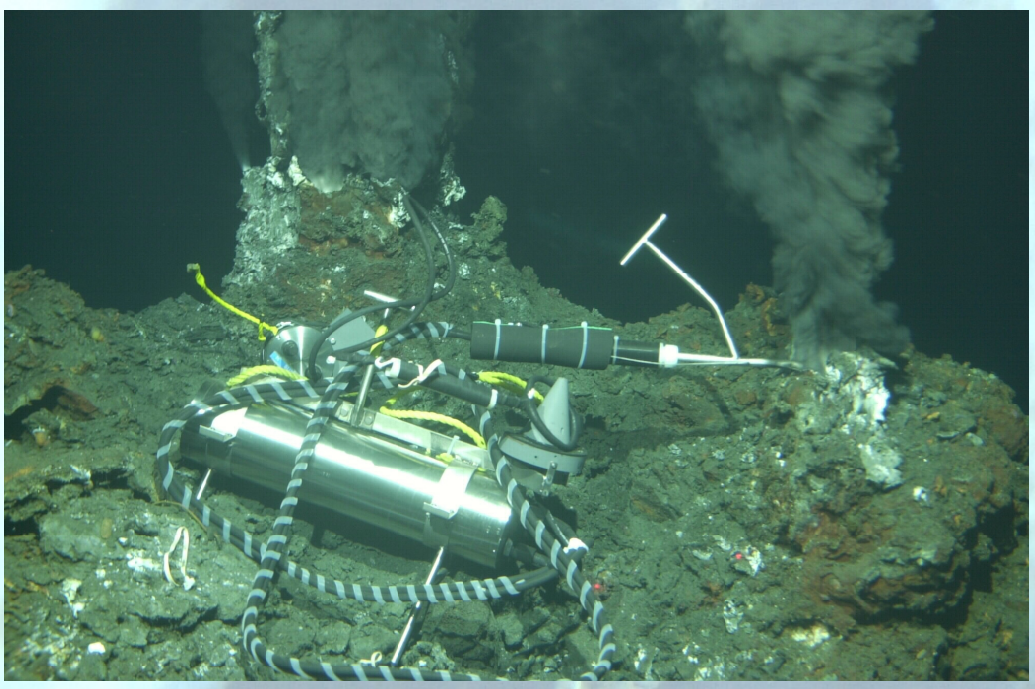
R/V Atlantis AT03-53
R/V Atlantis AT03-56
Main Endeavour Hydrothermal Field
Juan de Fuca Ridge
Perturbed 2000



June 10 - July 12, 2000
September 1 - September 19, 2000

Co-Chief Scientists
John R. Delaney
University of Washington
&
Margaret K. Tivey
Woods Hole Oceanographic Institution

Report Prepared by
Deborah S. Kelley
University of Washington

Temperature-resistivity probe in Sully

IN SITU TIME-SERIES EXPERIMENTS TO DEFINE THERMAL AND COMPOSITIONAL VARIABILITY IN TIDALLY PERTURBED SUBMARINE HYDROTHERMAL SYSTEMS

Image is of one vent in the newly discovered complex 'Cathedral'.

Principal Investigators

University of Washington
John R. Delaney
Deborah S. Kelley
Marvin D. Lilley
David A. Butterfield

Woods Hole Oceanographic Institution
Margaret K. Tivey

Cardiff University
Adam Schultz

University of Miami/RSMAS
David Kadko

Acknowledgements: We express our deep appreciation to Captain Crane, Captain Silva and the crew of the R/V Atlantis for their support, humor, and friendship. We also very much appreciate the diligence, professionalism, and significant effort put forth by the JASON and ALVIN group, which was instrumental in the success of the 'Perturbation' project. This program marked the first integrated field study at the NSF-funded Endeavour RIDGE Observatory. The data sets obtained will allow signifcant progress to made in understanding the linkages among physical, chemical and biological processes at thhe Main Endeavour Field. We are also grateful to the Canadian government for its continued support of work in this area.

PERTURBED 2000 CRUISE SUMMARY

The Perturbed 2000 project focuses on three questions concerning interactive processes within an active submarine hydrothermal system on the Endeavour Segment of the Juan de Fuca Ridge: 1) What are the physical and chemical consequences of phase separation? (e.g., boiling and condensation); 2) What are the origins of diffuse fluids?; and 3) How can tidal forcing be utilized as a natural perturbation to explore subsurface processes in a single hydrothermal system? The program is a collaborative effort by scientists from the University of Washington, Woods Hole Oceanographic Institution, University of Miami, and Universities of Cambridge and Cardiff funded by the National Science Foundation.

The field program was carried out during two legs on board the R/V Atlantis, and was highly successful. During the first leg (June 10 – July 12, 2000 using both *Jason* and *Alvin*), 74 hours of *Jason* bottom time were logged, 21 *Alvin* dives were completed, and over two hundred hours of sea-floor imagery were collected. A large suite of instruments, including prototype in-situ sensors, was successfully deployed and many hours of chemical-thermal data were collected. Instruments deployed for the summer included 5 temperature-resistivity probes, 9 HOBOs (high temperature data-loggers), 12 vemcos (low temperature data-loggers), 4 thermistor arrays, 3 gamma detectors and spectrometers, 3 MEDUSA samplers (flow rate/fluid samplers), 3 current meters, 2 OsmoSamplers (continuous fluid samplers), and a Parascientific pressure sensor. Intensive fluid sampling was carried out during both legs of the field program using *Alvin* titanium major samplers, gas tight samplers, a high-temperature fluid-particulate sampler (the "BEAST"), OsmoSamplers, and an in-situ McLane remote access sampler (RAS) that allowed 48 water samples to be taken. The Beast can be used on both *Jason* and *Alvin* and allows up to 14 water samples to be taken on a single dive. Also, a new manifold gas-tight sampling system was tested that allowed *Jason* for the first time to take up to 6 samples for volatile analyses.

In concert, the water sampler suites allowed round-the-clock water sampling of diffuse flow and high-temperature vents, resulting in geochemical characterization of 22 different venting areas within the MEF. During the second leg (September 1 – September 19, 2000 using *Alvin*), there were 14 successful *Alvin* dives. All of the instruments deployed on the first leg were recovered, fluids were sampled from diffuse and focused vents, macrofauna were imaged and sampled, and an in-situ hydrogen-temperature probe was successfully deployed and recovered allowing the first in-situ time-series measurements of H_2 to be made by a standalone instrument. In addition, as part of this program, two new areas of venting were preliminarily characterized: the "Cathedral" complex to the west of the MEF, and a new vent site to the north of the Salty Dawg Field. Vents at both of these areas have fundamentally different chemistries than any of the other vents sampled on the Endeavour Segment to date. Summaries of the various studies carried out on both legs of the Perturbed 2000 program are as follows:

Vent Fluid Studies:

Samples for gas extraction and analysis were collected using several different devices. Traditional titanium gas-tight samplers were used to collect 80 high-temperature fluid samples from the MEF (including the new Cathedral vent structure) and the newly discovered vent field to the far north. In addition, 28 gas-piston samples mostly from diffuse flow environments were collected using the Beast. The RAS was also used for gas sampling and 6 of the bags were extracted for analysis. Two additional samples were successfully collected and extracted using the new MEDUSA gas-tight samplers.

Non-gas tight samples were collected using the Beast (86 samples), the RAS (137 time-series samples), the OsmoSamplers (two 5-day long and two 67-day long continuous samples), the MEDUSA samplers (12 samples), and with *Alvin*'s titanium major bottles (57 samples). The

stand-alone RAS was successfully deployed three times at diffuse flow areas venting from basaltic substrates and once on a large flange on Grotto. At sea radon-222 measurements were carried out on sub-samples of collected fluids.

Long-term In-situ Instrumentation:

Five *resistivity-temperature probes* were inserted into seven different high-temperature vents for multi-day deployments, which ranged from 5 to 87 days. A total of 340 "instrument-days" of data was collected with sampling at either 1 minute or 5 minute intervals. An *inductively coupled link (ICL)* that could be used from *Jason* or *Alvin* was used to eavesdrop on the instruments to check to make sure that the sensor tips were working and were in the hottest parts of the vents. Snapshots of data were taken with the ICL on multiple dives, and two *standalone underwater communication up-link packages (SUCUPs)* were used to collect up to 7 days of continuous data that could be brought back to the lab without disturbing the instruments. The temperatures of vents monitored using the resistivity-temperature probes ranged from 360 to 380°C. Discrete fluid samples were taken when instruments were deployed and recovered as well as mid-deployment to aid in calibration of the sensors. Numerous other spot-sampling efforts were made including a few trials of high frequency (25Hz) measurement.

Nine *high-temperature probes (HOBO's)* were deployed for the 90 day period; these instruments were cycled during the second leg and are now redeployed for a 1-year period. The *hydrogen-temperature probe* was deployed in the Sully and Bastille vents and then recovered again on multiple dives.

A *pressure sensor* capable of <u>*centimeter resolution*</u> in water column height, was deployed for 90 days, recording nearly 3 months of semi-diurnal tidal variation.

Five areas of diffuse flow were instrumented with combinations of *MEDUSA samplers, gamma detectors and spectrometers, thermistor arrays, vemcos, OsmoSamplers,* and the *RAS*. *Current meters* were placed close to 3 of the sets of instruments to examine the extent to which observed variability is a result of tidally modulated currents. The *ICL* was used from both *Alvin* and *Jason*, and from *SUCUPs*, to eavesdrop on the thermistor arrays and to upload all data recorded on the first leg without disturbing the instruments. Data recovered show tidal variability of temperature at all 4 thermistor arrays, but also show a waning of activity at one site north of the S&M structure. The continuous monitoring of temperature, flow rate, and gamma-ray emission spectra of venting fluid was complemented with sampling of fluids using a number of different samplers.

Biological studies:

Relationships of faunal assemblages to various environmental factors were examined as part of a separately funded (NURP) study that added two *Alvin* dives to the program (Tivey and Sarrazin). One of the MEDUSA samplers was used to measure flow rate and sample fluid at sites characterized by distinct faunal assemblages, and then vemco temperature loggers were placed in each assemblage. Fluid samples were also taken at these sites using the Beast. Repeat video mosaics were used to examine changes within faunal assemblages over time in these and other instrumented areas. Seven samples of these faunal assemblages were taken at the end of the second leg using grabs or the slurp pump.

Detailed microbial analyses were completed under separate funding that complemented the primary cruise objectives and characterization of the subseafloor biosphere. During this study, numerous high-temperature and low-temperature diffuse flow samples were analyzed to examine how the number and diversity of microorganisms changed over tidal time scales. In addition, enrichments were completed for novel hyperthermophiles in fluids and sulfide rock samples using media designed to mimic a variety of hypothesized subsurface conditions (heterotrophic sulfur reducers, methanogens etc), halotolerant bacteria were quantified, and obligatory halophilic archaea

were cultured. Analyses were completed on fluids that ranged from 5°C to 379°C, and cell counts varied from <60 cells l^{-1} to 48,000 cells l^{-1}.

CTD and Sea Beam Surveys:

Night operations during both legs included intensive *CTD and Sea Beam surveys*. The CTD surveys resulted in the discovery of a new hydrothermal field ~ 2 km north of Salty Dawg, and the Sea Beam surveys allowed creation of a refined higher-resolution, GPS-navigated bathymetric map of the area from the Cobb propagator to West Valley.

Geological Mapping:

Geological mapping operations using *Jason* and *Alvin* resulted in 1) the discovery of a new hydrothermal complex "Cathedral" on the western valley wall at the MEF, which includes the first white smokers documented on the Endeavour; 2) characterization of the new hydrothermal field north of Salty Dawg, which contains active smokers and areas of diffuse flow; and 3) preliminary characterization of an extinct hydrothermal field east of the MEF which contains nearly continuous outcroppings of sulfide for at least 300 m. This deposit represents at least 5 times the total sulfide volume in all other MEF deposits.

Educational Outreach:

The REVEL (Research and Education: Volcanoes, Exploration and Life) program was an integrated component of the second leg and allowed four K-12 teachers to participate in seagoing research. The teachers stood watches during CTD operations and were significant contributors to the daily web site. As in past years, the teachers developed onboard science projects, which included 1) designing Sea Beam surveys and editing data, 2) collecting and interpreting CTD data, and 3) implementing microbial growth experiments. They participated in daily science meetings and they presented the results of their projects and ideas for classroom studies at the end of the cruise.

Preliminary Results

Data collected during the two sea-going legs show that since the earthquake activity in June, 1999, there have been fundamental changes in the nature of venting in the MEF with many structures exhibiting significant new growth and increased venting temperatures. There are abundant new areas of diffuse flow with some sites containing 2 m tall kelp-like microbial colonies, and there are new areas of black smoker activity. In addition, there have been significant changes in vent fluid compositions with salinities in the southern portion of the field increasing from 10 mmol/kg in September, 1999, to >300 mmol/kg during summer 2000. Changes were also observed during the summer, with waning of diffuse fluid flow in the area north of the S&M structure. The combination of data from the sites of diffuse and high temperature flow in the MEF will be used to assess the relationships between high and low temperature fluids, the causes of observed tidal variability of venting, and its effect on macrofaunal assemblages and microbial communities within the submarine vent environment.

This project is part of a consortium of projects being carried out as part of the NSF-RIDGE Endeavour Segment Seafloor Observatory effort. Three other related cruises were carried out within and north of the MEF during this same field season. In July, while our instruments were in place, acoustic imaging of hydrothermal flow regimes was carried out using the SIMRAD 2000 sonar system adapted for use on *Jason* to examine the behavior of hydrothermal plumes and diffuse flow. In August, the heat flux from MEF was determined from temperature, conductivity, pressure, electrochemical potential, and velocity data collected during repeated ABE surveys and time-series CTD casts at adjacent stations. Then after the recovery of our instruments, systematic arrays of acoustic current meters and thermistor strings were deployed within and north of the MEF for a year to measure vertical heat flux near the seafloor. Seafloor magnetometers and tilt meters, and a thermal blanket for conductive heat measurements, were also deployed. By

simultaneously characterizing temporal and spatial covariations, this consortium of projects is designed to examine links among tidal effects, phase separation, heat and mass fluxes from the crust, and microbial output, and to better understand the physical, chemical, and biological linkages in seafloor hydrothermal systems.

Summaries of data and equipment used, and of all operations carried out during Legs 1 and 2, are presented in Tables 1, 2, and 5.

Table 1. Data Collected, and Equipment Deployed and Utilized

JASON	Alvin	Instruments	
Simrad 2000 Sonar	Navigation	9 High-T Probes	12 Vemco Probes
35 mm chemical stills	Hi-8 Archive and Working	3 Medusas	3 Gamma Detectors
Data-Event Logger	SVHS Copies	3 Mav Current Meters	1 Pressure Sensor
HTFP Sampler (Beast)	8 Gas Tight Water Bottles	Stand Alone Mclane	4 Thermistor Arrays
Gas-tight Manifold	5 Major Water Bottles	2 SUCUP data loggers	Beast-14 Samples/ea
Hi-8 Archive and Working	35 mm Chemical Stills	5 T-Resistivity Probes	4 OsmoSamplers
SVHS Video 3-Chip, variable	ICL communication system		
ICL communication system			
Digital Still and Video Grabs			

Table of Contents

Tidal Perturbations 2000 Personnel, Leg 1

University of Washington

John Delaney	Co-Chief Scientist
Debbie Kelley	Scientist
Marv Lilley	Scientist
Dave Butterfield†	Scientist
Eric Olson	Oceanographer
Kevin Roe†	Oceanographer
Mitch Elend	Oceanographer
Andy Graham	Oceanographer
Giora Proskurowski	Student
Susan Lang	Student
Ben Larson†	Student
Matt Schrenk	Student
Jon Kaye	Student
Emily Lang	Student
Chris Oze	Student (Stanford)
Lars Berg¥	Oceanographer
Miles Logsdon¥	Student

Woods Hole Oceanographic

Margaret K. Tivey	Co-Chief Scientist
Steve Liberatore	Engineer
Rachel Stanley	Student
Damien Grelon	Student
David Simms	SSSG

University of Miami/RSMAS

Dave Kadko	Scientist

Cambridge-Cardiff

Adam Schultz	Scientist
Gyangyu Dai	Engineer
Martin Walker	Engineer
Amy Davis	Student

Atlantis Personnel

Margaret Crane	Master
Kent Sheasley	1st Mate
Joanne Cantu	2nd Mate
Richard Bean	3rd Mate
Charles Lewis	Com/ET
Wayne Bailey	Bosun
Patrick Hennessy	AB
Orville Kenerson	AB
Jennifer Ediger	AB
Eduwiges Martinez	OS
Justin Adcock	OS
Colin Vogler	OS
Jeff Little	Chief Engr
Peter Ferraro	1st Engr
Robert McMurray	2nd Engr
Sean Mulhall	Oiler
Paul Vinisky	Oiler
Calvin Lawson	Oiler
Michael Hotchkiss	Oiler
Carl Wood	Steward
Lawrence Jackson	Cook
Linda Bartholomee	Mess Attn

Alvin/Jason Crew

Patrick Hickey	Expedition Leader
Robert Waters	Pilot
Bruce Strickrott	Pilot
Stephen Faluotico	Pilot
Phil Forte	Pilot
Mark Drewery	Tech
Anthony Tarantino	Tech
Francis Taylor	Tech
James Varnium	Jason
Matt Naiman	Jason
William Sellers	Jason
Thomas Crook	Jason

†transfer to Brown July 3
¥transfer from Brown to Atlantis

Tidal Perturbations 2000 Personnel, Leg 2

University of Washington

John Delaney	Co-Chief Scientist
Debbie Kelley	Scientist
Marv Lilley	Scientist
Dave Butterfield†	Scientist
Veronique Robigou	Scientist
Kevin Roe†	Oceanographer
Mitch Elend	Oceanographer
Sheryl Bolton	Oceanographer
Susan Lang	Student
Ben Larson†	Student
Brian Kristall	Student
Tim Crone	Student

Woods Hole Oceanographic

Margaret K. Tivey	Co-Chief Scientist
Jozee Sarrazin	Scientist
Steve Liberatore	Engineer
Christina Courcier	SSSG

University of Miami/RSMAS

Mark Stephens	Oceanographer
Dan Schuller	Student

Cambridge-Cardiff

Martin Walker	Engineer

University of Quebec at Montreal

Mark Fox	Student

REVEL Teachers

Cindy Maldonado
Bob Mize
Misty Nikula
Beverly Mowrer

Alvin Crew

Dudley Foster	Expedition Leader
Robert Waters	Pilot
Bruce Strickrott	Pilot
Stephen Faluotico	Pilot
Mark Drewery	Tech
Francis Taylor	Tech

Table 2: Atlantis 03-53 Operations Summary:

Date	Operations	Comments
6/10/00	Transit from Astoria to Main Endeavour Field	
6/11/00	Arrived on site and deployed four expendable transponders (L, M, N, O).	High winds and poor sea state precluded dive operations
6/12/00	**JASON dive 275** completes shake down dive and successful sampling using the newly developed high-temperature fluid sample (BEAST). Bag, filtered particulates, and piston samples were taken.	Reconnaissance and water sampling at the structure S&M indicates more vigorous venting and higher temperatures than in the past (374°C)
6/13/00	**Alvin dive 3569** for reconnaissance of field and instrument deployment. Hobo deployed at Puffer in 1999 was recovered, temperature-resistivity (T-R) probe was tested, and gas tight and major water samples were obtained. Pressure sensor deployed at plain between Hulk and the Bastille complex. Sulfide sample recovered. Delaney, Lilley, Forte Subsequent to the dive a wireline test of MEDUSA was completed and a CTD vertical station was done for background and microbiological samples.	Entire vent field and area between Hulk and Bastille is more active. Northern plain in-between these sites hosts abundant fissures with 2 m tall "kelp-like" strands of bacterial mats present. Diffuse venting over entire plain very common.
6/14/00	**Alvin dive 3570** visited Cannaport, Sully, Puffer, and Bastille. Water samples taken from all structures, Hobo deployed in 1999 at Sully recovered, T-R probe tested and deployed at Sully, Hobo's deployed at Sully, Puffer, and Bastille. Sulfide samples recovered from Bastille. Kelley, Lilley, Waters Evening operations include elevator drop in area just south of Bastille complex. MAV deployed on elevator.	Area previously inactive around Milli-Q now hosts abundant black smokers emanating from what look to be older sulfide deposits. Bastille much more active, with multiple puffing vents-temperature of 379.8 measured.
6/15/00	**Alvin dive 3571** to Bastille complex. Hobo recovered from Bastille. Temperature-resistivity probes. Lilley, Olson, Strickrott MEDUSA tested again on wireline.	Late dive start due to high sea state and winds. Dive called early due to continued high winds.
6/16/00	**Alvin dive 3572** to Bastille complex for intense instrument deployment. The pressure sensor is deployed just NW of S&M, Hobo's and temperature-resistivity probes are deployed at Milli-Q and Cannaport, and a Hobo is deployed at Peanut. The current meter is recovered from the elevator. Tivey, Olson, Hickey Elevator is recovered and a wire line test of Medusa is completed.	
6/17/00	**JASON dive 276** to Bastille to begin 24 hour water sampling. A Hobo was deployed at S&M. A fluid temperature of 377°C measured with the BEAST at Bastille. Three water samples and one filtered sample are taken. Flushing pump on the BEAST clogged with particulates and so dive is called to clean and repair pump.	Difficulties are encountered calibrating gyro, pan and tilt malfunctions causing significant delay. ICL does not work to listen to temperature-resistivity probes.

