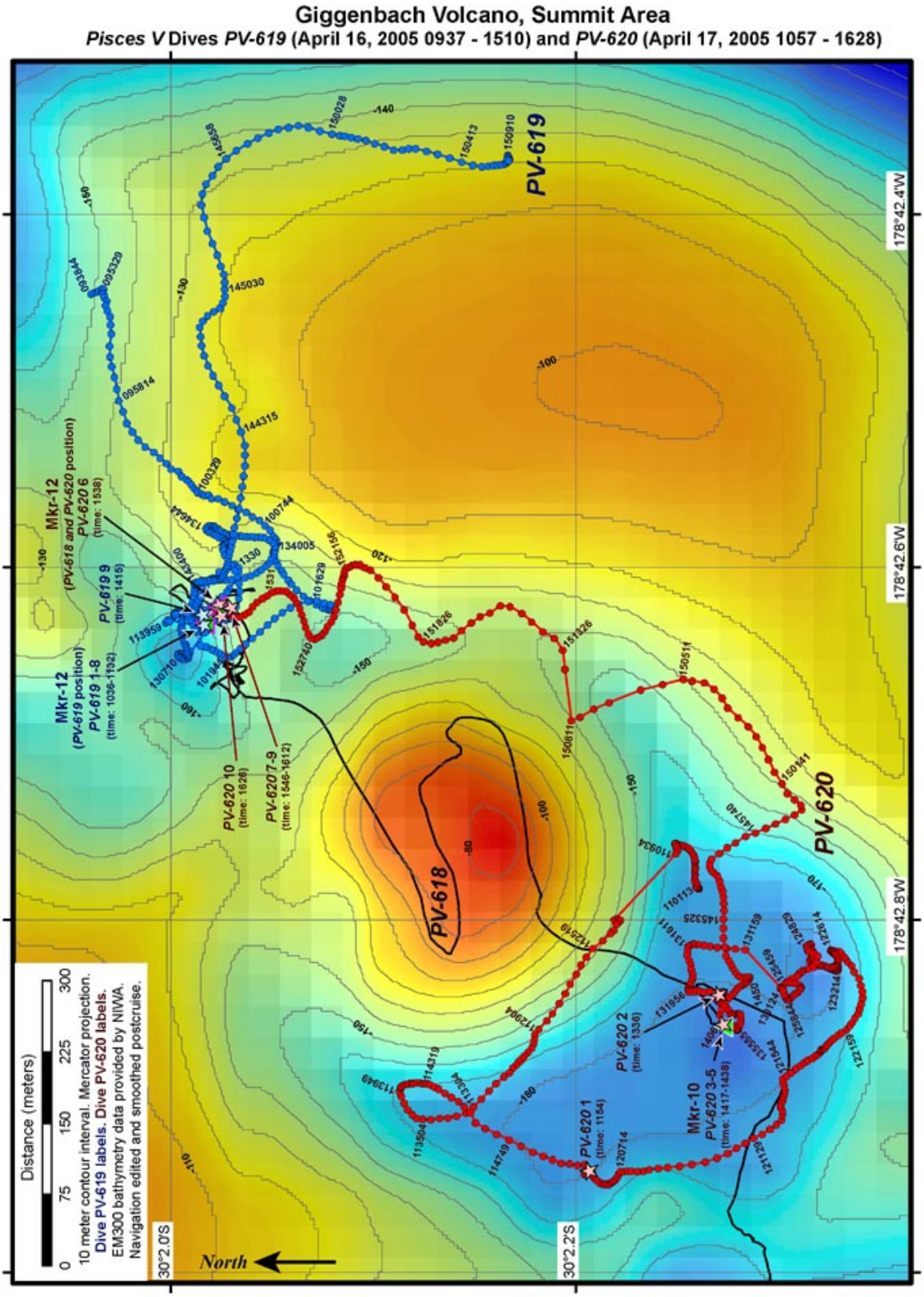

Figure 8: Dive map of *Pisces V* dives *PV-619* and *PV-620* at Giggenbach volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