Date	Operations	Comments
6/18/00	Winch launching MEDEA looses control and MEDEA drops over the side, is brought on deck safely, down day to evaluate situation	
6/19/00	**Alvin Dive 3573** to Bastille heavily loaded with major and gas tight bottles to complete fluid sampling over tidal interval.	Tidal low is at ~ 0800, dive begins at 0600 to "catch" event.
	Lilley, Butterfield, Faluotico	
6/20/00	**Alvin Dive 3574** to Easter Island with gamma detector. Reconnaissance for diffuse flow studies.	
	Kadko, Tivey, Forte	
6/21/00	**Alvin Dive 3575.** Reconnaissance of S.E. of Milli-Q and pick up sucup for TR probe, water samples at Salut (357°C) and Hobo Zo deployed for 1-year, test TR at Grotto with ICL (364°C), paired water samples at Dudley (362°C), and paired water samples at Hulk in diffuse flow site at base (10.6°C). Kelley, Tarantino, Waters	Elevator drop of current meters is aborted due to failure of datasonic release.
6/22/00	**Alvin Dive 3576** at Easter Island. Deployment of Gamma detector and Medusa at 4884, 6022. Schultz, Kadko, Strickrott	McLane and 2 hobos deployed by wireline at 4915, 6065.
	Night ops include wireline deployment of McLane sampler and vertical CTD for background	CTD target at 47° 57.00N 128° 55.0 W
6/23/00	**Alvin Dive 3577** to Easter Island to deploy two sets of thermistor arrays and short term osmo samplers at Easter Island and north of S&M. The RAS was also placed, two resistivity probes recovered, and the pressure sensor redeployed. Tivey, Liberatorie, Hickey	
	Night operations include a Seabeam survey from 48°N to just south of Middle Valley.	
6/24/00	**Alvin Dive 3578** to the base of the scarp at S&M for a Medusa deployment, a medusa was switched out at Easter Island, Hobos were recovered from Sully and Puffer, Marker DF2 was deployed at the base of Puffer. Schultz, Forte, Drewery	
	Night operations include a tow-yo starting at 1953 ~ 1 km south of the Main Endeavour Field and ending just to the north of the axial high. The goal was to explore for new venting sites between Salty Dawg and Middle Valley. The CTD ended on 6.25 at 0400. Strong plumes in axial valley to near axial high. Ground fog to the north.	Tow-yo started at 47°56.06N 129° 06.17 W. Ended at 48°02.19N 129°03.15W. Eight bottles tripped.
6/25/00	**Alvin Dive 3579** using the BEAST to sample diffuse flow sites which included Milli-Q and at the base of the scarp at S&M Delaney, Butterfield, Forte	Tow-yo started at 48°01.N 129°03.64 W and ending at 48°07.18 N 129°00.91W

Date	Operations	Comments
6/26/00	**Alvin Dive 3580** to central Bastille complex. Placed hobo in Sully and sampled with gas tight, put hobo in Puffer and Cannaport, deployed temperature resistivity probe in S&M, and sampled with gas tight bottle. Temperature resistivity probe recovered from Grotto. Kelley, Lilley, Waters	
	Night operations include a tow-yo starting at 0932 north of the axial high. The goal was to explore for new venting sites between Salty Dawg and Middle Valley. The CTD ended on 6.27 at 0150. Small plume at beginning of tow.	Tow-yo started at 48°01.00N 129° 03.64W. Ended at 48°07.18N 129°00.91W. Nine bottles tripped
6/27/00	**Alvin Dive 3581** initiated at ~0930 due to poor sea state. Ras was released from S&M, Reconnaissance completed at S&M, the base of S&M, and Milli-q for deployment sites for Medusa and Gamma detector. Tivey, Kadko, Strickott	High winds caused delay in launch
	McLane stand alone water sampler was released from the S&M diffuse flow site and recovered with 36 water samples taken.	
6/28/00	**Alvin Dive 3582** leaves deck at 0800 to deploy two temperature resistivity probes, 1 medusa, and 3 Hobos. Walker, Hickey, Taylor	Tow yo started at 48°11.21 128°59.32 and ending at 48°06.18 129°01.43
6/29/00	**JASON 277** Intense sampling of diffuse fluids using the Beast at the northern experimental site at S&M, site at the eastern wall at S&M, S&M medusa site, near Marker DK1 near Milli-Q, at the base of Puffer and at Easter Island.	
6/30/00	**JASON 278** First imaging of Cathedral of Cathedral, sampling of Puffer and Sully using the Beast.	
7/1/00	**JASON 279** Intense sampling of Puffer and Sully to characterize temporal variability using the Beast, listen with ICL to Puffer and Bastille resistivity probes, video transect of Sully	
7/2/00	**JASON 280** Time-series sampling of Sully with gas tight manifold, characterization of Cathedral, and vertical transects for video imaging of S&M, Peanut, and Cannaport.	
7/3/00	**JASON 281** Simrad2000 survey of the Main Endeavour Field flying 20-30 m off bottom with 11 020-trending transect lines spaced ~ 25 m apart, 35 mm downlooking transects of diffuse experimental sites	
7/4/00	Continuation of **JA281**, Transit to meet Brown and transfer personnel and equipment. Seabeam north to Main Endeavour Field on transit back.	
7/5/00	**Alvin Dive 3783**	Pogo started at 48°05.48 129°01.72

	Night operations include testing of the smart elevator, CTD	and ending at 48°05.1 129°02.2 to explore for plume just north of axial summit
	Faluotico, Kadko Tivey	
7/6/00	**Alvin Dive 3584** Macrofaunal characterization dive to define communities at different venting sites, deployment of 12 vemco probes in diffuse sties, digital imagery of communities, testing of Medusa.	
	Night operations included deployment of the stand alone Mclane water sampler. Seabeam to north of Endeavour-West Valley Faluotico, Schultz, Grelon	
7/7/00	**Alvin Dive 3585** McLane stand alone water sampler moved to northern S&M site, Gamma detectors deployed, recovery of resistivity probe at Bastille. Lilley, Kadko, Waters	During night operations CTD on last lowering during to-yo merges with the bottom-cable is re-terminated following day. Tow-yo starts at 48°20.0 129°07.20 and ends at 48°16.91 129°07.45
	Night operations include CTD at gap between Endeavour Seamount. Waters, Kadko, Lilley	
7/8/00	**Alvin Dive 3586** Deployment of 2 Medusas, recovery of low-temperature probe Strickrott, Tarantino, Schultz	
7/9/00	**Alvin Dive 3587** Intense water sampling with majors and gas-tights to complete sampling of field, deployment of suk-up at Easter Island, final deployment of current meters, determines Puffer resistivity probe working. Exploration of new structure "cathedral" with water and rock sampling. White smokers have pH of 2, 312°C. Kelley, Schrenk, Hickey	Tow-yo begins at 48°17.00 129°06.50 and ends at 48°12.46 129°06.82
7/10/00	**Alvin Dive 3588** Water sampling of diffuse and high--temperature vents starting in southern part of field at Salut and working north to Hulk. Hobo's deployed in Bastille, and Grotto. Kelley, Elend, Faluotico	Tow-yo begins at 48°01.2 129°04.0 and ends at 47°59.69 129°04.06 run in a zig-zag pattern north of axial summit. Encounters significant plume.
7/11/00	**Alvin Dive 3589** Exploration dive starting near Dante and running south of Quebec and east of S&M along easterly fissure system. -Transit to Astoria	
7/12/00	Transit to Astoria	

Cruise Operations

June 10: Transit

The R/V Atlantis began steaming to the work site at the Endeavour Segment of the Juan de Fuca Ridge at ~0900 hr from Astoria, and slowed because of poor sea state conditions.

June 11

The ship arrived on site at 0600 and held station to wait out the weather-winds blowing 18-21 kts. Winds up to 35 kts and high sea state in the early morning resulted in postponement of the first JASON dive. Four expendable transponders were deployed during the day and surveyed in (Figure 1).

Table 3. Transponder Locations: Origin = 47° 53.634'N, 129° 09.870'W Zone 9

Xponder	Reply/Xmit	Latitude	Longitude	UTM X	UTM Y	Depth
L-2000	9.0/10.0	47°57.36433'N	129°05.00449'W	493772.85	5311421.22	1881.1
M-2000	9.0/8.5	47°56.22351'N	129°07.01043'W	491273.62	5309311.18	1865.4
N-2000	9.0/7.5	47°57.65460'N	129°06.20849'W	492275.42	5311960.72	1866.2
O-2000	9.0/9.5	47°55.99211'N	129°05.64396'W	492974.05	5308880.22	1894.5
H-1997	9.0/11.5	47°54.8864'N	129°06.2068'W			1977.0
K-1997	9.010.5	47°56.0183'N	129°05.7321'W			1920.6
I-1995*	9.0/7.5	47°57.7530'N	129°04.9637'W			2000.4
J-1995	9.0/11.0	47°57.2209'N	129°05.9132'W			1997.2

**Transponder is still giving off a weak signal.*

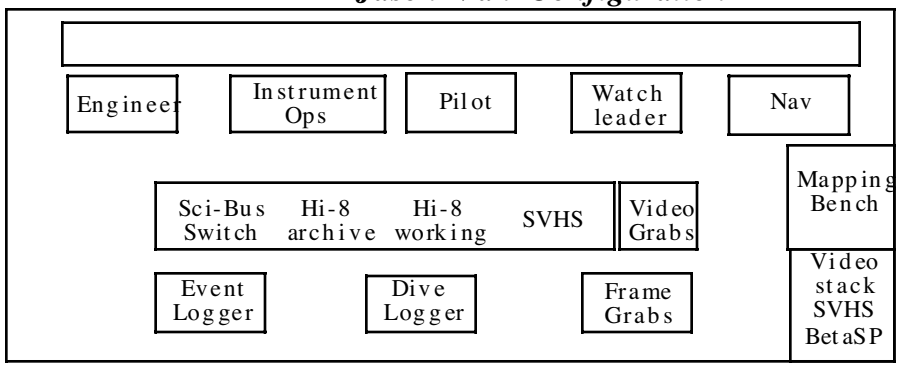
June 12: Jason Dive 275

The goal of this first dive was a shake down for JASON and the high-temperature fluid particulate sampler (BEAST) in the Main Endeavour Hydrothermal Field (Figures 2 and 3). In addition, this was a reconnaissance dive to the Main Field to examine possible diffuse sites near the structure Smoke and Mirrors (S&M)(Figure 3). The configuration of the JASON van was modified to allow optimal data collection and documentation of the dives. Video imagery using 1-and 3-chip cameras were collected continuously throughout the dives and collected on Hi-8, SVHS, and BetaSP tapes. All dives included both archive and working copies. In addition, discrete frame grabs and video grabs were made as well as collection of 35 mm stills. Logging during this operation included the JASON LOGGER with frame grabbing of the pan and tilt camera, a running log of watch leader communications, and frame grabbing and video clipping of the 3-chip camera. The JASON datalogger system was modified for hydrothermal-geologic-biologic event logging, and all dive operations were documented on a dive transcript log. Video imagery collected included paired working and archive Hi-8 video of the pan and tilt cameras and pencil cameras, and paired BetaSP and SVHS video of the 3-chip and pan & tilt cameras

The ROV went in the water at ~0800 to a target of X = 5050, Y = 6000, approximately 100 m east of the structure S&M(Figure 2). Navigation was not available for JASON, but was available for Medea. The first lowering was successful and JASON reached bottom at 1211 in an area hosting old sulfides. Subsequent to tether management JASON surveyed a small portion of the plateau north of S&M and imaged the Medusa sampler near S&M. The ROV proceeded due west to S&M for reconnaissance of appropriate black smoker sampling sites to test the Beast. S&M was reached at 1233 and JASON maneuvered to the northeast face. A vigorously venting orifice, which lacked a significant chimney was found on the north east side of the structure approximately 9 m up and JASON was positioned for stable sampling. The temperature of the vent was 374.5°C, significantly higher than the 368°C measured during previous years. Minor excavation of the vent occurred prior to sampling. The temperature remained steady for over 1 hr. Samples from the BEAST (Figure 3A & B) included an unfiltered background water sample (HRF8), unfiltered bag (HFS9=366°C), gas piston sample (HFS5=373°C), finishing of HFS9 (373°C), filtered bag sample (HFS11, =374°C), gas piston sample (HFS2=374°C), piston sample

(HFS22= 374°C), and a filtered sample (HFS21=369°C). Water volumes obtained varied from 250 to 400 ml. Reconnaissance of the top of S&M shows that it has changed dramatically with multiple, new several meter tall new anhydrite-sulfide pinnacles.

Jason Van Configuration



Shipboard analyses of the recovered samples indicate that nearly all fluid samples had more water than expected and looked mixed--black, but not a lot of particulates. There was also an extra gas piston and bag sample than what was believed sampled. Unexpectedly, the samples do not appear gassy and are of higher salinity.

Upon successful completion of the water sampling, JASON lifted off for reconnaissance of the adjacent terrain. At 1436 the structure Needle (Figure 2) was encountered; no obvious venting was observed. A flyover of Bastille was completed and JASON surveyed a portion of Puffer near marker U. Abundant blue ciliates were observed on the outer surface of the structure near sites of diffuse venting. The high-temperature probe deployed in 1999 was imaged. This hobo was deployed in the throat of the main Puffer orifice and was completely sealed in with only diffuse venting observed at this site. The chimney above the hobo deployment site is still very active, although obvious puffing was not observed. The area was difficult to work in with the ROV, and stable fluid temperatures could not be obtained with the temperature probe of the BEAST. One water sample was taken using HFS16; 180 ml was collected. The dive ended at 1500.

June 13 Alvin Dive 3569
Pilot: Phil Forte
Port Observer: John Delaney
Starboard Observer: Marv Lilley

The submersible was deployed at 0830. Alvin reached bottom at 0952 east of S&M and headed north to Hulk over pillow and lobate flows. Alvin reached Hulk at 1026 and measured a temperature of 337°C. The temperature resistivty probe was tested (340°C, V = .176-.177; 335.8°C, V = 0.179; 339.9°C, V=0.177; 338.5°C, V = 0.178) (Figure 4). Major and gas tight water samples were taken (X = 4962, Y=6251) and Marker AX was deployed. Alvin transited towards Grotto, but had difficulty finding it so the sub headed to Bastille. In the area between Grotto and the Bastille complex, the basaltic terrane is heavily fissured and abundant new diffuse flow sites are present within the fissures. The area is highly colonized with the development of 2 m tall bacterial mats that form kelp-like strands that wave within the diffuse flow. While transiting south, the Parascientific® Sensor was deployed (X=4919, Y = 6025, Z =2198) northwest of

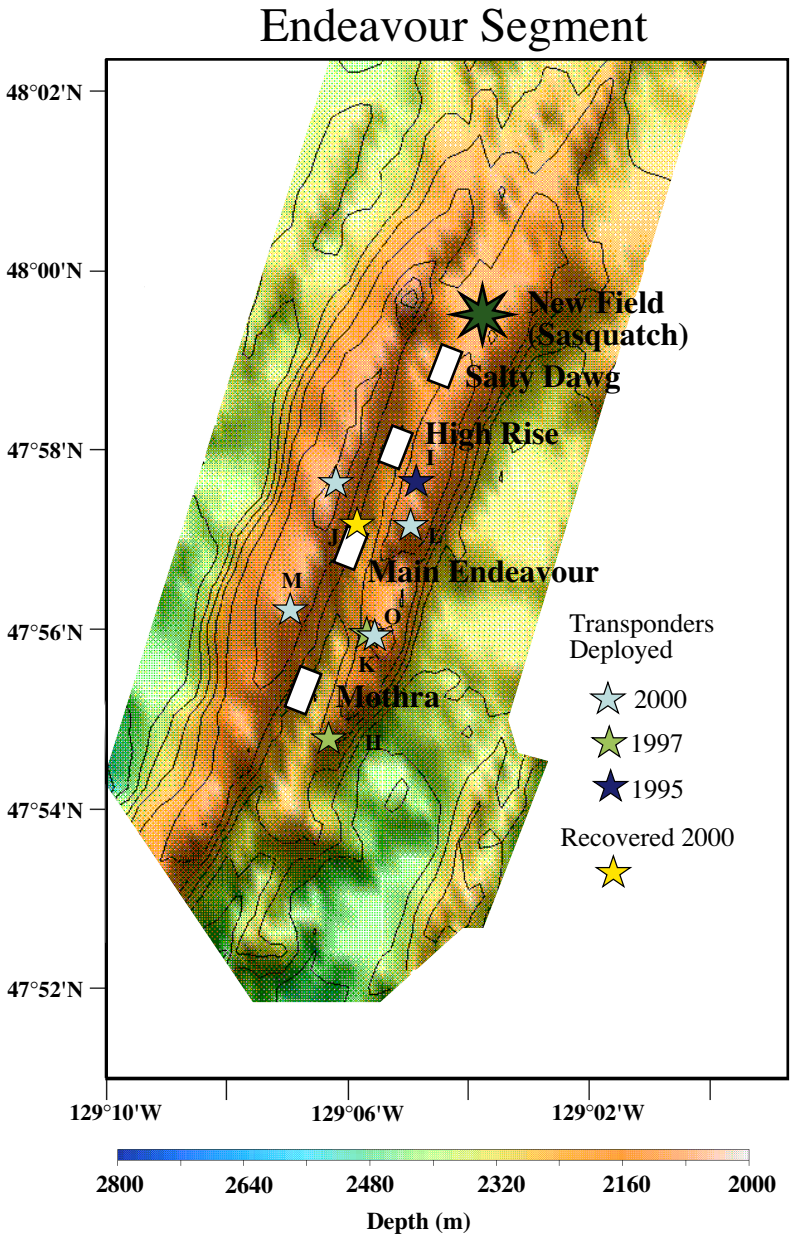


Figure 1. A subset of Seabeam bathymetry collected during this field program showing the location of expendable transponders deployed and recovered during the period 1995-2000. The location of a new vent field to the north of Salty Dawg, which was defined by CTD work during this cruise, is also shown

S&M and marker MD was placed to mark this site. The dive ended at S&M at 1427.

Evening operations included a wireline test of Medusa at 47° 57.47N –129° 5.82 W using the CTD . The test was run at a lowering rate of 6m to 36 m/min to a depth of 2000 m. Follow-on operations included a Niskin rosette with a CTD-turbidity package that was deployed to obtain background water from various depths to create a comparative basis for hydrothermal-vent microbiological studies. Control water was taken at 10 m, 1000 m and 2000m depth in the vicinity of the Main Endeavour Field at 47°57.03N 129°05.69W (Cast #AT03-35-1, June 12) and 47°57.46N 129°05.82W (AT03-35-2, June 13). Quantitative enrichments for halotolerant bacteria and obligatory halophilic archaea were performed on appropriate media. Water was also preserved for enumeration of the total microbial population.

June 14 Alvin Dive 3570
Pilot: Bob Waters
Port Observer: Debbie Kelley
Starboard Observer: Marv Lilley

The goal of dive 3570 was to complete temperature-resistivity measurements at several vents within the Main Endeavour Field with complementary discrete gas tight and major water samples, deploy 1-2 temperature-resistivity probes (Figure 3 D), recover a HOBO at Sully that (Figure 3A) was deployed in October, 1999, deploy 3 additional HOBO's and complete reconnaissance operations for future temperature-resistivity measurements.