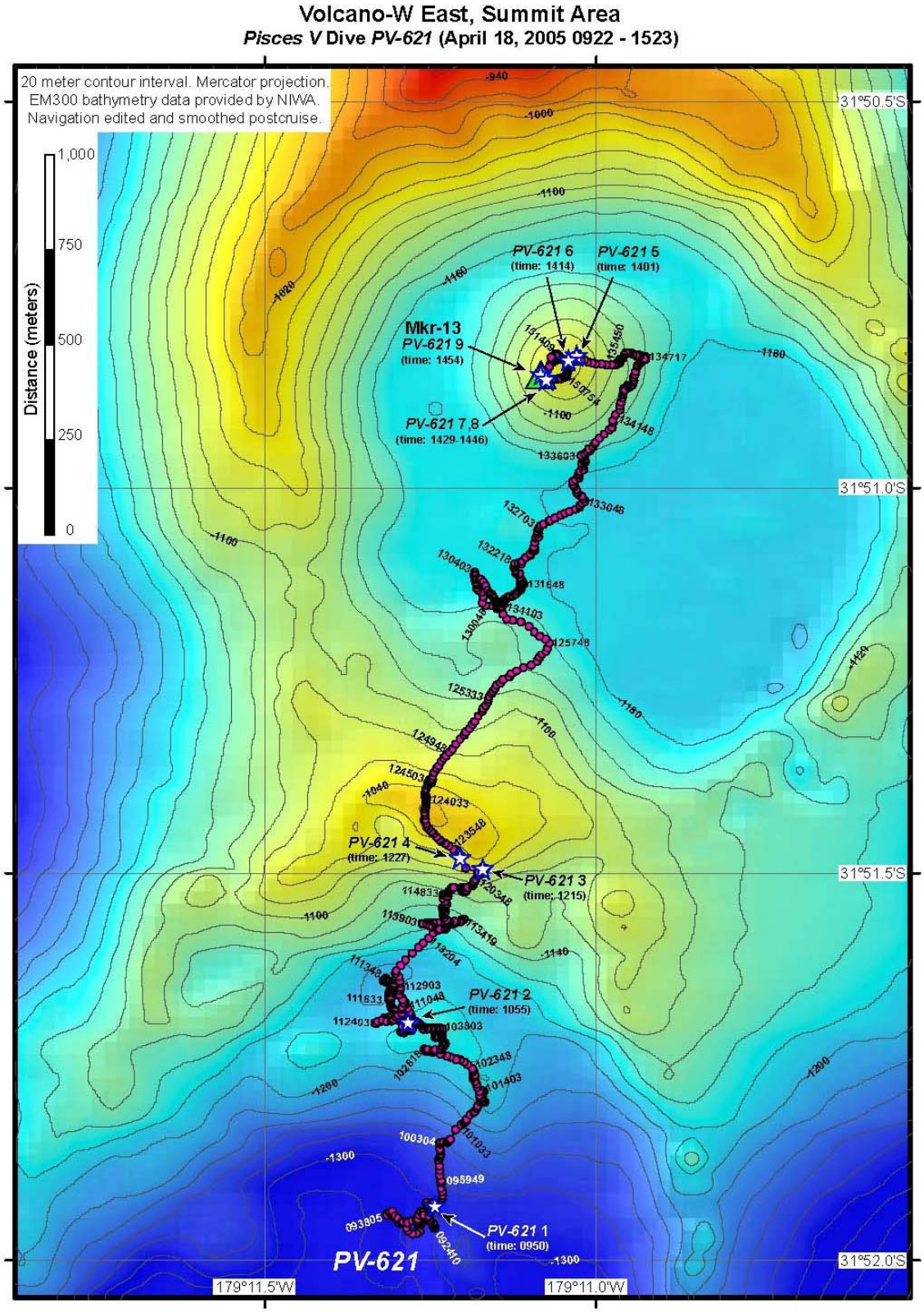

Figure 9: Dive map of *Pisces V* dive *PV-621* at Volcano "W". Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