Alvin operations began at 0800 with a dive target of X = 5000 y = 5900 south of Milli-Q. Alvin reached the bottom at ~0900 and transited northwest towards Milli-Q (Figure 2). East of Milli-Q several previously unmapped active structures were encountered with multiple sites of moderate venting. Many of the vents were on oxidized structures, which appeared to have been inactive in the past. Approximately 1.5 hours was spent transiting around this area in search of Milli-Q. Although many active structures and sites of diffuse flow with rich tube worm patches were observed, Milli-Q was not found. The decision was made to transit northwest to the Bastille complex and initiate water sampling and temperature-resistivity measurements.

At 1050 a temperature of 372.5°C was measured at the structure believed to be Cannaport, although no markers were observed for definitive identification. Two discrete temperature-resistivity measurements were made with temperatures of 274°C, and at 371°C and corresponding resistivity measurements of 0.816V and 0.368V, respectively. At 1130 fluids were sampled from Cannaport using the major sampler yellow bottle and at 1136 using the discrete gas-tight white bottle. Marker MB was deployed at 1137 (X=4847, Y=5965) and digital pictures of the vent were obtained. During revisitation of this site during the second field program, Marker MB was gone due to melting by hydrothermal fluids (Figure 5).

Following investigation of Cannaport, Alvin transited easterly to the structure Sully, reaching this site at 1158. Digital images were obtained from a smoker near the top of Sully from which a HOBO deployed in October, 1999 was recovered (X=4893, Y=5976, hdg 145, alt = 4.8 m. A several m tall anhydrite-sulfide-rich, multiple spired structure had subsequently grown over the 9 month period and embedded the tip of the HOBO. The HOBO was recovered at 1203, and a solid temperature of 374.5 was measured using the Alvin high-temperature probe. Two discrete temperature-resistivity measurements were obtained at 375.8°C and 374°C, with corresponding resistivity measurements of 0.686V and 0.644V, respectively. At 1309-1313 discrete water samples were taken using the major blue and gas-tight red bottles. Subsequent to water sampling, the temperature-resistivity probe and attached suk-up were deployed. Alvin moved to a second site just upslope from where the temperature-resistivity probe was recovered and measured a vent temperature of 371.6°C. At 1334 the hobo MT was deployed at this site and Alvin left this station

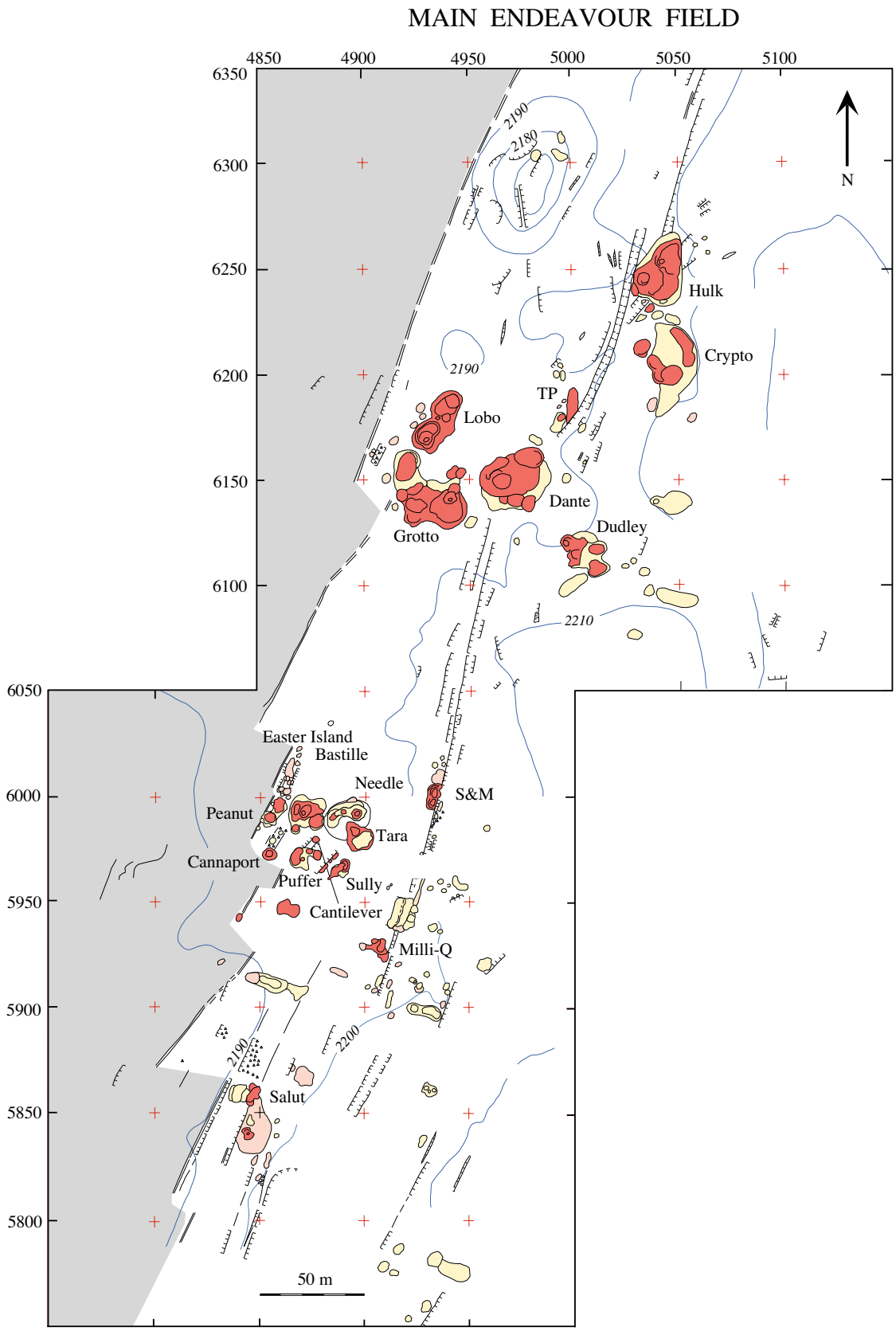


Figure 2. Map of the Main Endeavour Hydrothemal field (after Delaney et al., 1992), showing the location of structures. A new vent complex called "Cathedral was found in the southwestern protion of the field during this program (see acknowledgment page)

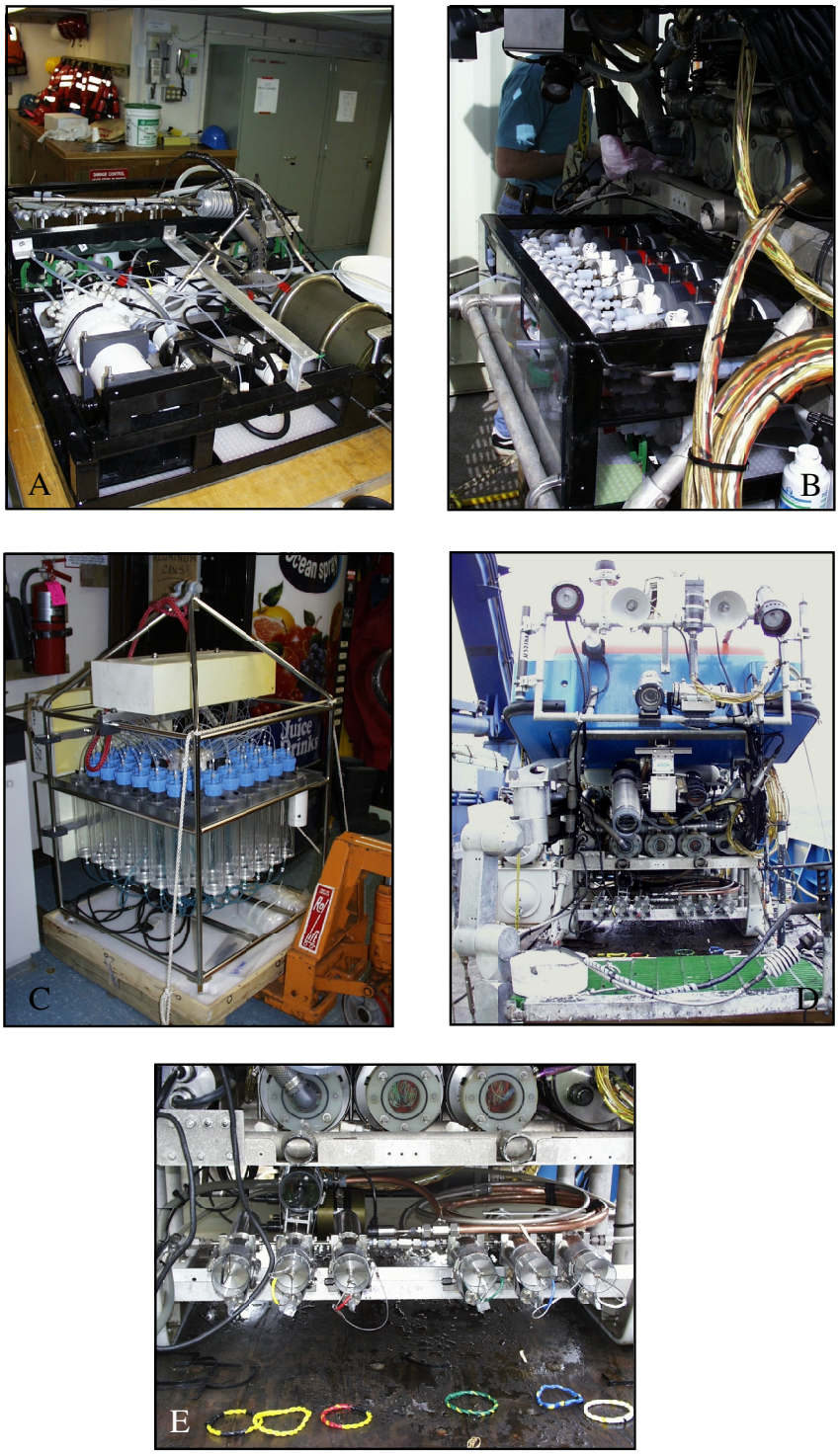


Figure 3. Vent fluid samplers used during this program. A) Fluid-particulate sampler (the BEAST) that allowed up to 14 water samples and additional filtered particulate and microbial samples. B) BEAST mounted on JASON, which allowed over night sampling of vents. C) Stand alone in-situ diffuse fluid sampler (the RAS), which allowed up to 48 water samples to be taken at predetermined intervals. D) Gas tight manifold sampler builts during this cruise. The sampler allowed JASON for the first time to take up to 6 gas tight samples on a single dive. E) Gas tight manifold sampler on front of JASON.

to complete sampling at Puffer. Puffer was reached at 1338 and a temperature of 372°C was measured (X=4885, Y=5984, Hdg = 232, Alt = 6.3 m). At 1348 a fluid sample using the gas-tight black bottle was obtained, a sulfide sample was taken from this vent, and a HOBO was deployed at 1352.

Alvin transited north to Bastille and completed preliminary reconnaissance of this structure. Bastille now hosts several very vigorously venting smokers with multiple orifices and appears to be much more active than in past years. Several newly grown spires are present near the top of this structure. At 1359 a temperature of 379.8°C was measured using the Alvin high-temperature probe (X = 4880, Y = 5994, Depth = 2193, Hdg = 338, Alt = 4.9) and at 1403 a discrete water sample was obtained using gas-tight blue. At 1409 the HOBO ML was deployed in this vent as was triangle marker MB2. Alvin transited up to a new vent from which a temperature of 372.8°C was measured (X = 4885, Y = 5998, Depth = 2189, Hdg = 031, Alt = 61 m). The Alvin temperature probe was dropped and unsuccessful attempts were made to recover it into the basket. However, a large sample of a beehive structure was obtained from the 372.8°C vent. The beehive is chalcopyrite rich with very thin (cm) walls lined with lower temperature sulfide minerals.

Upon completion of the sulfide sampling, Alvin transited up over the top of Bastille onto the flatter plain between the Bastille complex and Hulk to recover the temperature probe into the basket. This was not successful and Alvin left this site to attempt recovery of the MEDUSA near S&M. Following the fissure south towards S&M, an attempt was made to find the MEDUSA, however, a strong northerly current which blue smoke down onto the bench at the base of this structure precluded finding the instrument package. The dive was called due to power expenditure and Alvin came to the surface.

Evening operations included an elevator launch to deploy a current meter as a follow-on operation of the dive.

June 15 Alvin Dive 3571
Pilot: Bruce Strickrott
Port Observer: Marv Lilley
Starboard Observer: Eric Olson

The dive started late due to poor sea state and high winds. Alvin reached bottom at 1231 in an area of dead sulfides and proceeded to traverse on the northeast side of Bastille. Alvin transited to the western axial valley wall and then turned south on the west side of Peanut. The microbiological colander experiment deployed in 1997, was observed at 4885, 6023. Alvin continued to Bastille and at 1323 measured a temperature of 377.6±1.87 at the vent near marker B2. The Hobo deployed during dive 3570 was recovered, and fluids samples were obtained using blue major sampler (had trigger trouble) and the green gas tight bottle. At 1359 a temperature resistivity measurement was made (T = 376.1°C, V = 0.44°C) and the temperature-resistivity probe was then deployed (V = 0.7)(X =4884, Y = 5988). An attempt was made to deploy Hobo UW1, but was aborted. After completing the work at Bastille, the sub transited to Sully and at 1432 recovered the sukup from Sully marking the end of the dive. Following docking of Alvin a second wireline test of Medusa was completed at 47° 56.9079N 129° 5.8743W using the CTD.

June 16 Alvin Dive 3572
Pilot: Pat Hickey
Port Observer: Meg Tivey
Starboard Observer: Eric Olson

Alvin was launched late due to high winds, and reached the bottom at 1057 near an old, extinct sulfide south east of S&M (5019, 5994). Alvin transited over sedimented basalt to the N-S trending fissure and followed it to the north side of S&M. New smokers were observed a the base

of the S&M structure. Alvin went south along the fissure toward Milli-Q. At 1120, Alvin reached Milli-Q (X = 4914, Y= 5940) and measured at temperature of 373.6±1.9°C. Water samples using black major and black gas tight samplers were completed and the temperature resistivity probe 2E3 was deployed (T = 373.8, V =0.47). Sukup 2 was deployed on 2E3. Alvin pivoted clockwise around Milli-Q to a second vent and measured a temperature of 371°C±1.8°C. The Hobo PP was deployed.

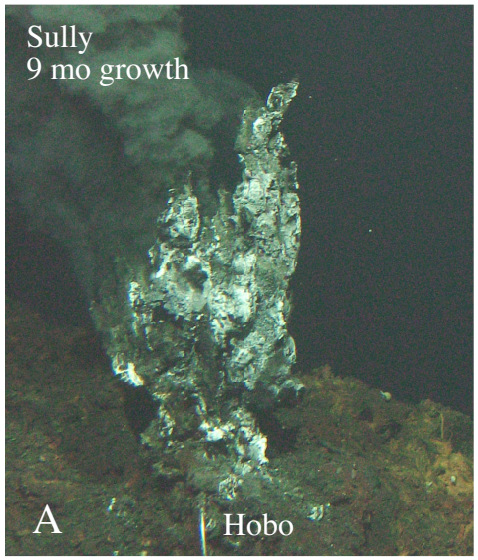
Upon completion of work at Milli-Q, Alvin transited to the west wall and north to Cannaport (4861, 5969) and measured at temperature of 370.5±1.77°C. Fluid samples were taken using the red major bottle, and the orange gas-tight. Resistivity probe 3C2 was deployed (T = 365°C, V = 0.28). At 1253 Alvin reached Peanut and excavated a spire high on the structure, resulting in capture of volunteer sulfide into the basket (X = 4865, Y = 6000) that mixed with other volunteer pieces from Milli-Q and Cannaport. A temperature of 349°C was measured and the Hobo ML was deployed. Alvin transited to the pressure sensor (X = 4914, Y = 6028) and the sukup 1 was retrieved.

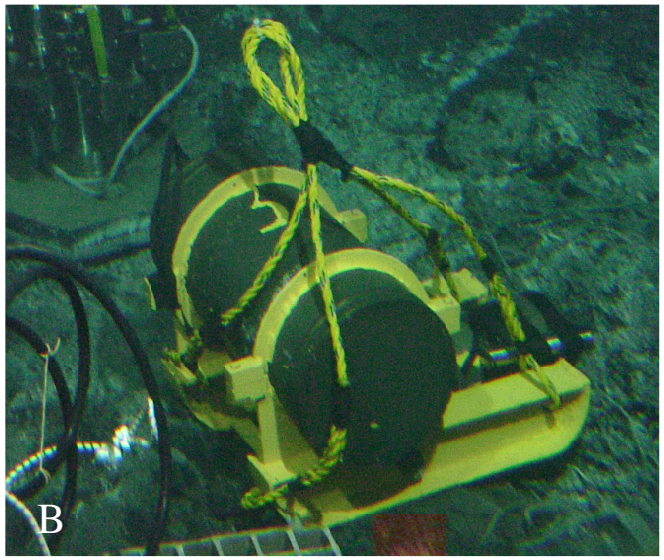
Alvin transited to the elevator and brought the temperature-resistivity probe into the basket, and also placed the current meter upright on the elevator. Alvin then went to Grotto (X=4934, Y = 6135) and measured a temperature of 366.2±1.9°C. Yellow major and bare gas-tight samples were obtained and the temperature resistivity probe 5F5 was deployed at Marker B1. The ICL loop was buried in the basket, so no temperature or voltage measurements were captured. The submersible then transited back to the elevator, retrieved the current meter, and released the elevator. Alvin then started for Easter Island and altered its course to S&M, reaching S&M at 1447 (X = 4948, Y = 6022). The current meter was deployed (4934, 6017) near marker 8K. An attempt was made to recover Schultz's Medusa deployed in 1999, however only the pressure housing could be recovered (X = 4948, Y = 6021). At 1500 the weights were released. Upon nearing the surface, Pat Hickey noticed that the recovered pressure housing was streaming bubbles and so the pressure housing was jettisoned.

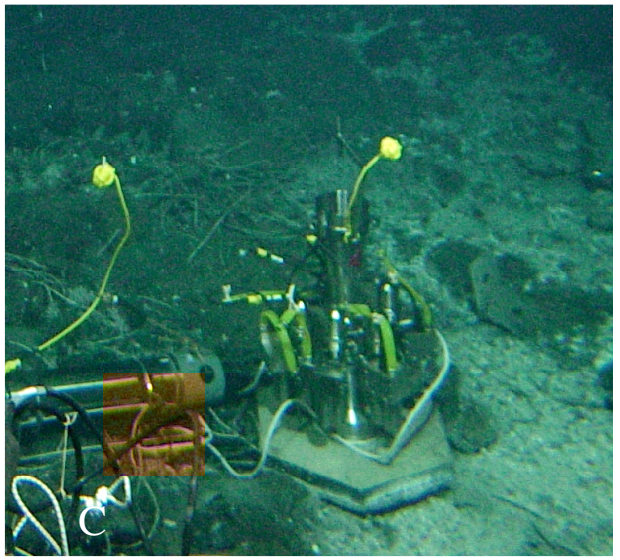
June 17 JASON Dive 276

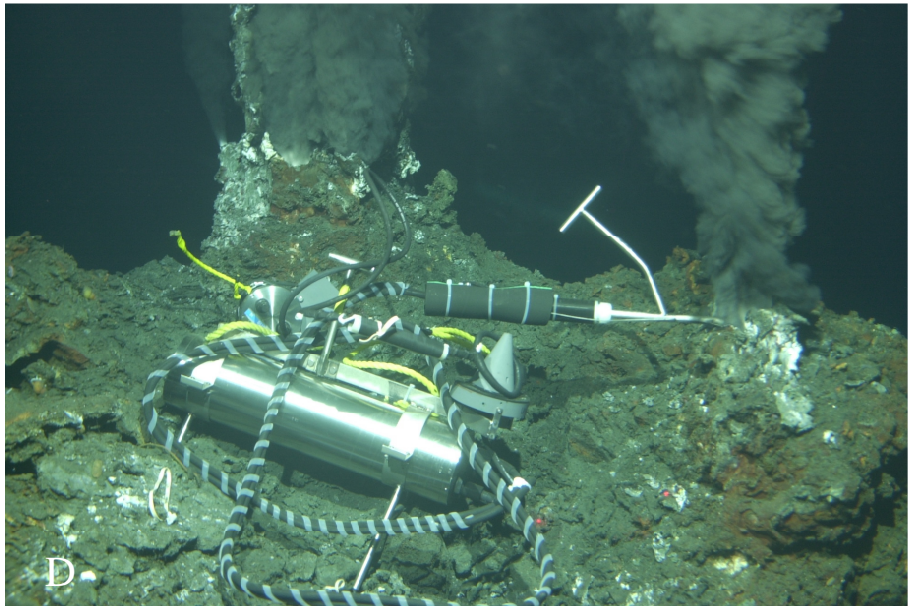
The goal of this dive was to complete a 24 hour sampling session using JASON and the BEAST. JASON reached bottom at 1122 approximately 50 m east of S&M in an area of rough topography, extinct sulfides, and oxidized hydrothermal sediment (Figures 2&5). The pan and tilt capability of the camera failed and was worked on from 1157-1216. After fixing the pan and tilt and calibrating the gyro JASON transited westward to S&M. At S&M the vent visited on the JA275 dive was revisited and a HOBO was inserted into the orifice, which was located about 2 meters up the structure on the most northern face (Figure 5). Jason transited westward to the axial valley wall in the vicinity of Easter Island and south to the structure Peanut. From Peanut, Jason transited to Bastille to work at the temperature-resistivity site and to begin intensive water sampling. The ICL loop was tested on the temperature-resistivity probe, but JASON was not able to listen to this instrument package.