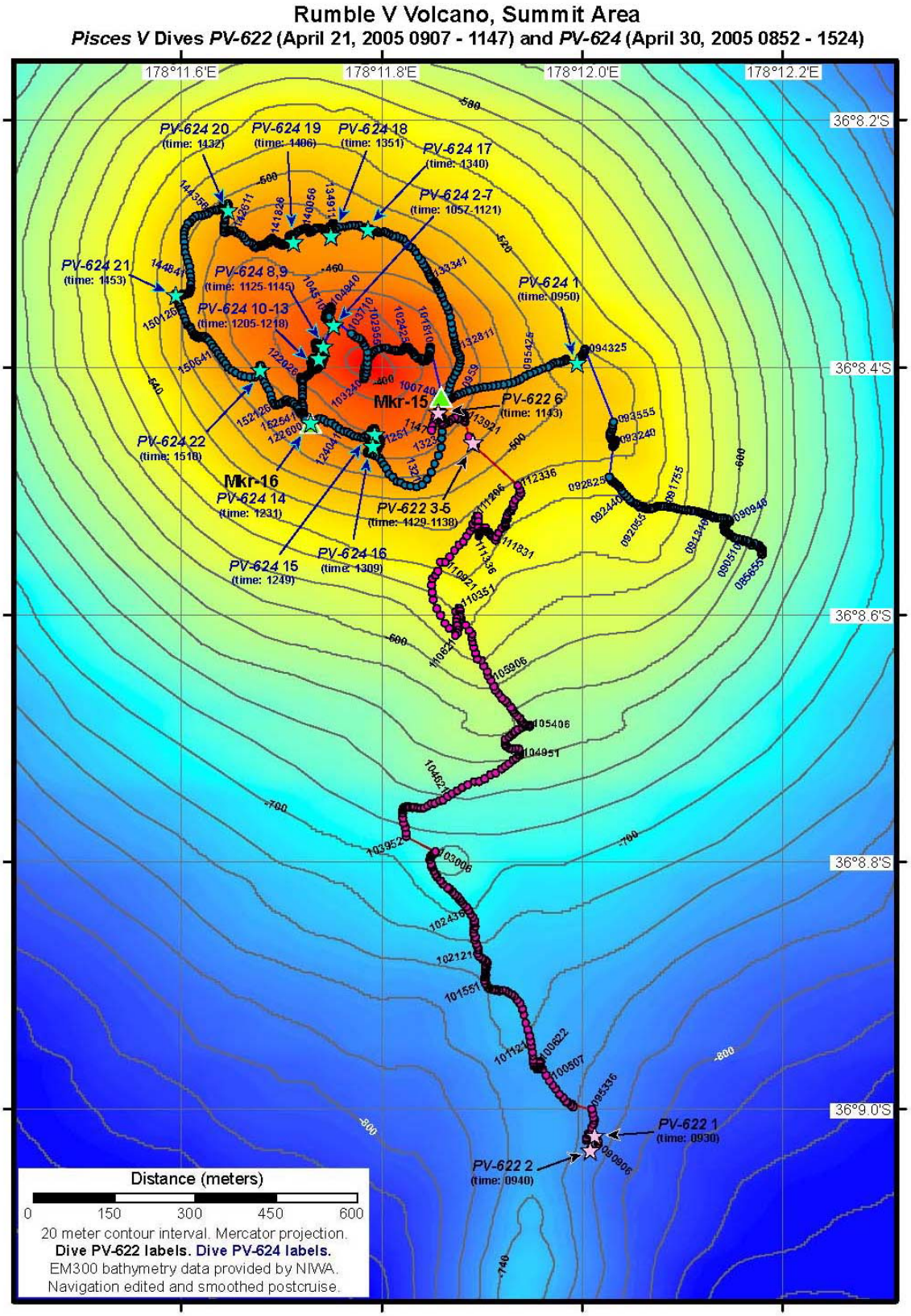

Figure 10: Dive map of *Pisces V* dives *PV-622* and *PV-624* at Rumble V volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