The high-temperature fluid-particulate sampler intake was first positioned into the same orifice that the resistivity probe was placed, but because of the precariousness of this site, the adjacent orifice at the same vent was chosen as the sample site. There were problems with the computer operating the BEAST, perhaps in part because the ICL, 3-chip and BEAST were all on the same science bus. After rebooting, a temperature of 378°C was measured. The orifice was difficult to work in, however, and the intake was inserted multiple times. At 1458 the first water sample was obtained (bag 38) with about 500 ml collected. Problems were encountered with the computer and the system was rebooted multiple times. Upon additional water sampling, the flushing pump became clogged with particulates and stopped working. At 1530 HFS #1 was sampled with a volume of 140 ml. After continued reinsertion of the probe the orifice was changed significantly. It was difficult to measure a high-temperature-this was partially due to the flushing pump failure and to the difficult working conditions at this vent. At 1720 bag 11 was filled with a









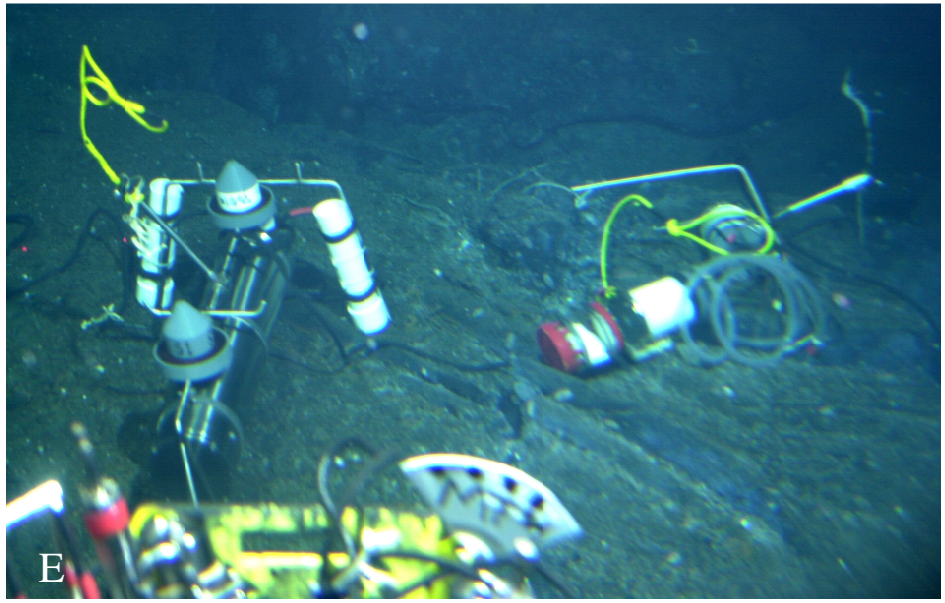
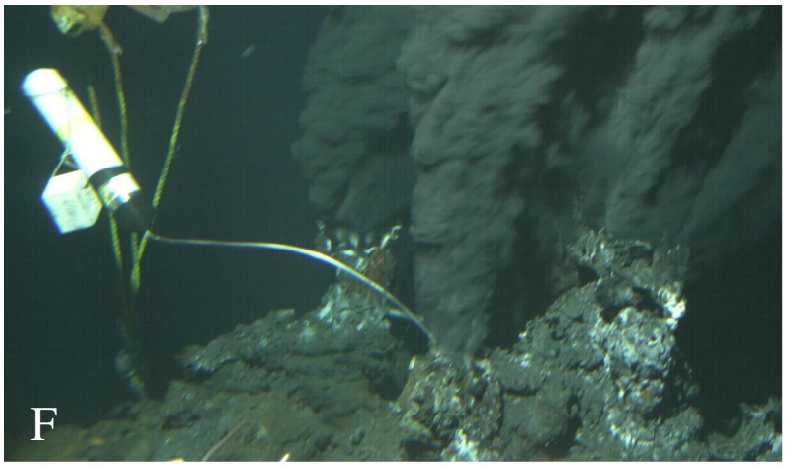
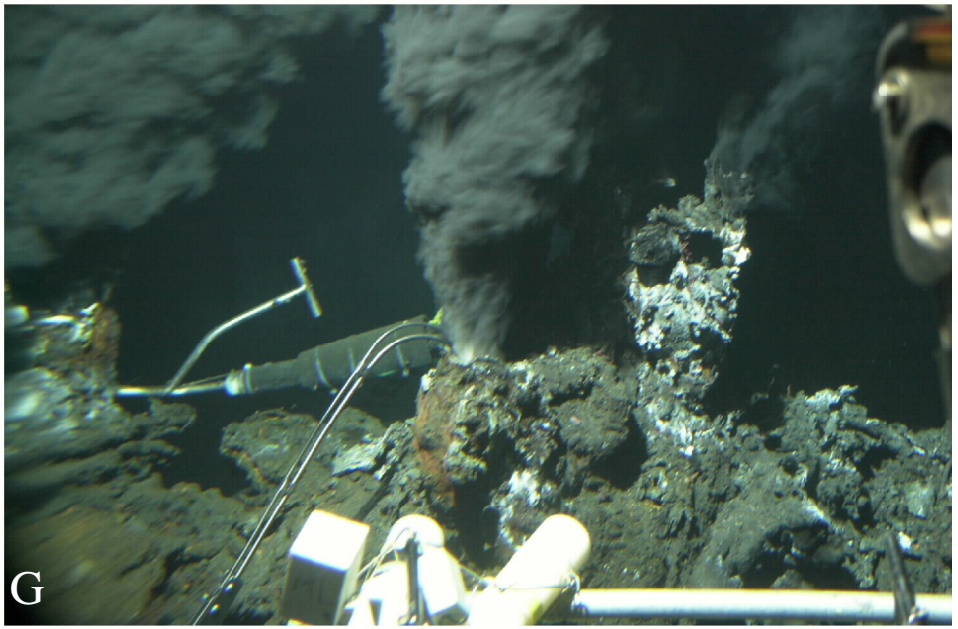


Figure 4. A subset of in-situ instruments utilized during the first leg of the Perturbations project. A) Hobo emplaced at base of the 380°C vent "Sully". This temperature probe, deployed in 1999 recorded 9 months of data. Subsequent to it's recovery a new Hobo was emplaced. Note several meters of new sulfide grwoth. B) Gamma detector at Easter Island deployed adjacent to Medusa. C) Medusa deployed at the diffusely venting site Easter Island. D) Temperature-resistivity (chlorinity) probe deployed in Sully at vent where Hobo was recovered. E) Thermistor array and osmo sampler at the S&M experimental site.





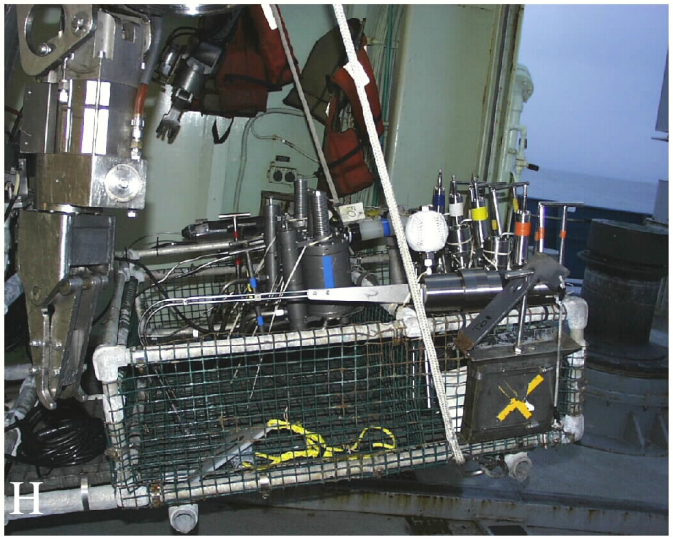


Figure 4 cont. F) Hobo in Sully which was left for a 1-year deployment. G) The Sully vent site showing the hydrogen probe in the foreground and a temperature-resistivity probe to the back. H) Basket of Alvin with gas-tight and major water bottles, the hydrogen probe (instrument with softball handle), a toaster for radon measurements, and numerous hobos. Cable in basket runs to an ICL loop.

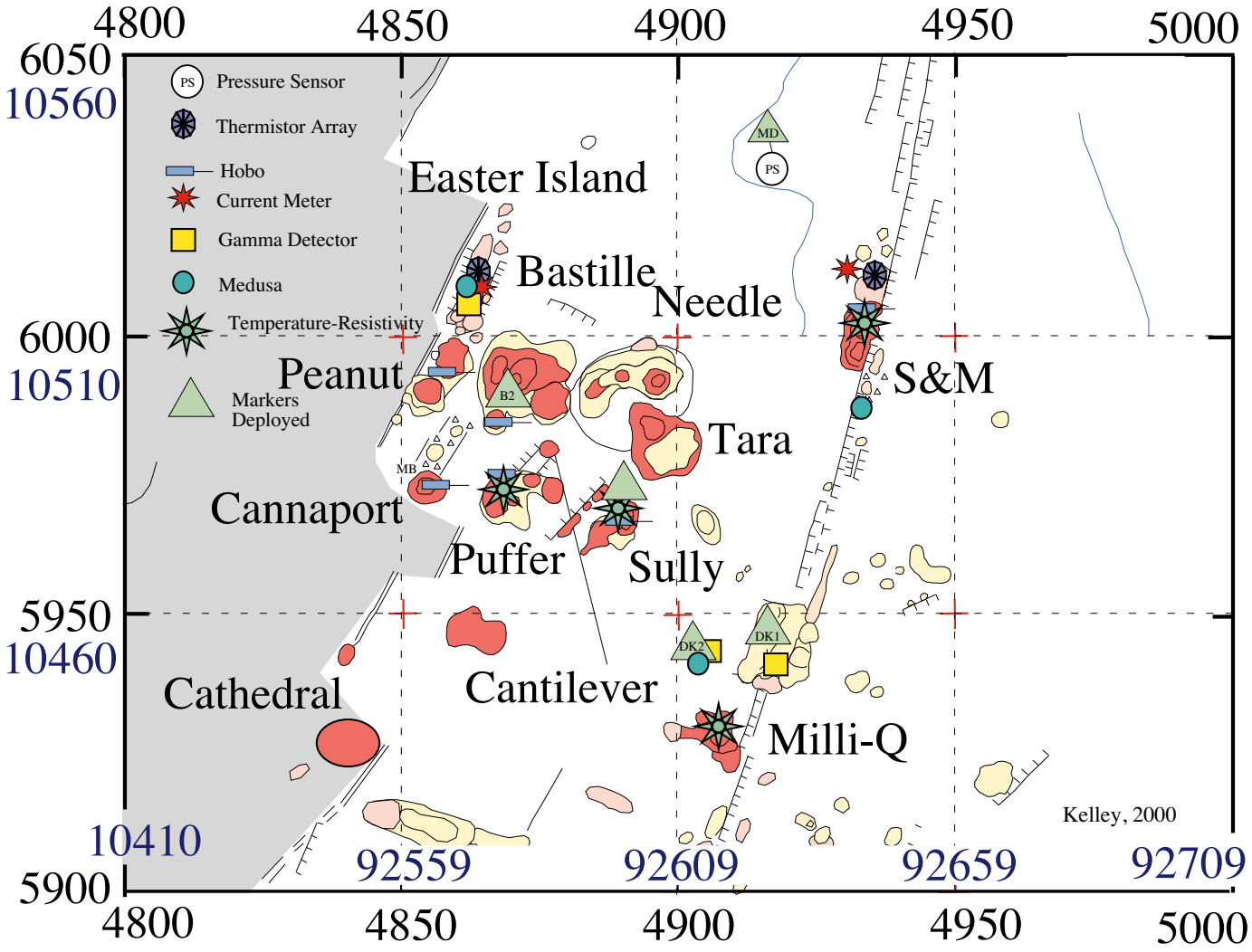


Figure 5. Final location of instruments and markers deployed in the southern portion of the Endeavour Ridge Observatory site during the first leg of the "perturbations" study. Most low-temperature instrument experimental site were chosen because of their proximity to high-temperature sites (S&M, Easter Island, and DK2). High-temperature sites were chosen based to measure temperature and chlorinity gradients within the field. A temperature-resistivity probe and two Hobos were also deployed in north of the Bastille complex. Also shown in this digram is the location of the newly discovered vent complex "Cathedral". This site is unique to the Endeavour in that it hosts abundant delicate, white smoker spires that are up to 4 m tall. The 300•C vents are in close proximity to one, more massive structure, and to abundant lying, white flanges that lack significant macrofanual communities.

temperature of 360°C, and the dive was called due to the failure of the pump and ICL. Upon pulling away from the sampling site, reconnaissance was done above the vent and at the top of Bastille. There is a black smoker on the south side of the structure and the cap is characterized by two distinct candelabra structures with multiple venting orifices. Jason transited over the top of Bastille and imaged the beehive structures on the south side imaged during dive 3570. At 1751 JASON left bottom.

June 18 JASON Dive 277

JASON Dive 277 was initiated at ~ 0300 to begin around-the-clock water sampling at Bastille to catch tidal low and possible perturbation. During launching of MEDEA, while the crane was going out there was an apparent failure of the control box and the wire rapidly played in, pulling MEDEA into the winch block. MEDEA fell to the deck and bounced over the side. The winch cable parted and caught fire and pieces of the block became shrapnel. MEDEAS tether, although partially parted held and MEDEA dangled over the side for almost 1.5 hrs while the deck crew worked hard to recover the vehicle. Thanks to the crew and Bosun, MEDEA was safely recovered and an evaluation of the failure and status of both JASON and MEDEA began. The down-looking camera on MEDEA was lost and the frame bent. MEDEA and JASON were secured. The day was a down-day to allow evaluation and rest of personnel involved.

June 19 Alvin Dive 3573

Pilot: Steve Faluotico
Port Observer: Dave Butterfield
Starboard Observer: Marv Lilley

Because of the JASON mishap an extended Alvin dive was planned at Bastille, with the goal to obtain vent fluids for ~ every hour water to catch a tidal low beginning at 0800. Alvin went into the water at 0600 and reached the bottom ~100 m east of S&M. It then drove to Bastille loaded with gas-tight and major water bottles. The table below summarizes the water sampling for this portion of the program, which was completed at the same orifice as the one sampled by JASON.

Table 4: Tidal water sampling at Bastille

Time	Depth	Hdg	X	Y	Alt	Bottles Triggered	Temp (°C)
0950						Black GT, Blue major	379.8
1002							379.9
1055	2192	167	4880	5997		Orange GT, Yellow major	380
1155						Blue GT	379.9
1316						White GT	379.7
1335						White MJR Pr	
1410	2194	165	4878	5994	2.7	Hi T	379.2
1415						No tape GT	
1420						Red simple major	
1450	2194	164	4878	5995	2.6	Green MJR Pr Red GT	379.1
1512						Yellow GT	

Sampling ended at 1512 as the submarine left the bottom.

Although obvious perturbations were not observed during this event, data recovered from the HOBO at Puffer shows that a small ~10-12°C perturbation occurred, which was also observed in a fainter single by the temperature resistivity probe in Sully (see dive 3578).

Evening operations included a third wireline test of Medusa on the CTD at 47° 56.9079N 129° 5.8743W, using a lowering rate of 3 to 36 m/ minute. The instrument was lowered to a depth of 2059 m.

June 20 Alvin Dive 3574
Pilot: Phil Forte
Port Observer: Dave Kadko
Starboard Observer: Meg Tivey

The purpose of Dive 3574 was to carry out reconnaissance for deployment of low temperature instruments (Figure 5). Areas targeted included Easter Island and the area to the north of S&M. If time permitted the plan was to recover the suk-up that was on the resistivity probe at Milli-Q.

Alvin reached bottom at 0928, setting down over sedimented basalt (x=5019, y=5994). As Alvin transited west it came up a wall, passing two dead sulfide spires. At 0942 two pieces of basalt were recovered from the wall below S&M (x=4952, y=5986). Alvin then proceeded up the scarp, past diffuse flow, over tubeworms, white staining, and crabs. Alvin proceeded north, up the wall to the top, came southwest, passed the pressure sensor and Marker MD, and then turned west to Easter Island. At 1023 Alvin arrived at Easter Island. A pan and tilt survey was carried out from 1040 to 1046 (Hdg 279, y6021, x4884), the colander was recovered at 1110, temperatures were measured in areas of diffuse flow from 1115 to 1123 (7 to 62C using the high temperature probe), gamma readings were made from 1126 to 1145, Marker 3 (Bike flag) was deployed at 1153, and the concrete Medusa Base was emplaced at 1155. Alvin then maneuvered to reach other possible low temperature sites at Easter Island. Temperatures and gamma readings were made at different spots at x = 4882, y = 6025, hdg 250 (2°C to 36°C), a temperature of 25°C was measured ~10 inches from the colander site (x=4880, y=6024, hdg 251), and marker MT1 was deployed. More maneuvering was completed, and Bike flag 2 was deployed.

At 1359, Alvin left Easter Island, heading east to the area north of S&M. At 1416 two concrete bases and marker MT3 were left within 10 to 15 m of current meter MAV-1 (at x = 4929, y = 6011), and a background gamma reading was taken.

Alvin then transited over sedimented pillows and lobate flows to the base of Milli-Q. An attempt was made to recover the suk-up from the resistivity probe at Milli-Q, but Alvin became lost on the smoke and the current was very strong. Alvin circled a small structure, ~ 2 m in diameter and 3 m high, active at the top but with no smokers, and then left the area, heading east before dropping the weights at 1500.

June 21 Alvin Dive 3575
Pilot: Bob Waters
Pit: Anthony Tarantino
Port Observer: Deborah Kelley

The goal of this dive was to complete a reconnaissance survey of the newly venting area believed to be southeast of Milli-Q, work Salut and deploy a Hobo, survey the area adjacent to the western valley wall during transit to Grotto, listen to the temperature resistivity probe at Grotto with the ICL, and to obtain water samples from Dudley (Figure 2&5).

This dive was the third pit dive for Tarantino. The dive started on time, but required significant driving in the water column because the dive target had been changed and was in error by 800 m south of the target. Alvin reached bottom by ~0930 about 50 m east of S&M. Alvin transited east and dropped off a gamma detector at the north side of S&M at the same location where Medusa weights had been deployed the previous dive.

Alvin transited south to Milli-Q and recovered a temperature-resistivity probe. A short survey was completed in the area southeast of Milli-Q, however this was not highly successful due to the high speed driving and operator navigation difficulties with Alvin. However, two new venting sites approximately 20 m southeast of Milli-Q were examined. They include small diffusely venting structures: one of which measured 247°C, and the other 303°C (4917, 5909, hdg 022). This site was weakly venting, light smoky fluid, but upon excavation more vigorous venting occurred.

Subsequent to completion of the survey, Salut was worked. A small orifice (357.1°C) on the top of Salut, which lacked a chimney, was sampled using blue major and white gas tight bottles (X = 4866, Y = 5872, hdg = 248). Digital images of this site were taken and the Hobo ZO was deployed with a sampling period of one year.