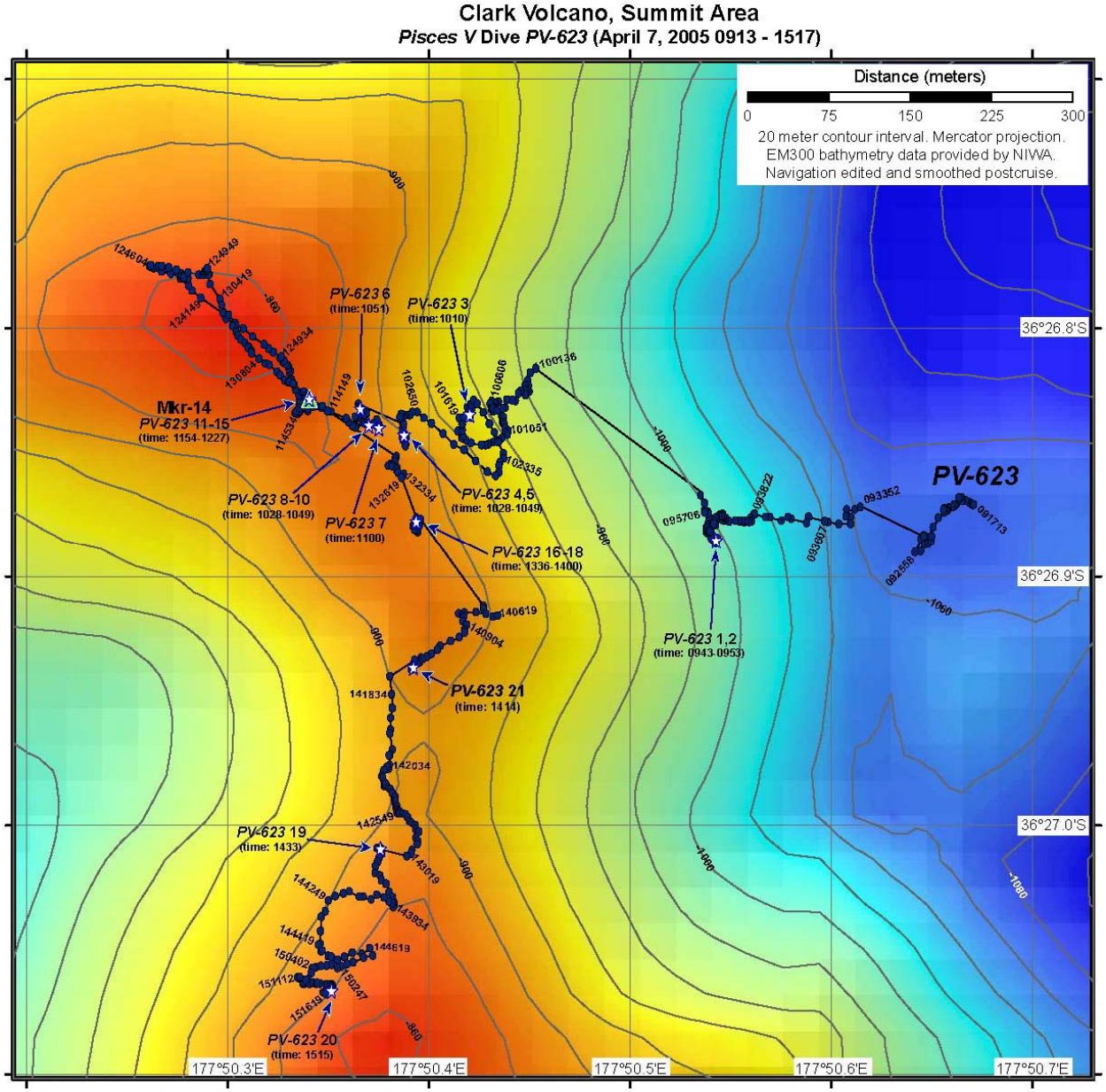

Figure 11: Dive map of *Pisces V* dive *PV-623* at Clark volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

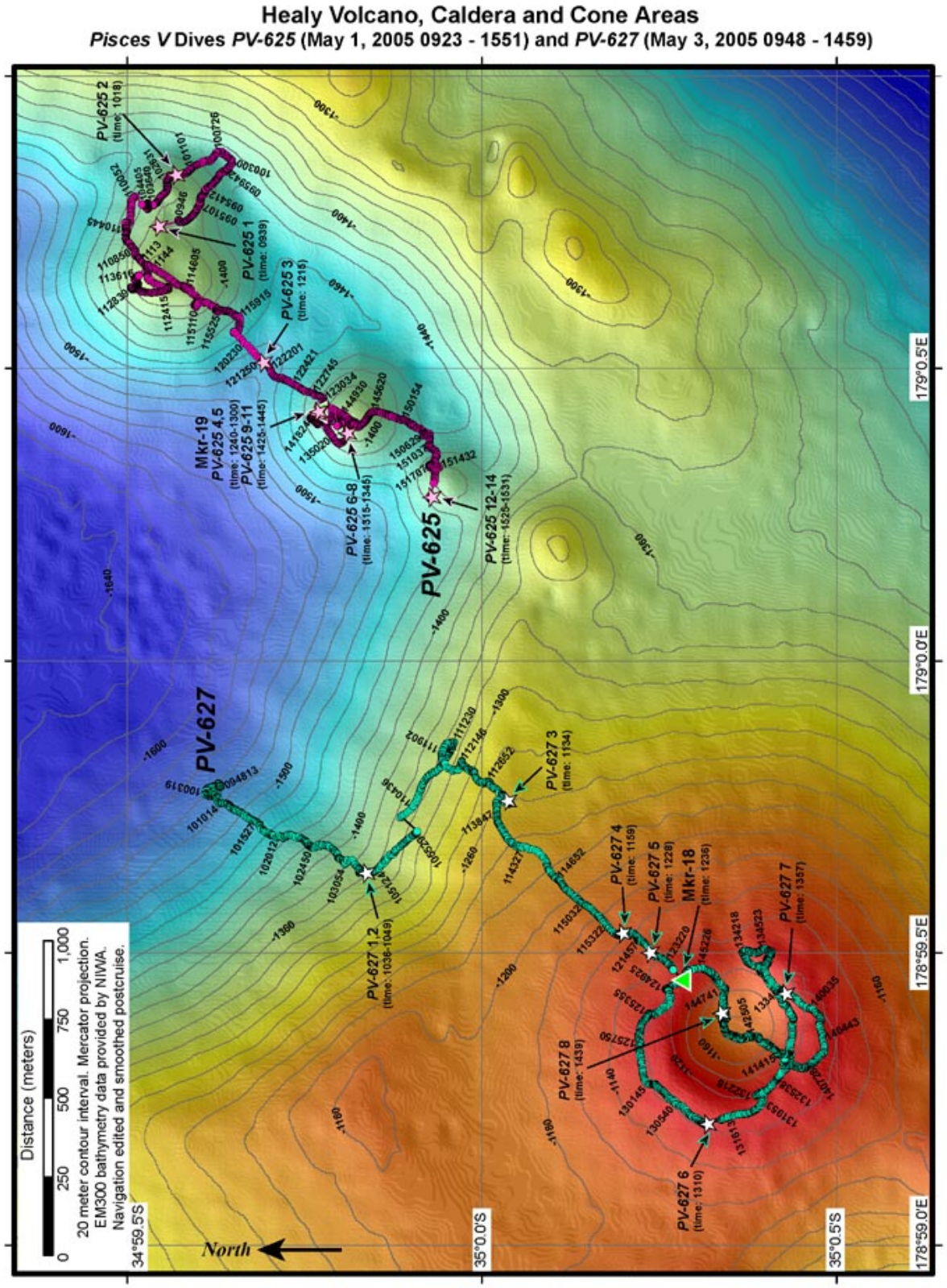

Figure 12: Dive map of *Pisces V* dives *PV-625* and *PV-627* at Healy volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