A survey of the western boundary of the axial valley wall was attempted, but driving-orientation problems associated with having a young pilot precluded this operation and a direct transit was made to the western edge of the Bastille complex and then up to Grotto. At Grotto (1344), the temperature-resistivity probe was listened to using the ICL and 5 measurements were made (temperature = 364°C)(X = 4947, Y = 6134, hdg = 332). Since the deployment on 6.16.00 of the temperature-resistivity probe an approximately 1 m tall sulfide-anhydrite-rich edifice has grown.

Alvin reached Dudley at 1359 and sampled an active vent on the top of the structure (X = 5006, Y = 6117, hdg = 165, alt = 9.4 m). A steady temperature of 362.8°C was measured and fluid samples were taken using the major black bottle and the green gas tight bottles. A short reconnaissance survey at the base of Hulk was completed to examine possible sites suitable for deployment of the gamma detector, medusa and thermistor arrays. The western side of the structure hosts diffuse flow site on sheet flow and lobate to pillow flows. The sheet flow area is bounded by a large fissure and hosts a large tube worm colony, however temperatures were too low to be measured with the Alvin high-t probe. The second area was more active, a temperature of 10.6°C was measured using Alvin's high-temperature probe (X = 5046, Y = 6233, hdg = 159-289). Fluid samples using red major and black gas tight bottles were taken at this site and video imagery was collected. This ended the dive sequence and at 1500 the weights were dropped.

Evening operations included an aborted elevator drop, the goal of which was to get another current meter to the seafloor. The drop was aborted, however, because the Datasonic acoustic release failed to release.

June 22 Alvin Dive 3576
Pilot: Bruce Strickrott
Port Observer: Adam Schultz
Starboard Observer: Dave Kadko

The goal of this dive was to characterize the low-temperature experimental sites and begin instrument deployment. Alvin reached bottom at 0910 in the area east of S&M. After transiting to S&M, the gamma detector and concrete Medusa bases were located. The gamma detector and one concrete base were brought into the basket and Alvin transited to Easter Island to begin deployment operations (Figure 4).

At Easter Island, temperature measurements were conducted in diffuse flow sites on an apparently solidified, smooth topped bottom on which the Medusa base was deployed (51°C, X=4881, Y = 6028, hdg = 232). The diffuse flow is concentrated at the periphery of the silicified material. At 1034 spot measurements were made with Medusa which showed effluent temperatures of 12°C. Medusa was deployed at this site and the water sample bottles were

programmed to fire starting on 23.06.00 every three hours. The deployment was complete at 1142.

High-temperature measurements were subsequently made for preparation of deployment of the gamma detector (X = 4885, Y= 6023, T = 24.5°C, 38.5°C). This area gave a relatively weak radon signature. At approximately 2 meters northeast of Medusa a temperature of 107°C was measured at the base of a small 10 cm high ledge which hosted palm worms, and from which diffuse fluids were venting. This site exhibited a stronger radon signature and was chosen as the deployment site for the gamma detector (X = 4883, Y=6022, Z = 2194; hdg = 215). At 1313 a major sampler was taken. A temperature of 12.8°C was measured at the diffuse flow site Maker G.

The submersible transited towards S&M to complete reconnaissance and at 1356 a temperature measurement was taken in a fissure at the base of the northern flank of S&M of 14.6°C (X = 4941, Y = 6027, Hdg = 246). At Marker R, diffuse flow temperatures measured 13.2°C (X = 4936, Y = 6031, Hdg = 183).

Evening operations included the successful wireline deployment of the McLane stand-alone water sampler and two Hobos that were attached to the sampler north of S&M (X = 4915, Y = 6065)(Figure 3). Due to the experience gained on the previous nights aborted drop, two Datasonic® acoustic releases were linked in parallel. Follow-on operations included a vertical CTD for background ocean water sampling and to obtain an accurate sound velocity-conductivity profile. The vertical cast was completed ~ 10 miles east of the ridge at 47° 57.0N and 128° 55.0W.

June 23 Alvin Dive 3577
Pilot: Pat Hickey
Port Observer: Meg Tivey
Starboard Observer: Steve Liberatorie

The purpose of Dive 3577 was to deploy two sets of thermistor arrays and short-term osmo samplers at Easter Island and north of S&M(Figures 4 & 5). The Remote Access Sampler (RAS)(Figure 3) also needed to be placed at one of the thermistor sites, two temperature-resistivity probes needed to be recovered, and the pressure sensor needed to be re-deployed.

Alvin reached bottom at 0906, landing at the edge of a scarp, and transited west over a small ridge with a dead sulfide structure on it, passing a string of markers, and coming to a wall of diffuse flow. Alvin proceeded up the wall below S&M, and wandered some while looking for Marker D. At 0928 the pressure sensor was redeployed at Marker D (x=4919, y=6031). Alvin then transited west to Easter Island (x4883, y6030), where two thermistor arrays (TM3 near Bike flag 3 and TM4 near the enya marker), logger 2 (x4877, y6027), and the blue osmosampler (with TM4) were deployed between 0945 and 1054. A pan and tilt survey of the site was carried out at 1030, and video was collected showing the locations of the thermistors. Alvin left Easter Island for the area north of S&M at 1106 (x4930, y6025). Two thermistor arrays (TM1 in a crack and TM2 over a patch of worms), logger 1, and the red osmosampler (with TM1) were deployed between 1114 and 1158. Video of the thermistors was taken from 1209 through 1228.

At 1231 Alvin left the area north of S&M, went north to retrieve the RAS (from x4912, y6054), and returned to north of S&M by 1251. The RAS was deployed (x=4934, y=6027) and the nozzle was put down the crack within 2 feet of TM1. A temperature taken near the intake with the high temperature probe measured 5C.

Alvin then transited west and south, around Peanut and down to Cannaport. The ICL was used on the Resistivity probe (T=367C, 0.11v), and the red gas tight was taken at 1337:42. Digital pictures of the new growth were taken, and then the Resistivity probe was recovered at

1343. Alvin then transited to Sully where digital pictures were taken of the new growth at 1359. The ICL was used on the Res probe (374C), some nice 3-chip video was taken, the yellow gas tight was fired, and the Res probe was recovered at 1414. Alvin then transited east and dropped weights at 1417.

Night operations involved initializing a Seabeam survey of the Endeavour and Middle-West valley areas for use in CTD operations and to obtain a more recent map of this area (Figure 6).

June 24 Alvin Dive 3578
Pilot: Steve Faluotico
Pit Pilot: Mark Drewery
Port Observer: Adam Schultz

The goal of this dive was to deploy the Medusa at Easter Island and to complete reconnaissance for other diffuse sites acceptable for deployment of another Medusa and gamma detector deployment. The dive started on time, and Alvin reached the bottom at 0921 at the normal landing site east of S&M. At 0945 a temperature-resistivity probe was deployed near the RASTIS site for cold storage. Subsequent to this a reconnaissance survey was completed using the Medusa for possible deployment sites. At 1000 a small fissured area immediately north of S&M was examined with a temperature of 16.3°C measured (4930, 6036, hdg 184). A few meters northwest a spot flow measurement was made near a deep crack adjacent to the ROPOS marker. Several more measurements were completed in this area and then Alvin transited to east to the base of the scarp at S&M. There was abundant diffuse flow in this location (4941, 5997, hdg 148). This site was deemed acceptable for a MEDUSA experiment and the marker DF1 was deployed. Alvin returned to the top of the scarp and picked up a cement base from the cold storage area and at 1207 redployed it at marker DF1. This area was called S&M east (4947, 5993, hdg 244). Temperatures of 16°C were measured in this area. Alvin departed at 1219 for Easter Island.

At 1230 Alvin reached Easter Island at the Medusa site (4884, 6018, hdg 189). Limpets had already highly colonized this deployment after two days, and Medusa 1 was switched out with Medusa 2. Spot measurements indicated good diffuse flow at this site. at 1309 the programming for bottle tripping was completed, with the bottles scheduled to begin firing at 0000 on June 28. It is believed that a ground in the cable and decoupling from the Alvin caused the operating program for Medusa to go into standby mode. No data was collected on the Medusa recovered from Easter Island deployed on dive 3576, and the bottles did not fire.

The submarine was then repositioned adjacent to the gamma detector and a temperature of 50°C was measured on the ledge on which the gamma detector was to be repositioned. Temperatures at the top of the detector are 4-10°C. Diffuse flow in this area is issuing from a small crack where the highest temperatures at the source are measured at 23°C. At 1348 the gamma detector was repositioned to this site ~ 10 cm away from it's original placement in fluids that are believed to be 7-12°C. Alvin departed this site at 1359 and transited to Sully to recover the Hobo. This was successfully completed at 1411.

At 1428 Puffer was reached, the Hobo at this site was recovered, and a small area of diffuse flow at the base of the structure was examined (4884, 5970, hdg 337). Temperatures of 5.1-13°C were measured. Marker DF2 was deployed and the dive ended at 1506.

Hobo data from Sully and Puffer were downloaded subsequent to recovery. A moderate to weak tidal perturbation on the day of the full moon (June 16) was recorded on the Hobo recovered from Puffer. This was correlated with a weak temperature-resistivity anomaly at Sully recorded by the in-situ probes. Another perturbation was observed in Sully, however, this may have been due to insertion of the probe into Sully. In contrast, the Puffer perturbation occurred a couple days subsequent to deployment of the probe.

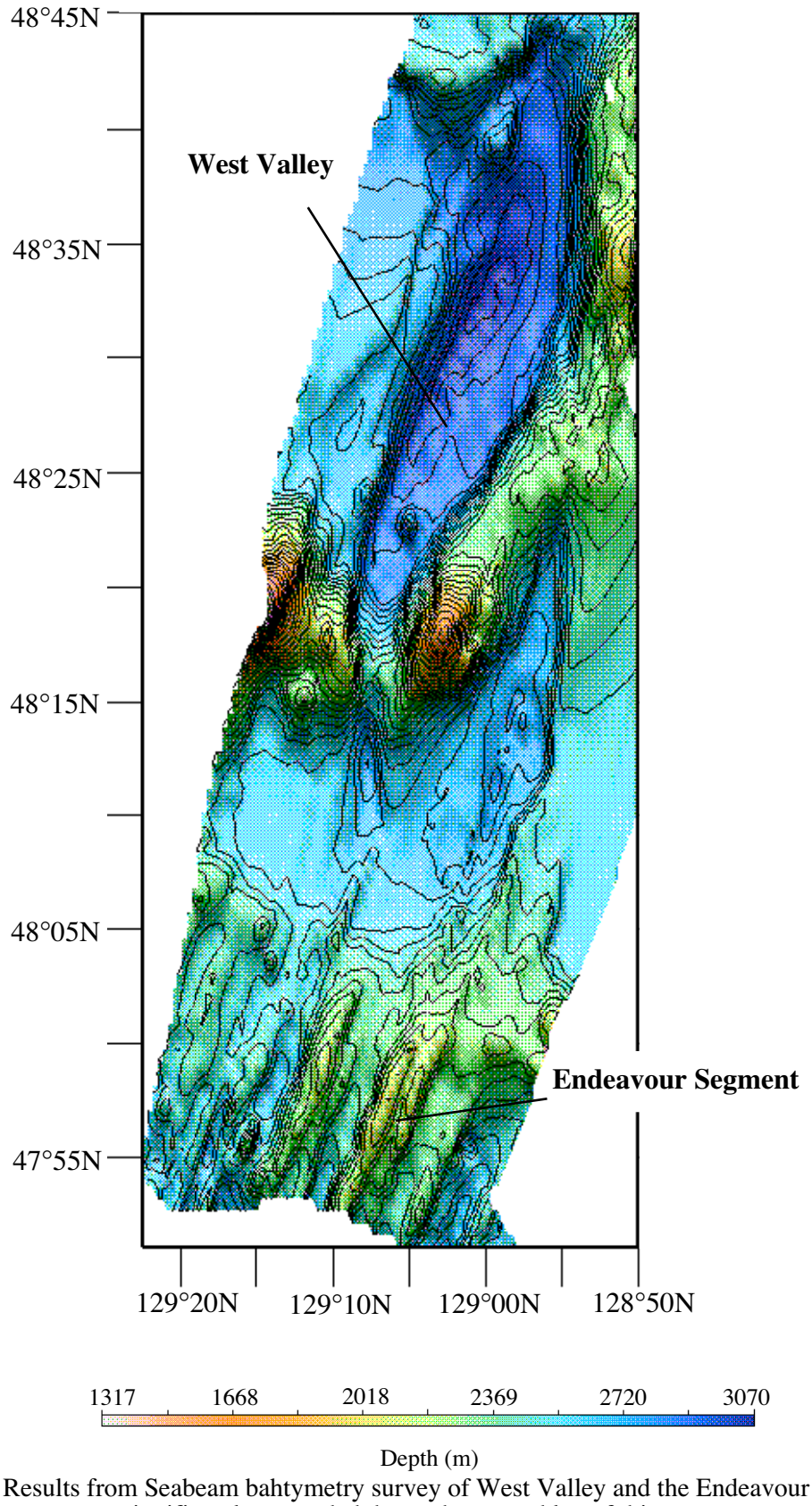


Figure 6. Results from Seabeam bahtymetry survey of West Valley and the Endeavour Segment. This survey area was significantly expanded durng the second leg of this program.

Evening operations included a CTD tow-yo to explore for new venting sites north of the axial summit to Middle Valley. The tow AT03-53-6, began at 1943 approximately 1 km south of the Main Endeavor Field (47°56.057N, 129°06.171 W). The tow was conducted along strike of the axial valley at 1 knot and ended at 0400 on June 25th at 48°02.195N, 129°03.153W.

June 25 Alvin Dive 3579
Pilot: Phil Forte
Port Observer: John Delaney
Starboard Observer: Dave Butterfield

The goal of this dive was to use the BEAST to sample diffuse flow sites in a series of locations likely for experimental sites and to deploy a temperature-resistivity probe at Milli-Q. Alvin reached bottom at 0849 and transited toward Milli-Q. The diffuse flow site was 10 to 15 m away from Milli-Q. Water sampling began at 1015, with temperatures of 9.0°C to 11.5°C measured. At this site, piston 4, bag sample 8, microbial filter 7, and GFF filter 10 were taken. Alvin transited to the northwest of Milli-Q and at 1254 begins sampling again with the Beast (X = 4934, Y - 6021, hdg 034). Subsequent to completion of sampling at this site, Alvin transited to the instrument site north of S&M and took samples piston 5, bag with filter 11, Cerevex filter, gas piston 22, gas piston 20, and bag with filter 17. At 1420, the resistivity probe was deployed at the storage area northwest of S&M. Follow-on operations included sampling at the base of S&M where the Medusa had been placed during a previous dive. Samples included bag 14, piston 23, bag filter 19. This completed the goals of this dive and Alvin returned to the surface.

June 26 Alvin Dive 3580 (HUMP DAY)
Pilot: Bob Waters
Port Observer: Debbie Kelley
Starboard Observer: Marv Lilley

The dive started on time and reached the bottom ~0915 just east of S&M (5000, 6025). Alvin transited west to the equipment storage area near the current meter deployment and recovered what was believed to be a temperature-resistivity probe. The instrument turned out to be the pressure sensor, and about 30 minutes was spent redeploying this instrument in on flat ground. Subsequent to this the resistivity probe GB'4 was recovered from the this area and Alvin transited to Sully for its deployment. At 1021 a temperature of 379°C was measured at the vent where the temperature-resistivity probe had been previously deployed (4895, 5974, hdg 147) and a gas tight (green) sample was taken. During the attempt to deploy the temperature-resistivity probe in Sully, the thermocouple became parted from the electrodes, preventing placement of the probe tip in the vent orifice. At 1045 the Hobo PP was deployed for a sampling period of 3 months.

Alvin transited to Puffer for reconnaissance of deployment site for a resisitvity probe, reaching the site at 1111. The low-laying flange was investigated at which previous Hobos had been deployed and water samples taken, and a temperature of 380°C was measured (bad fixes because down low). After attempting to place a Hobo by the flange, this site was abandoned and a site at the top of the structure was chosen for placement of a Hobo. During this process, the ~ 1 top portion of the candelabra structure was knocked over. The Hobo M&M was deployed at a small orifice on the north side of the structure.

At ~1140, the ship called down to give a weather warning, so the decision was made to recover the non-working Medusa at Easter Island. Alvin transited to this site and successfully recovered the Medusa. Video imagery was taken of the cement bottom platform showing extensive biofouling in the sampling area which covered approximately 1/2 of the orifice. At 1220, Alvin reached Cannaport were the Hobo MT was deployed with a sampling period of 3 months (4835, 5969, hdg 273, alt, 2.6). The top of the structure contains abundant small vigorous to moderately

venting chimneys. Subsequent to this, Alvin drove to Cantilever where a temperature of 362.9°C was measured (4824, 5973, 094). The vent orifices were too small for Hobo deployment.

Alvin drove to S&M for reconnaissance of a site in which to place a temperature-resistivity probe. The northern vent where the Hobo was deployed was too steep for instrument deployment and therefore Alvin drove south over the top of the structure. S&M has changed dramatically in the last year or so with much new growth at its top and more high-temperature orifices. At 1325 an possible deployment site was found (4945, 6016, hdg 212), but the temperature of the vent was only 352°C. About 8 m south a second vent was found which measured 374°C (4938, 6009, hdg 257) and an orange gas-tight sample was taken. However, when the resistivity probe was placed into the vent, it was clear that the orifice was too small for the tip and so a third vent was examined about 2 feet to the west of the 347°C vent. This vigorously venting chimney measured 375°C (4945, 6012, hdg 245, alt 24.5). The vent it at the far western side of the structure and the tip was precariously placed within the vent, but the deployment was successful. The instrument was checked with the ICL and at 373.3 read 0.155 V. Alvin then drove to Grotto where the temperature resistivity probe was recovered (4960, 6119, hdg 315, alt 5.6) and a gas-tight blank bottle was used for sampling near Marker B1. The dive ended at 1452.

June 27 Alvin Dive 3581
Pilot: Bruce Strickrott
Port Observer: Meg Tivey
Starboard Observer: Dave Kadko

The purpose of Dive 3581 was to locate 2 sites for deployment of long-term gamma spectrometers (Figure 4B) and to release the RAS. Alvin was launched late because of high winds, and reached bottom at 1103. Alvin transited west toward the scarp, and came up the east-facing side of S&M, reaching the RAS at 1123. Hobos were recovered from the RAS, and the RAS nozzle was removed from the crack (leaving the T-handle and vemco temperature logger lost in the crack) at 1138 (x=4935, y=6028). Suk-up 2 was placed on the master loop of thermistor logger 1 at 1149, and then the RAS was released at 1211:34. The suk-up was recovered at 1220. Alvin then moved to Marker MT2 (x=4934, y=6029), and temperature (up to 16°C) and gamma readings (up to 2665 counts over 5 minutes versus 1600 counts over 5 minutes over basalt) were taken from 1249 to 1323.

Alvin left marker MT2 at 1331 and headed to the east of S&M Medusa base site (marker DF1, x=4942, y=5993) where temperature measurements (~7°C) and gamma readings (~2600 counts) were made from 1350 to 1412.

Alvin then transited south toward MilliQ, and stopped at a patch of diffuse flow just north of Milli-Q (x=4930, y=5944). Temperature measurements (44 to 158°C) and gamma readings (very high, causing errors in sensor (35000 counts in 1 minute 6 inches off bottom)) were made from 1427 to 1454. A piece of sulfide was removed from the orifice (it had lain loosely on top) and placed in the starboard basket at 1431. Fluids were sampled using the green major at 1458-1459 and blue gas tight at 1502:45, and marker DK1 was deployed.

Alvin continued south to Milli-Q, and began to circumvent it clockwise. A cluster of white to gray smokers was found (x=4909, y=5940) and temperatures were measured (~116°C to a high of 285°C) and 2 toasters were taken between 1518 and 1530. Before leaving the site and dropping weights at 1533, a piece of sulfide that broke off while excavating the orifice was placed in the port basket.

June 28 Alvin Dive 3582
Pilot: Pat Hickey
Port Observer: Martin Walker
Pit: Fran Taylor

The purpose of this dive was to deploy a Medusa (east of S&M), 2 Resistivity probes (and take 2 gas tights at Sully and Puffer), 3 Hobos (at Dudley, S&M, and Puffer), move 2 Hobos (at Puffer and Sully), and recover 2 Hobos (from Peanut and S&M).