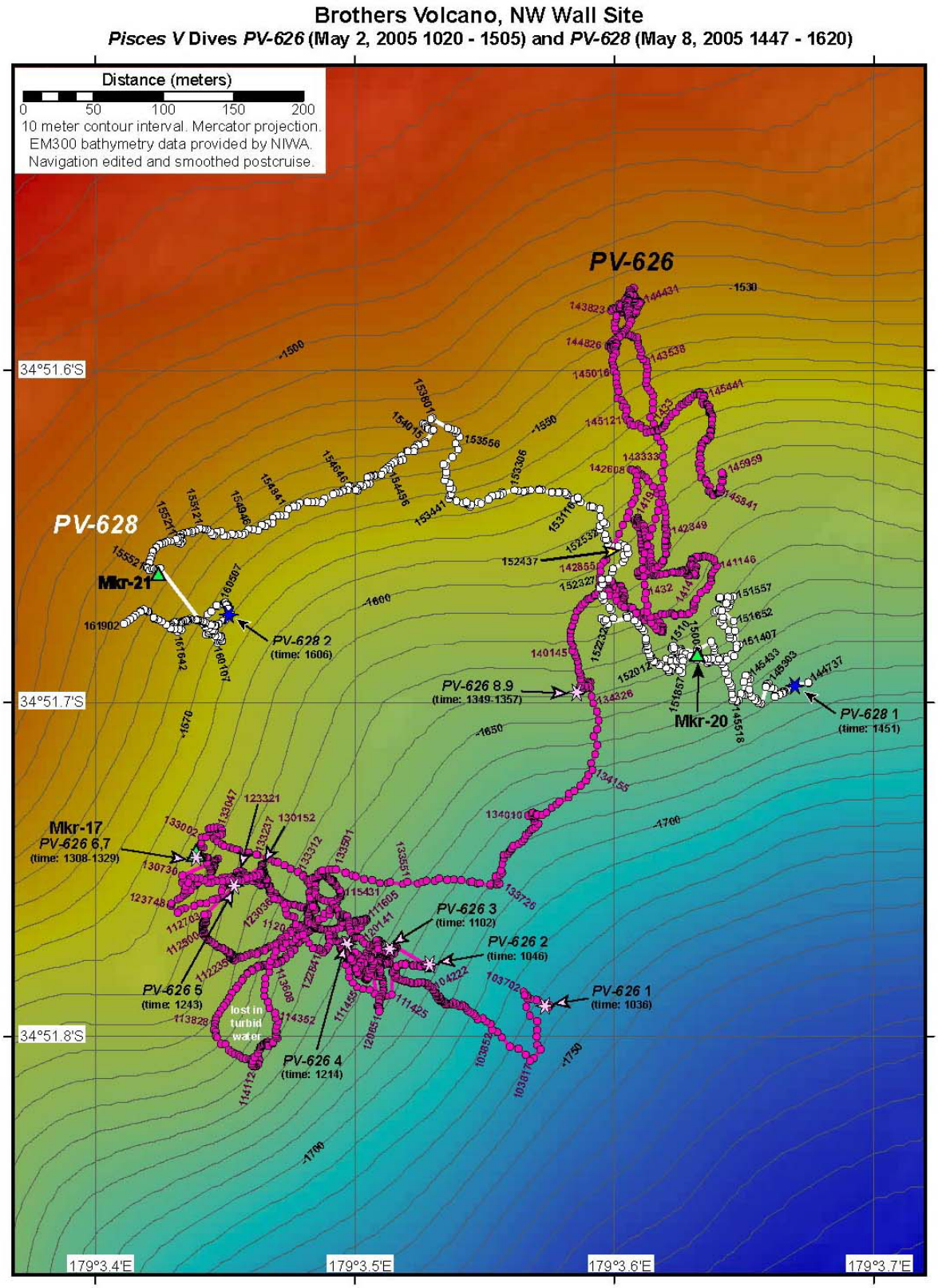

Figure 13: Dive map of *Pisces V* dives *PV-626* and *PV-628* at Brothers volcano. Final edited navigation shown. Outliers, caused by navigation noise, and obvious loops, most likely caused by calibration errors, were removed from the navigation data postcruise (see Navigation section 5.0). EM300 data were provided courtesy of NIWA.

10.0 *RCV-150* Remotely Operated Vehicle Operations

The *RCV-150* attempted three dives on the NZASRoF'05 cruise. All dives were in the vicinity of Macauley volcano. The first dive, *RCV-310*, on the flank of Monowai cone, was aborted after 10 minutes on the bottom. The second dive, *RCV-311*, took place on Curtis Ridge, NW of Macauley caldera. The third dive, *RCV-312* took place on the SW rim of Macauley caldera. No ROV navigation was available for any of the dives. Ship tracks during the dive times are shown for dives *RCV-311* and *RCV-312*.

The high-resolution EM300 bathymetry data on the dive map are proprietary, courtesy of New Zealand National Institute of Water and Atmospheric Research (NIWA). Data resolution is ~25 meters. For a higher resolution adobe illustrator file of the *RCV-150* dive map, or for the ship navigation files displayed here, contact Susan Merle or Bob Embley. Text files and ArcGIS shape files are available.