Alvin reached bottom at 0941, and transited to the concrete base for Medusa east of S&M (x=4946, y=5993) at marker DF1. The Medusa was deployed at 1004, and a temperature reading was made at its top (13°C). Alvin then transited to Sully (x=4896, 5970) at 1020, where the temperature was measured using the high temperature probe (377.2°C), the Resistivity probe was deployed, data were captured from the probe using the ICL, and the green gas tight was taken.

Alvin moved to Puffer (x=4846, y=5972) at 1100 and again a high temperature measurement was made (380.8°C), the white gas tight was used, the Resistivity probe was deployed, and data were captured using the ICL. Alvin then moved to Bastille and used the ICL to capture data from the Resistivity probe there. At 1214 Alvin reached Easter Island and recovered the blue osmosample (x=4881, y=6023). A Hobo was then recovered from the seafloor at 1235 (x=4943, y=6016). Alvin then transited north to Grotto and deployed a Hobo at 1305 after measuring 366.7°C with the high temperature probe. That ended the dive.

June 29 JASON Dive 277

Upon completion of testing Medea and Jason, Dive 277 was initiated at 0800 with a dive target ~100 m east of S&M. The main goal of this dive was to obtain a good spatial sampling of diffuse flow sites using the BEAST. Jason reached bottom at 1050 and transited to the northern diffuse experimental site near S&M. A short video survey of the area was completed and temperatures were measured at the crack where the RAS temperature probe was stuck. Milky, flock-laden fluid was observed issuing from the vent, with variable floc density. A temperature of 1.9-6.1 was measured and at 1155 gas piston sample 5 was taken, followed by bag sample 8 (5.5°C; 670 ml). At 1211 the bio-filter sample 1 (500 ml, 5.9 °C) was taken nearly coincident with an increase in floc output. A second filter sample was taken (#2) with a temperature of 7.4°C (400 ml). A low temperature hobo was placed in the crack where the RAS sampler had been deployed.

After deployment of the Hobo, another video survey of the experimental site was completed and the ROV transited south to image the resistivity probe in S&M. The tip was embedded in sulfide with ~ 2 m of new growth. The ICL was positioned over the resistivity probe and a temperature of 372°C and resistivty of 0.123 V was measured. Jason transited down the east face of S&M, to obtain fluid samples near the Medusa site near the base of the scarp. During the transit along the scarp, a diffuse flow site was found and was explored using the BEAST (UTM = 492643, Y = 5310519, Z = 2206, hdg 296) A temperature of 15°C was measured in an area of palm worms and gas piston sample 4 was obtained (600 ml), as was filter 12 (645 ml, 11.5°C), filter sample 3 (370 ml). Temperature mapping of this area showed temperatures of 11 to 15.6°C. At 1430 sampling was completed at this site and Medea moved to look for the Medusa site.

Medusa was found at 1300, and a temperature of 16.8°C was measured at below the base. Following the temperature measurement, bag sample 14 was taken (400 ml). A second sample was taken at 1541 (gas piston 20, 150 ml). Jason then transited south along the wall to look for the gamma deployment site near Milli-Q and Marker DK1, which is characterized by abundant tube worms and bacterial mats. At this mound, a temperature of 90°C was measured and sample 16 and piston 22 (T = 140°C, 140 ml) were used to obtain water. The mound around DK1 was imaged, but was not deemed acceptable for Medusa deployment. In a small area ~ 5 m northwest of Milli-

Q (UTM = 492609, Y = 5310545, Z = 2196, hdg = 050), temperatures and water samples were again measured at a diffuse flow site. Sample bag 17 was taken at a temperature of ~ 5°C (560 ml), and filter # 21 with a volume of 415 ml and temperature of 8°C. This area is a small, flat plateau, heavily sedimented with very small fractures and sparse sites of tube worms, bacterial mats and diffuse flow.

Jason transited up to the main Bastille complex to go to Puffer and down load data from the temperature-resistivity probe. In the area immediately adjacent to the probe, a small worm covered steep slope rich in diffuse flow was sampled using bag and filter #11 at 13°C, gas piston 23 (410 ml), 0.2 membrane filter #6 (450 ml), and the gff filter # 10 (~400 ml). Jason subsequently transited to Easter Island, passing Peanut and Bastille.

At 2048 Easter Island was reached and the gamma detector and base of Medusa were imaged. The orifice of the Medusa was encased in a thick bacterial mat, and a temperature of 8-16°C was measured during sampling with the BEAST. Sample bag 18 (T = 6.4-8.5°C, 600 ml), gas tight piston 24 (T=9.9, 398 ml), and steriviex filter 13 (t = 8-17\5.7°C, 507 ml) was taken at the Medusa site. The biological community at the Medusa was imaged, with floc, scale worms, and limpets observed that may represent a community 3 colony. The gamma detector and thermistor array was imaged. Subsequent to completion of the water sampling and video documentation at Easter Island, Jason transited north to Grotto to explore the diffuse flow and kelp-like bacterial mats observed during the initial Alvin dive to this area. Although small fissured areas with oxidation and sparse microbial mats were observed, the main fissured area was not found and at 2324 Jason left bottom to return to the surface.

June 30 JASON Dive 278

The main objective of this dive was to sample Puffer and Sully using the high-temperature fluid sampler to characterize possible perturbation events. Jason reached bottom at 1010 about 10 m southwest of an active unnamed structure south of the Bastille complex. Jason transited over old sulfide deposits, and areas of scattered tube worms and bacterial mats. At 1053 a new area of venting was discovered near the western valley wall (492558, Y = 5310422) which consists of abundant high aspect ration delicate tubular extinct and active white smokers, a few larger edifices, and an unusual low-lying ground flange that is white in color and hosts community one organisms (only palm worms). There are abundant tube worm bushes and areas of intense diffuse flow. The area was subsequently called Cathedral (Figure 7).

Following initial documentation of this site, JASON transited north to Puffer to listen to the resistivity probe via the sucup. There were several attempts to listen with this during which time the resistivity probe was knocked over. The casing was subsequently righted, and the suk-up was positioned on a diffuse ridge immediately adjacent to the probe. Because of the initial problems the attempt to use the ICL was abandoned and a test of the prototype manifold hydraulically triggered gas tight bottle was successfully accomplished with triggering of the bottle via a pull pin. The structure was explored to find an adequate site for sampling with the BEAST. At 1409 a spire near the top of the structure was decapitated (Z = 2192 m, hdg 044), exhibiting a large annular, chalcopyrite-lined channel through which flowed 374°C fluid. The nozzle from the Beast was put into the orifice and the arm of Jason withdrawn. Sample bag # 8, gas piston sample 5, bag sample 11 were taken over a period from 1415-1429. Subsequent to sampling, Jason was repositioned and additional reconnaissance was completed of the structure for appropriate sampling sites. Jason returned to the original orifice sampled by the Beast and at 1503 gas piston 4 (400 ml, 372°C), sample bag 9 (600 ml, 373.2°C), Gff filter 15 (900 ml, 374.1°C), 0.2 filter 6 (250 ml, Sterivex filter 12 (1200 ml), and bag sample 7 (450 ml) were taken, ending at 1547. Following the last sample, the temperature recorded by the Beast became very erratic, ending the water sampling component of this dive.

To obtain a complete image of the structure Puffer, a series of vertical transects were completed around the structure. Frame grabs and video grabs were obtained during this period as well as 3-chip and pan and tilt imagery. Upon completion of the transects at Puffer Jason transited to Bastille, imaging the candelabra at the top of Bastille. The dive was completed by visiting Sully and listening with the ICL to the temperature-resistivity probe (377.6, 0.618 V). Jason lifted off at 2000. During the break between dives, the nozzle to the Beast was repaired as chaffing against the sulfide structure had worn through the casing.

July 1 JASON Dive 279

The goal of this dive was to complete an extended time-series sampling of Puffer to characterize temporal variability of the fluids at this site using the Beast. Jason landed ~ 30 east of Sully at 0720, transited to Sully and then to Puffer to look for an appropriate sampling site. A sucup was temporarily stored near the Marker U, for later deployment. At Puffer, a series of vertical traverses and fly arounds were completed to find a good sampling site for long-term sampling with the Beast. The sampling site visited during the previous dive was examined, however, the chimney orifice was broken farther down on the structure than the previous day, and was no longer accessible by Jason. A sampling site was found near the top of the structure (2584, 0488, hdg 280) with a measured temperature of 318°C. The pump on the Beast was turned on and a temperature of 365°C was measured, however, this site was too unstable for continued sampling and was abandoned. Navigation during the beginning of this dive was difficult because of an error in the compass calibration, which was offset by 20°. Continued exploration of Puffer failed to find an acceptable sampling site.

Subsequent to exploration at Puffer, Jason transited to Sully to begin sampling (1339, X = 2601, Y = 0483). Two sites were sampled that include one adjacent to where the temperature-resistivity probe was deployed and another single orifice site a few meters away. At the later site, the chimney was knocked over and a temperature of 369.3°C was measured with the Beast. At 1411 bag sample 8 was sampled (T = 370•C) with a volume of 500 ml. Jason held position and piston sample 4 was taken at 1326 (T = 369.5, 150 ml). The chimney was imaged intensively with video. Sampling resumed and at 1416 sample bag # 9 was completed (370.1°C, 500 ml). Because this vent seemed stable, the decision was made to listen to the temperature-resistivity probe at Sully using the ICL loop. The instrument was working with temperature readings of 377.1°C and 377.2°C.

Following checking of the resistivity probe, JASON transited to Puffer to listen to the temperature-resistivity probe at this site. After some confusion in JASON positioning, Puffer was reached at 1532 and the ICL loop was emplaced on the probe. Temperatures of 376.4°C and 376.6°C were measured, indicating that the probe was working correctly. Jason transited to Bastille, reaching the site at 1540 and the ICL loop was placed on the temperature-resistivity probe at Marker B2. This probe was also working, with a temperature of 376.9°C measured. During this period the 3-chip camera was not working well, producing washed out video.

Jason again went back to Sully and repositioned the STAR Marker on top of the structure adjacent to the twin venting orifices. Sampling initiated at 1900 with piston sample 5 (T = 366.6°C, 152 ml) at the farthest vent. At 1954 Jason transited to the twin vent adjacent to the Star marker and measured a temperature of 377-378.5°C. Bag sample 18 and piston sample 20 were taken with 500 ml and 142 ml taken respectively. These were followed by sample bag 11 (370.3°C) and bag sample 14 (343°C-364°C) with a volume of 368°C. Sampling at Sully continued switching between the twin vent near the star maker and the farther vent until 0029, at which point a series of video transects were completed.

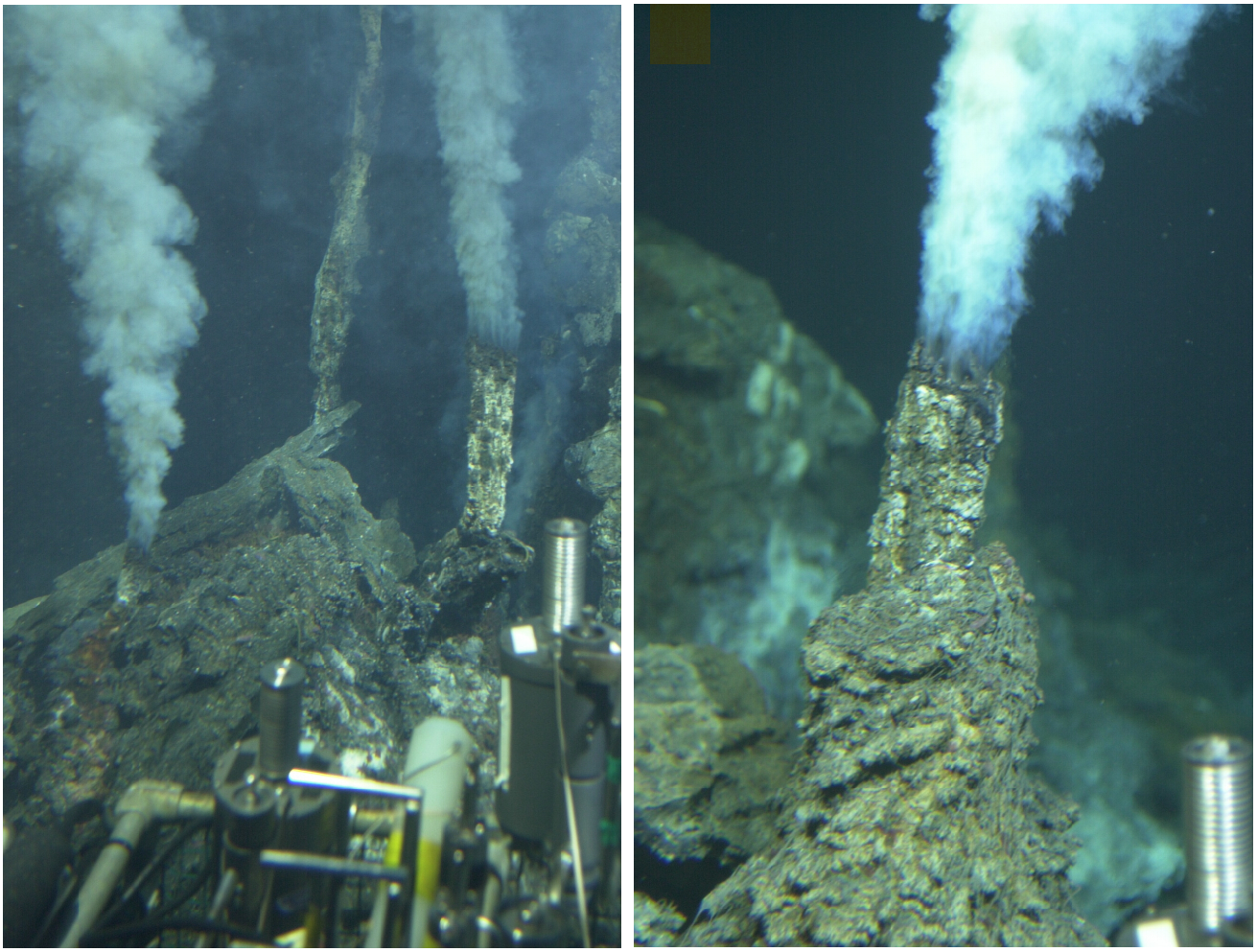


Figure 7. White smoker chimneys in the "Cathedral" complex. The pipes are ~20 cm in diameter and up to 4 m tall. The complex hosts tens of these structures, and a larger massive structure similar to those in the rest of the Main Endeavour Field. This complex, located ~18 m up on the axial valley wall, is enclosed by abundant sites of diffuse flow that host dense macrofaunal communities.

July 2 JASON Dive 279 and 280

At 0048 the tether for Jason became entangled around a structure. At the time it was unclear what the cause of the was, but on a subsequent dive it was found that the temperature-resistivity probe had been ripped out of Bastille, damaging the probe. Subsequent to getting the tether free, a series of transects were completed of Sully. At 0124 sampling of the vents at Sully were reinitiated; these ended at ~0200. The ICL was then used to listen to the temperature-resistivity probe at Sully with a temperature of 377.°C measured and a resistivity measurement of 0.583v. The vents were again sampled ending at 0300.

Subsequent to sampling Jason traversed to Puffer and used the sucup for downloading data for the temperature-resistivity probe. Bastille was then visited and the ICL was used to listen to the temperature-resistivity probe at the vent near Marker B2. A temperature of 377°C was measured and a resistivity of 0.673-0.739 v was measured. A hobo was then recovered from Peanut ending the dive at 0721.

JASON Dive 280

The goal of this dive was to complete time-series gas tight sampling using the new manifold system, alternating with vertical imaging transects of the structures. Jason reached bottom at 1505 near Puffer, transited to the vent site and placed the ICL loop on the sucup attached to the temperature-resistivity probe. The ICL was not working, however, so Jason transited to the Sully site. At 1538 sampling began at this site with a temperature of 376.9 measured and an attempt to trigger gas tight bottle red. It was unclear if this bottle triggered and so a second attempt was made using gas tight green with a temperature of 377.2°C. Following the successful triggering of this bottle, there was a second attempt to trouble shoot the ICL, but this failed. Jason left the site and transited to S&M where a series of vertical transects were completed beginning at the north of S&M and imaging the face of the scarp bounding this structure. Fourteen vertical transects were completed, ending at 1812.

Upon leaving this site, Jason drove past Needle and Tara to Sully. The gas tight manifold sampler was again used, sampling gas tight bottle yellow with a temperature of 377.7°C. Jason transited to the newly discovered Cathedral site. During this transit south, areas of diffuse flow and bacterial mats were imaged. Cathedral was reached at 1908 (X = 2561, Y = 0431). The site is about 18 m up on the wall near a break in the wall trend, and is characterized by abundant tall white smokers that are up to 4 m tall and 6-8 inches in diameter. The area was surveyed for diffuse flow sites, which are abundant at this site. A few temperatures were measured (up to 258°C), and a small top portion of a white smoker was sampled. Following this, Jason was used to map out the extent of the field by following the sulfide-basalt contact and lateralling around the venting area.

Jason transited back to Sully, to continue the time-series sampling. At 2200 a temperature of 377.5 was measured and gas tight blue was tripped. Jason transited back to the cathedral site and looked for possible Medusa and Gamma detector sites. Jason again went back to Sully and sampled gas tight black with a temperature of 377.6°C. At 0014, July 3, a series of vertical imaging profiles were initiated at Cannaport. Thirteen transects were completed and the top of the structure was imaged for characterization of the macrofaunal communities. Bastille was then selectively imaged, and a transect of Peanut was completed. The dive ended at 0232 and Jason returned to the surface.

July 3 JASON Dive 281

The goal of this dive was to complete a SM2000 sonar survey of the Main Endeavour Field (Figure 8) and detailed mosaics of the diffuse experimental sites using the 35 mm camera. This survey included a series of seven 020 trending survey lines spaced roughly 25 meters apart initiating at X = 5800, and Y = 6300. An additional 4 nearly east-west lines were completed over the Bastille complex. The lines were flown with JASON flying ~ 20-30 m off the bottom at 0.3 to 0.4 knots, and the sonar was mounted on the rear of the vehicle. The 35 mm still camera was

mounted adjacent to a pencil camera in the down-looking position, and the 3-chip and pan and tilt mounted in the forward-looking position.

July 4 JASON Dive 281 Continued

Jason reached bottom at 0450 and began the track lines. The initial line was used as a learning period for both vehicle flying and adjustment of the Simrad system to the proper data acquisition settings. During all survey lines the gain settings were continually adjusted for optimal acquisition. During flying of line four ship, rov, and fish navigation were lost and so this line was flown twice. Upon completion of the N-S trending lines, the E-W lines were completed for a total of 12 transects ending at 0344.

Upon completion of the transect lines, JASON transited to Easter Island to complete a down-looking mosaic with the 35 mm still cameras. The survey began at 0423 with images taken using the 35 mm stills and by frame grabbing using the Jason logging system, and Adobe Premier. Similar transects were completed at the diffuse flow experimental site north of S&M, and at Milli-Q. Near the completion of the dive, Puffer was revisited and the sucup on the temperature-resistivity probe was listened to. The dive ended at 0700. Once Jason was secured on deck, the Atlantis began steaming south to transfer equipment and personnel from the Brown to the Atlantis.

The rest of the day was spent in transit to the transfer site, and back to the Endeavour Hydrothermal Field. During the transit back north a Seabeam survey was completed of the ridge, across the Cobb propagator, to the Endeavour.

July 5 Alvin Dive 3583

The purpose of dive 3583 was to identify final gamma detector sites and to deploy one detector, taking 2 major fluid samples and some gamma measurements at the deployment site. Other goals were to recover a Resistivity probe (taking a gas tight) and to recover the 2 sucups at Puffer.

Alvin reached bottom at 1108 following a late launch required by the Jason to Alvin 24-hour switchover policy. Alvin landed to the southeast of S&M and northeast of Milli-Q, and transited west and up the scarp. The Medusa south of S&M was spotted while transiting up the wall. Alvin proceeded south to marker DK1, where temperature and gamma sensor measurements were made, and the DK1 marker was moved to the spot deemed best for deploying the gamma detector.

Alvin then transited to the previously identified spot of diffuse flow due west of DK1 and Milli-Q (and spent some time being lost/wandering during this transit). Temperature measurements and gamma sensor readings were made in palm-worm rich patches of diffuse flow that emanated from cracks in the basalt. Temperatures were as high as 28C, and 60 second readings were as high as 14,000 counts. Fluid was sampled using the blue major, and then over an hour was spent deploying the detector, which preferred to be in an upside-down orientation. Temperature measurements, sensor readings (15,000 per minute), and a fluid sample (using the black major sampler) were taken at the spot where the detector was deployed, and Marker DK2 (with a whale bone) was deployed nearby.

Alvin then transited 10 meters east and up to near the top of mill to recover the Resistivity probe. Fluid was sampled from the same orifice using the red gas tight, and the high temperature probe was used to measure a temperature of 375.5C. A toaster was then taken at the same orifice, and the dive was over.

July 6 Alvin Dive 3584
Pilot: Phil Forte
Port Observer: Damien Grelon
Starboard Observer: Adam Schultz

The purpose of this dive was to identify a set of vent faunal communities, to obtain Medusa measurements of physical and chemical environmental characteristics of those communities, and to acquire high quality video and still digital image documentation of the various habitats. Alvin reached bottom at 0926, and transited to the Medusa S&M East (x=4943, y=5992). The instrument was coated heavily with limpets, but flow was still visible out of the top of the sensor head. The Medusa pressure case was observed to be on its side, rather than sitting centered on its stand. Alvin transited to the west side of the S&M platform to the concrete base intended for Medusa # 3 (x=4927, y=6011), adjacent to marker MT3. The MAV-2 current meter was deployed 2 m from small diffuse flow patch, next to marker MT3.

Subsequent to deployment of the current meter, Alvin transited to marker DK2 site (x4903, y5949). Medusa concrete base installed on seafloor atop moderate diffuse flow patch adjacent to small community of tube worms. Medusa spot measurement taken atop base (x4904, y5946) at 1100. Alvin repositioned to marker DK2 site on vent structure with large white-coated flange (x4936, y5940). Medusa spot measurement taken at 1159 and Medusa gas-tight titanium sample bottles (0 and 1) fired at this location. Second Medusa spot measurement taken 60 cm from first location at 1211, and Medusa sample bottle 2 fired at this location. Vemco temperature probe V10 deployed at Medusa Measurement Spot 2, and Vemco V9 deployed at spot 1.

Medusa sensor head moved atop small white-coated flange with palm worm community at 1245. Medusa spot measurement begun at 1250, and Medusa bottle (3) fired. Alvin then repositioned about 3 m S of previous location. Medusa spot measurement taken atop a tubeworm bush at 1332. Medusa sample bottle fired (4) on this site. Sensor head then moved on to adjacent patch of dead tubeworm tubes through which seawater appears to be trickling. Medusa spot measurement obtained at 1347, and Vemco V2 deployed on this site. Vemco V? and V3 deployed on previous tube worm site.

Alvin transits to Puffer Resistivity Probe site (x=2193, y=4750) and Sucup placed in basket at 1424. Marker DF2 is observed immediately off the starboard side of the submersible. Medusa spot measurement obtained at 1458 on small community of tube worms adjacent to rock depression from which vigorous diffuse flow is observed. Medusa sample bottle fired (5). Sensor head moved a few cm onto the edge of the depression in the rock bordered by tubeworms. Medusa spot measurement and water samples (6) and (7) obtained.

At DK2 (x=4903, y=5946) near marker DK2. The diffuse flow seen from the center of the base on deployment two days previously had ceased. The base was relocated several tens of cm atop a small patch of palm worms from which flow was seen to be vigorous. Flow as high as 17.5° was observed from the base. The Medusa was deployed at 1020, and a temperature reading was made at its top (11.1°).

Alvin then transited to S&M East (x=4940, y= 5998) at 1133, where the Medusa pressure case already installed at the site was righted to sit properly on its frame. Temperatures of 17° were measured from the top of the Medusa sensor head already positioned at the site. The top of the sensor head was coated thickly with limpets and a thick film of bacteria was observed inside the flow exit cone.

Alvin moved to the platform north of S&M (x=4932, y=6032) at 1214 at the thermistor array. A Suk-Up was deployed on the master ICL cone of the array, a hobo was retrieved and at 1238 the MAV-2 current meter was picked up for transit to Easter Island.

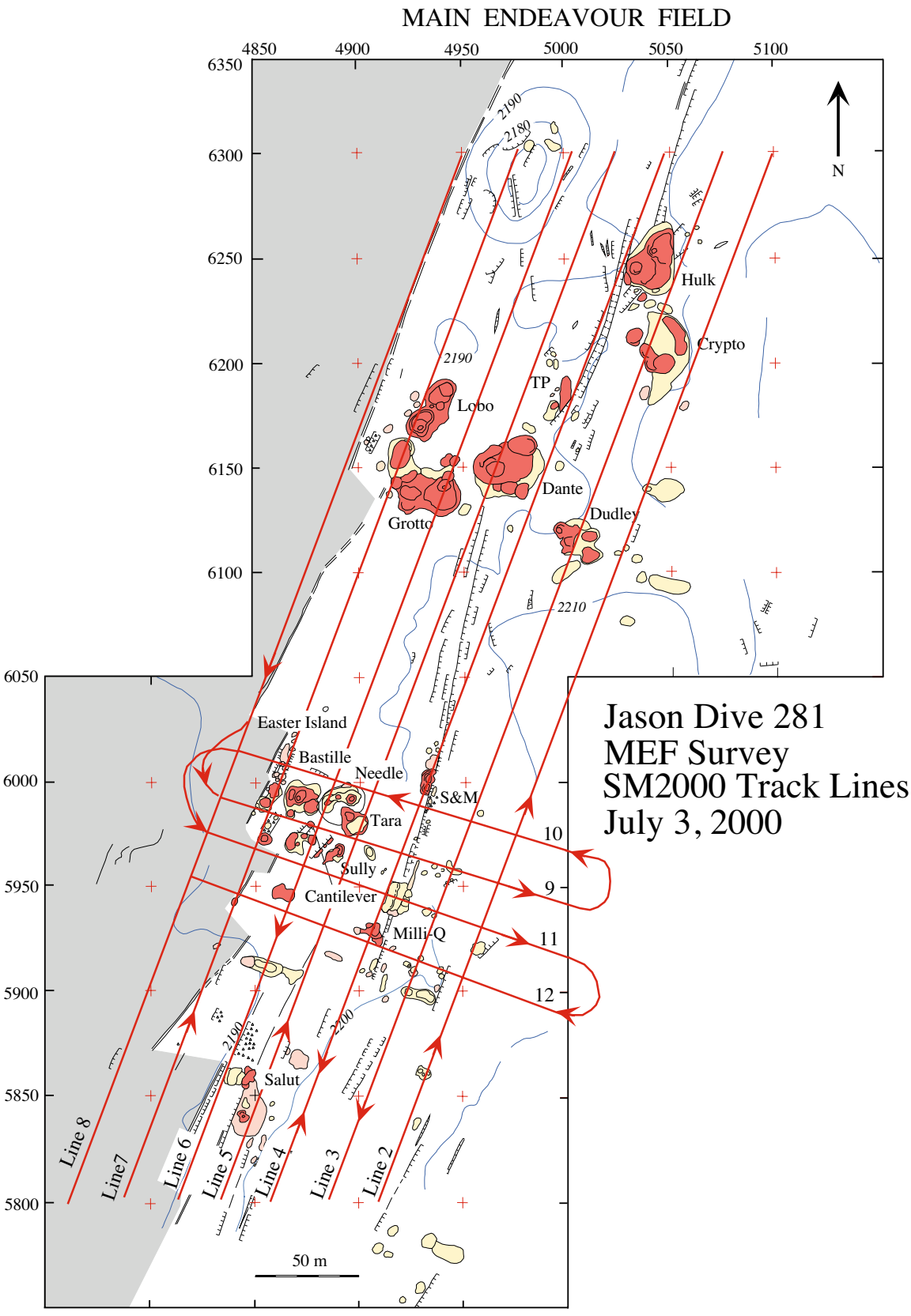


Figure 8. Map of the Main Endeavour Field showing the location of survey lines run with the SM2000 system. The SM2000 was mounted in a down-looking mode and flown at an altitude of 20-30 m above the seafloor.

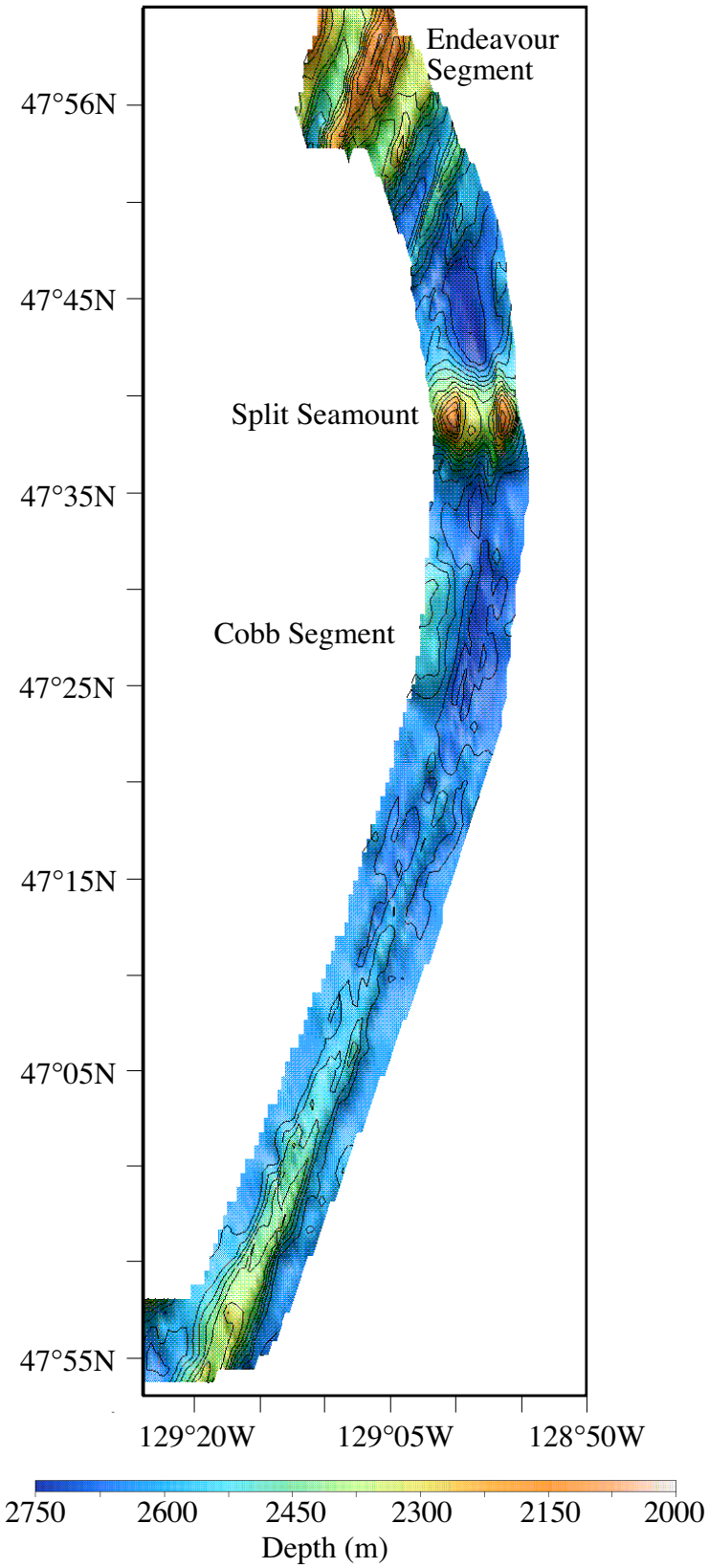


Figure 9. Seabeam bathymetric data collected during the transit from the personnel transfer with the Brown.

Alvin moved to Easter Island site (x=4878, y=6016) at 1248. MAV-2 current meter stowed on seafloor immediately to port side of Alvin basket, and effluent of 9.02° measured in center of Medusa concrete base already installed on site. Temperatures of 26 °C measured touching the tip of the low-T probe to the seafloor in the center of the concrete base, and 14°C measured a few mm above this point. Medusa deployed on concrete base at 1312. Effluent of 10.05 °C exiting top of sensor head. Alvin departed Easter Island site for Sully at 1409. Considerable navigational difficulties, in part due to high smoker levels and strong currents, and also difficulties with acoustic navigation. Arrive Sully Resistivity Probe site (x=4892, y=5973) at 1518. Suk-Up attached to Resistivity Probe recovered at 1520, and sulfide sample recovered from same site at 1529. Alvin weights dropped at 1534.

During the evening there was a test of the directed elevator. Elevators play a crucial role in extending the capabilities of both our manned and unmanned submersibles. The elevators in use today fall passively to the sea floor and despite our best efforts often land hundreds of meters from the work site. This has led us to develop an elevator with a limited capability to maneuver. The directed elevator is equipped with two small lift surfaces, a microprocessor controlled rudder and a simple acoustic command system that doubles as a relay transponder. A first test of this new elevator was performed. It was ballasted with four ALVIN weights and released on the fringe of the LBL navigation net deployed in the Endeavour hydrothermal vent field. The elevator was programmed to hold first a northerly course then to turn east, south, and finally west, holding each heading for seven minutes. After the last leg, the elevator was set to spiral by holding the rudder hard over. Acoustic data indicates a decent rate of 30 meters per minute (Fig. 1) and a glide ratio of about .25 (Fig. 2)

Fig. 1 Depth

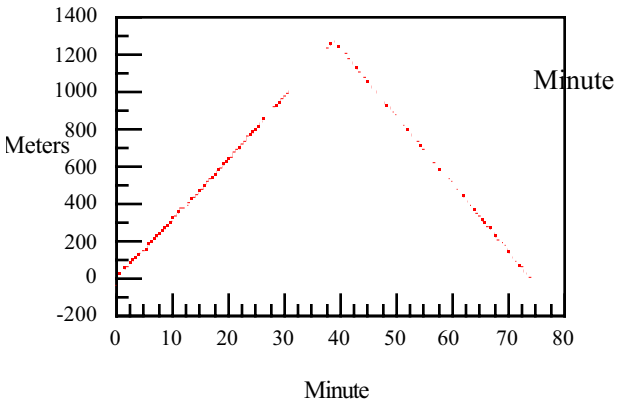
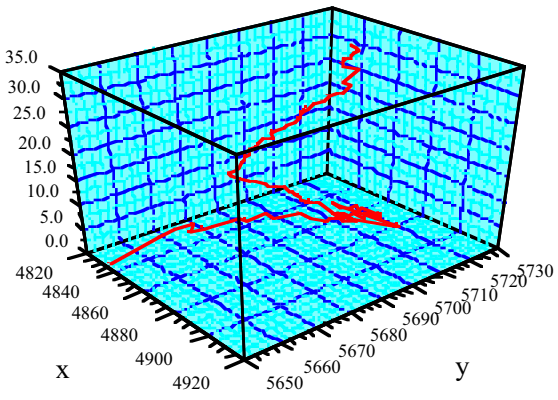


Fig. 2 Acoustic Tracking



Operating in proportional only mode, the elevator's Proportional, Integral, Derivative (PID) controller did a reasonable job of holding heading with minimal hunting and overshoot. (Fig. 3) There was an increasing heading error to the east. (Fig. 4)

Fig. 3 Heading

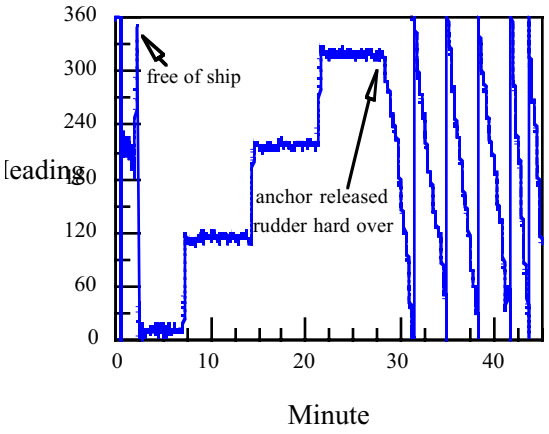
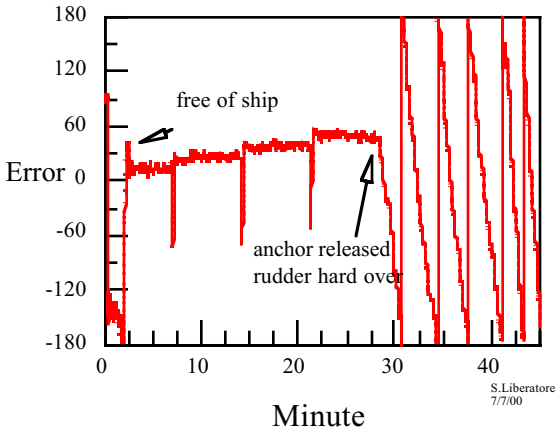


Fig.4 Heading Error



July 7 Alvin Dive 3585
Pilot: Bob Waters
Port Observer: Dave Kadko
Starboard Observer: Marv Lilley

The third and final gamma detector was deployed at the DK1 flange near Mill-Q. Additionally, the second gamma detector previously deployed at the DK2 site was repositioned to be in diffuse flow more precisely in a white, worm patch. The upper temperature within the diffuse flow was ~13°C. Alvin proceeded to Milli-Q and deployed a temperature-resistivity probe and measured a temperature of 376.3°C with the probe. Subsequent to deployment of the resistivity probe, the stand alone McLane sampler (the RAS), was picked up and deployed near marker MT2 within a depression filled with palm worms. Marker DK3 was placed at the site with a whale bone attached.

Following the RAS deployment, Alvin transited to Sully and deployed a suck-up on the temperature-resistivity probe, but the ICL failed to capture data. Alvin proceeded to Bastille to recover the temperature-resistivity probe that had been deployed early in the dive program, however, the probe had been dislodged from the vent and the tip was broken. The resistivity probe was recovered in pieces and gas tight blue was taken.

Alvin proceeded to the base of Puffer on the north side were abundant diffuse flow was observed. A Hobo was recovered from Puffer, but the temperature-resistivity probe was left alone and not disturbed. Fluid was sampled using the gas-tight white bottle and the Hobo was switched out. Video was taken of the vemcos deployed in diffuse flow and of tube worms at the base of Puffer. Alvin transited back to Sully to retry reading the temperature-resistivity probe, but the ICL loop could not be dislodged from the basket.
Alvin transited back to DK1 where video was taken of the DK1 gamma deployment site and a search was made for possible alternative positions with the temperature probe.

July 8 Dive 3586
Pilot: Bruce Strickrott
Port Observer: Adam Schultz
Starboard Observer/PIT: Anthony Tarantino

The purpose of this dive was to Deploy Medusa at DK2 site, service Medusa at S&M East site, and deploy Medusa at Easter Island site. A Suk-Up 2 was to be left in Inquisition mode at north of S&M site and the MAV-2 current meter MAV-2 was to be relocated to Easter Island. Finally, a Suk-Up was to be retrieved from Sully. If time permitted, we were to travel north and

measure temperatures in smokers in north part of field, and then were to drive north to release navigational network transponder.

Alvin reached bottom at 0911, and transited to the concrete base for Medusa at DK2 (x4903, y5946) near marker DK2. The diffuse flow seen from the center of the base on deployment two days previously had ceased. The base was relocated several tens of cm atop a small patch of palm worms from which flow was seen to be vigorous. Flow as high as 17.5° was observed from the base. The Medusa was deployed at 1020, and a temperature reading was made at its top (11.1°).

Alvin then transited to S&M East (x4940, 5998) at 1133, where the Medusa pressure case already installed at the site was righted to sit properly on its frame. Temperatures of 17° were measured from the top of the Medusa sensor head already positioned at the site. The top of the sensor head was coated thickly with limpets and a thick film of bacteria was observed inside the flow exit cone.

Alvin moved to the N Platform of S&M (x4932, y6032) at 1214 at the thermistor array. A Suk-Up was deployed on the master ICL cone of the array, a hobo was retrieved and at 1238 the MAV-2 current meter was picked up for transit to Easter Island.

Alvin moved to Easter Island site (x4878, y6016) at 1248. MAV-2 current meter stowed on seafloor immediately to port side of Alvin basket, and effluent of 9.02° measured in center of Medusa concrete base already installed on site. Temperatures of 26° measured touching the tip of the low-T probe to the seafloor in the center of the concrete base, and 14° measured a few mm above this point. Medusa deployed on concrete base at 1312. Effluent of 10.05° exiting top of sensor head.