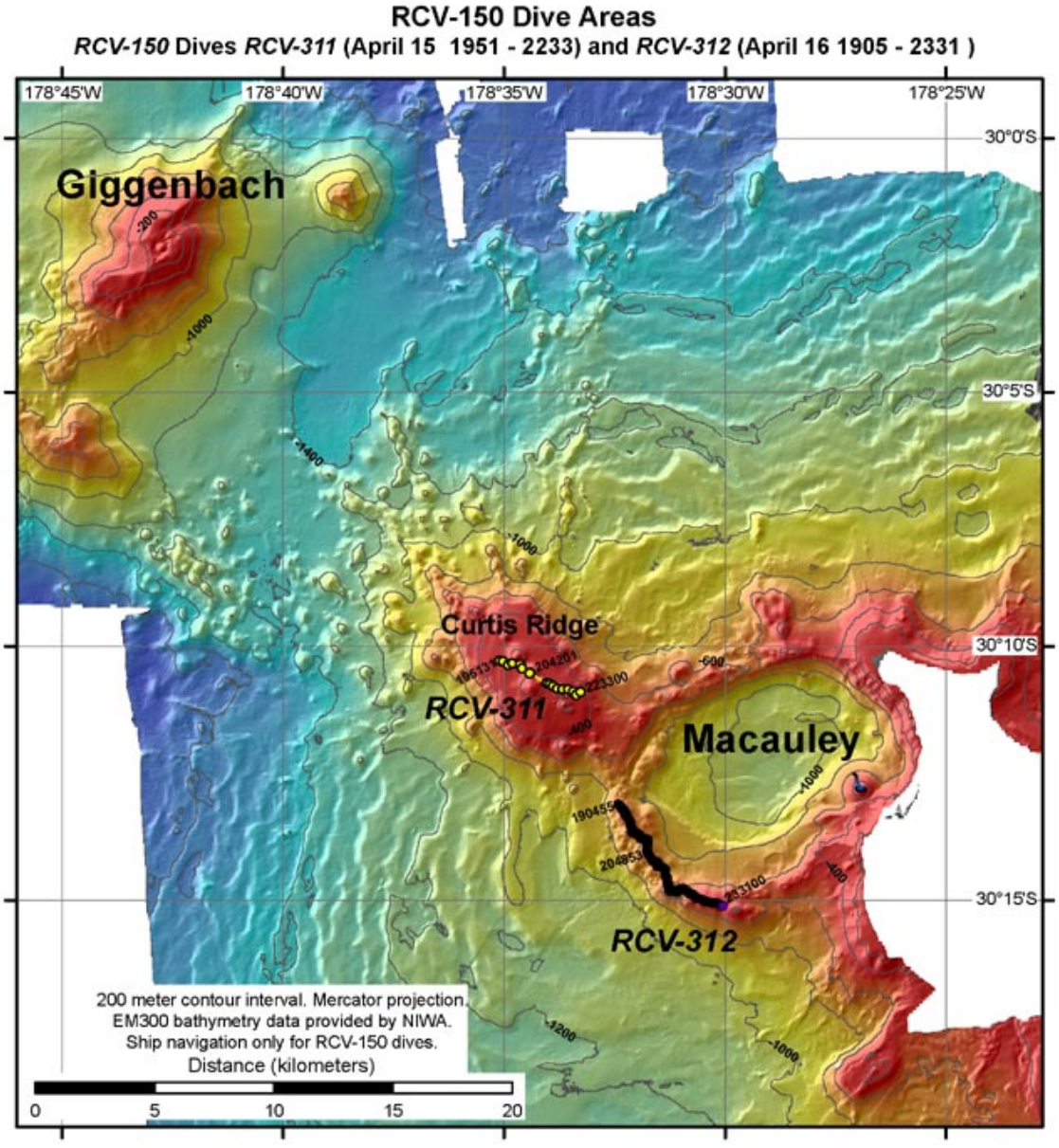

Figure 14: Dive map of *RCV-150* ROV dives RCV-311 and RCV-312 in the vicinity of Macauley volcano. Navigation tracks shown are the ship track. No ROV navigation provided. EM300 data provided courtesy of NIWA.