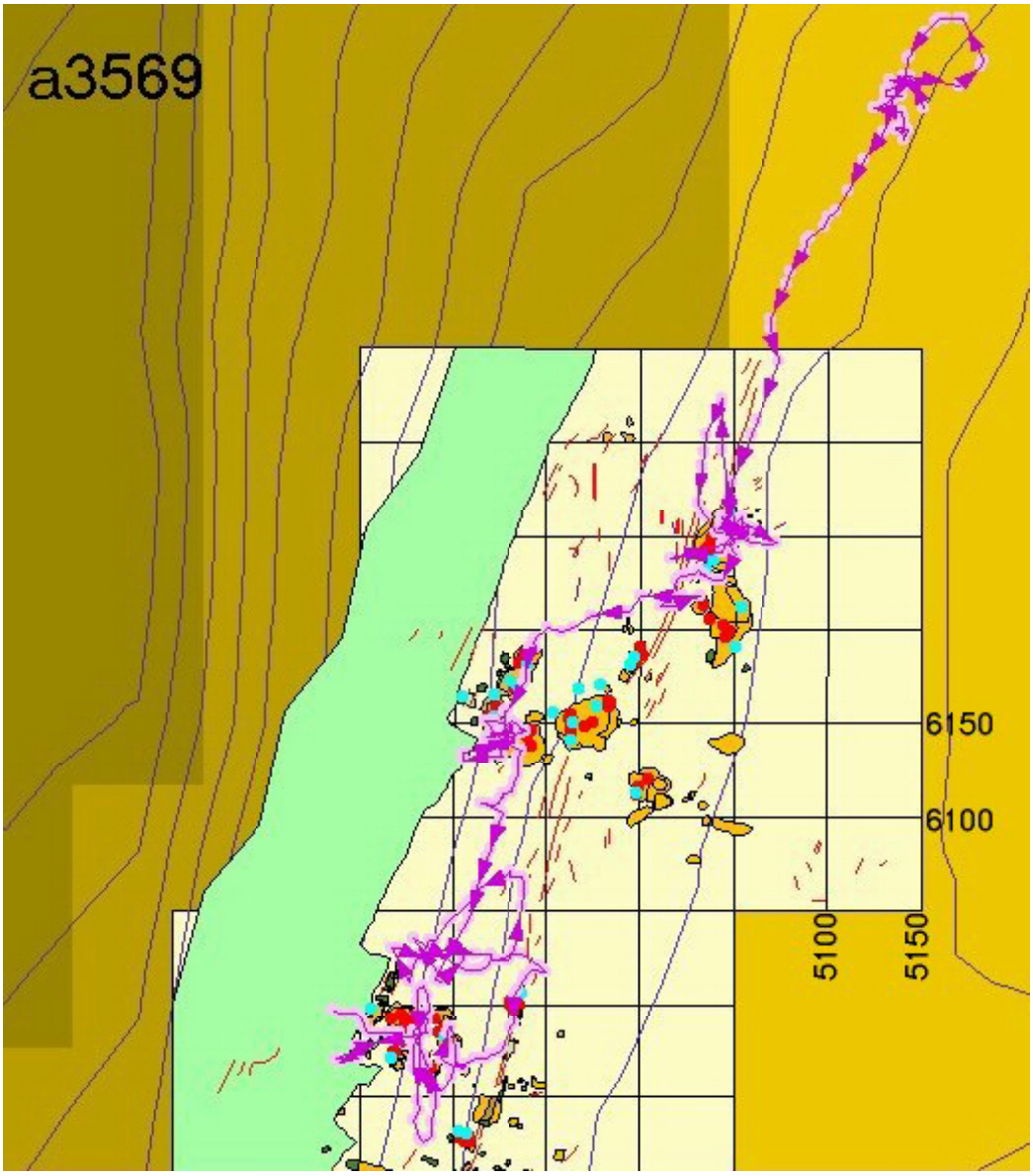
Alvin departed Easter Island site for Sully at 1409. Considerable navigational difficulties, in part due to high smoker levels and strong currents, and also difficulties with acoustic navigation. Arrive Sully Resistivity Probe site (x4892, y5973) at 1518. Suk-Up attached to Resistivity Probe recovered at 1520, and sulfide sample recovered from same site at 1529. Alvin weights dropped at 1534.

July 11 Dive 3589
Pilot: Phil Forte
Port: John Delaney
Starboard: Giora

The goal of this dive was to document activity outside the Main Field and to examine the major fissures/sulfide deposits east, south, west and north of the field. The dive was initiated in the main field just south of Grotto. We drove east toward Dante and Dudley and then to Crypto. We used the technique of driving around specific sulfide structures to define them in space. Beginning at a location east of Crypto, we drove south, defining old sulfide deposits along the way. The navigation was interrupted by having the still camera on 15 second REP rate.

The major result of the dive was to define the eastern boundary of nearly continuous sulfide deposits along the fissure that is 75-100 meters east of the main field. This feature trends along a heading of 020 and is only intermittently exposed beneath sulfide deposits that have localized deposition along the fissure. A second important result was the definition of the bounds on the large inactive sulfide deposit centered on about 5680, 4950. This rugged deposit lies on a basalt base at about 2210-2215 m depth. In some areas, the deposit rises, resulting in the depth decreasing to 2185 m. The deposit covers an area that is approximately 100 m long (020) and 75 m wide (110). In concert with the deposits extending northward along the eastern Endeavour fissure, this ensemble of sulfide represents more total tonnage than all deposits in the main field.

Alvin Track Lines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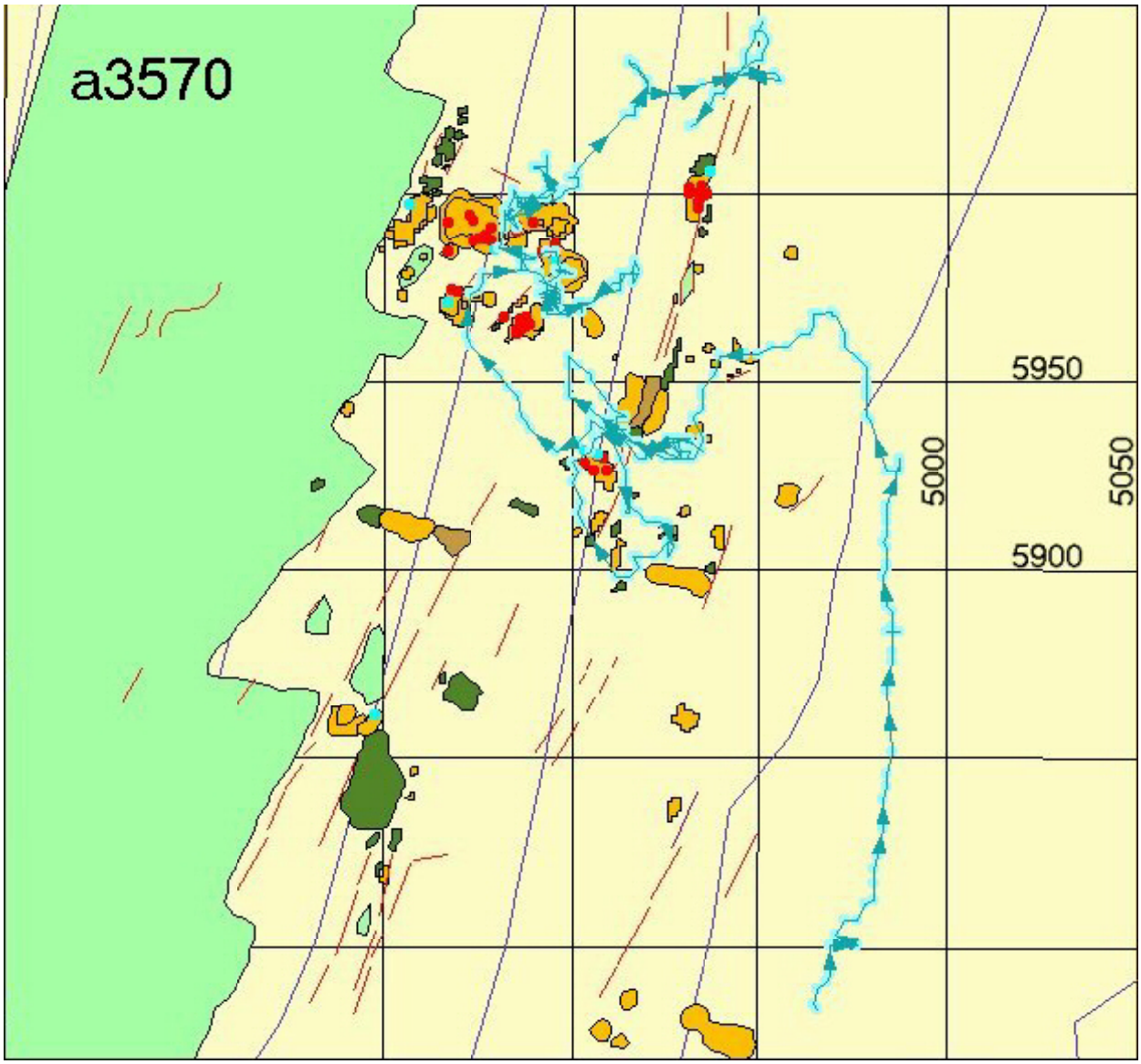
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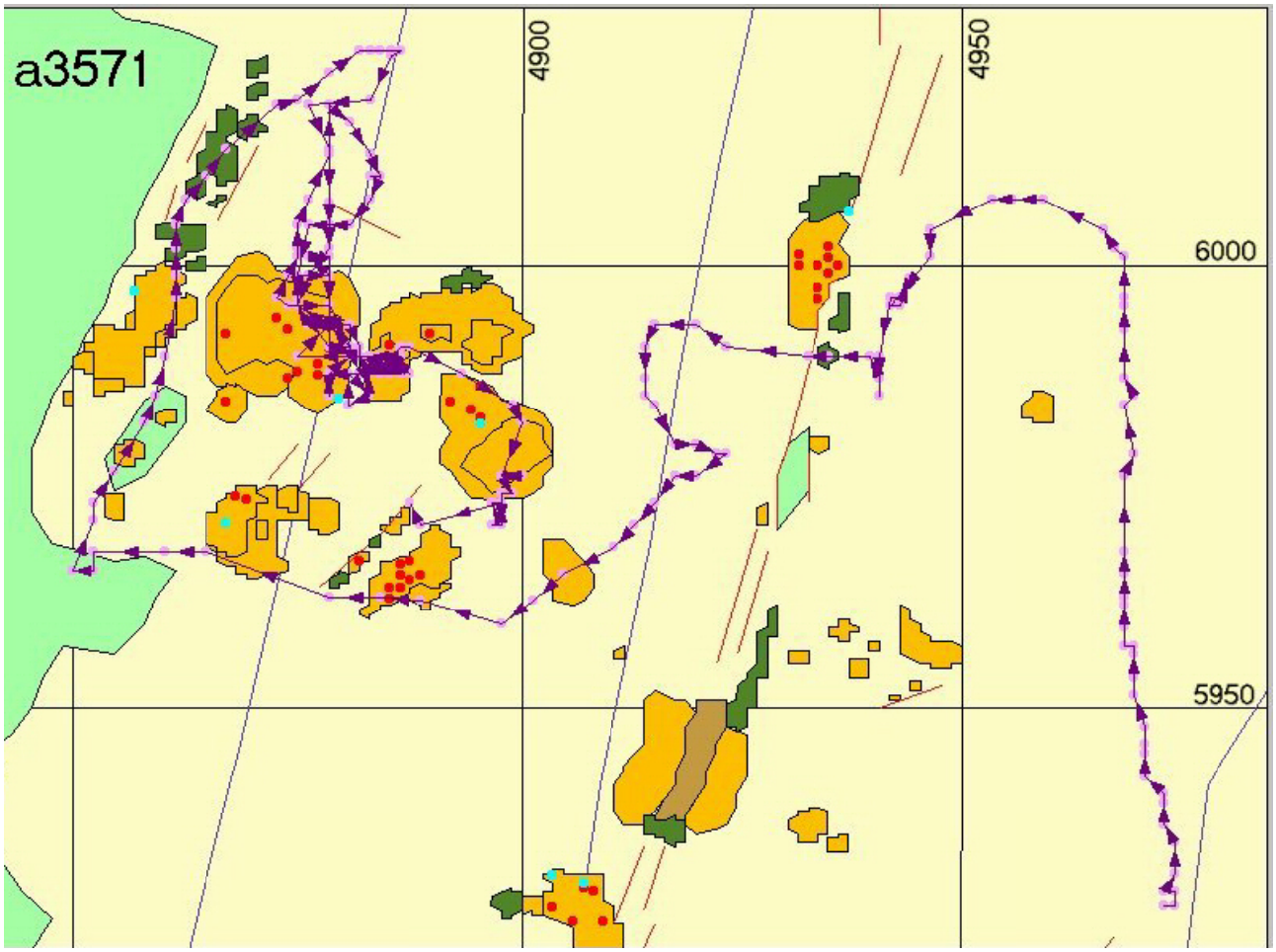
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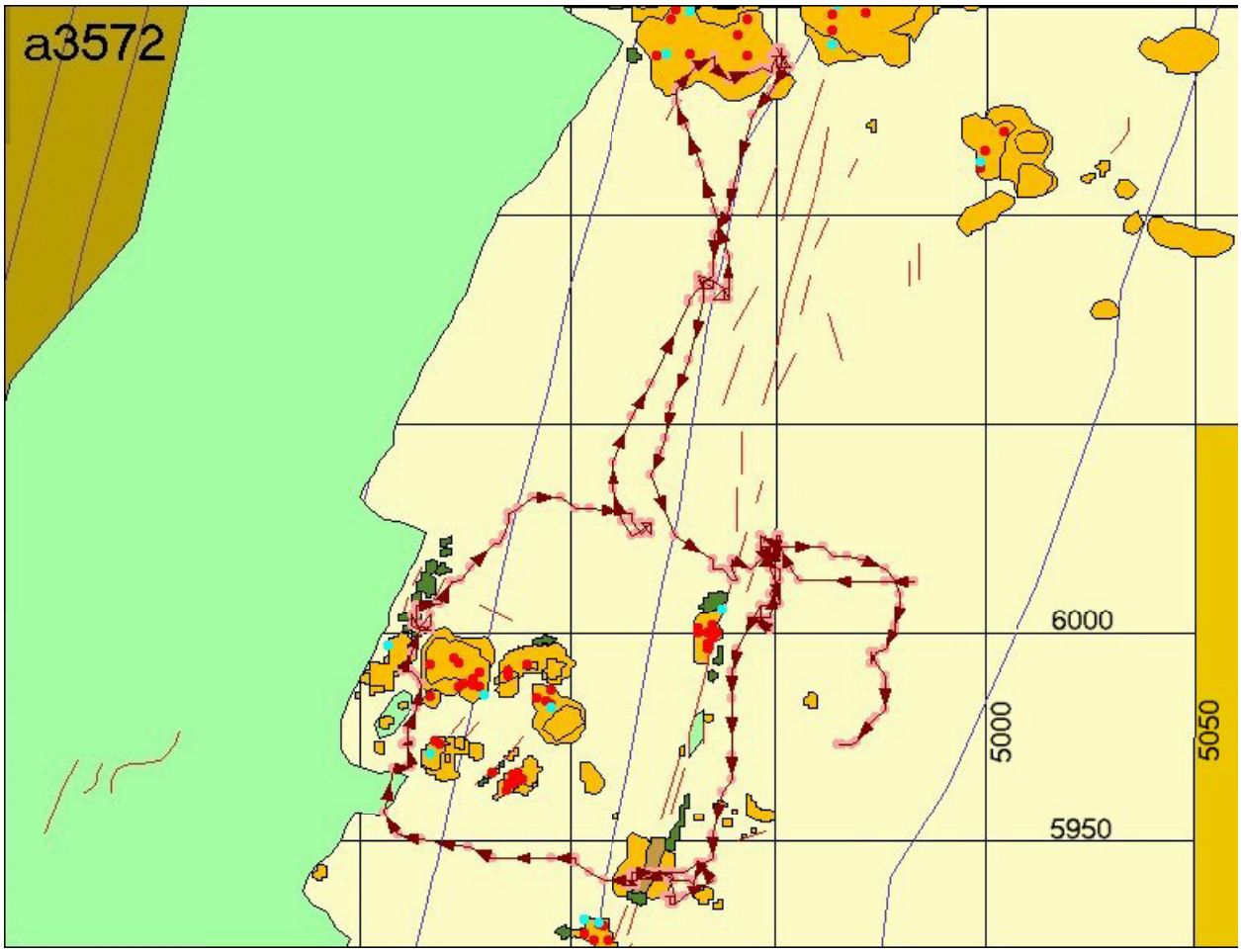
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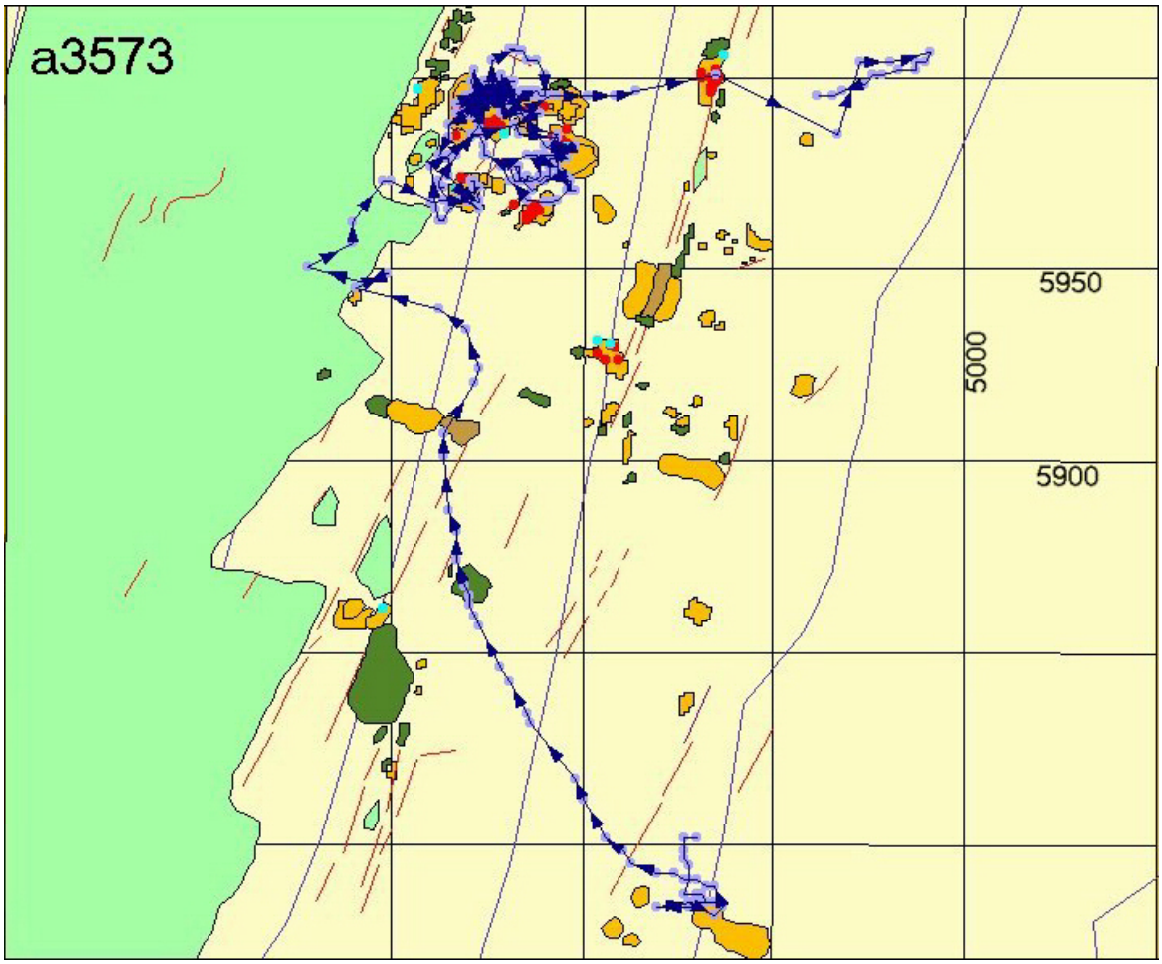
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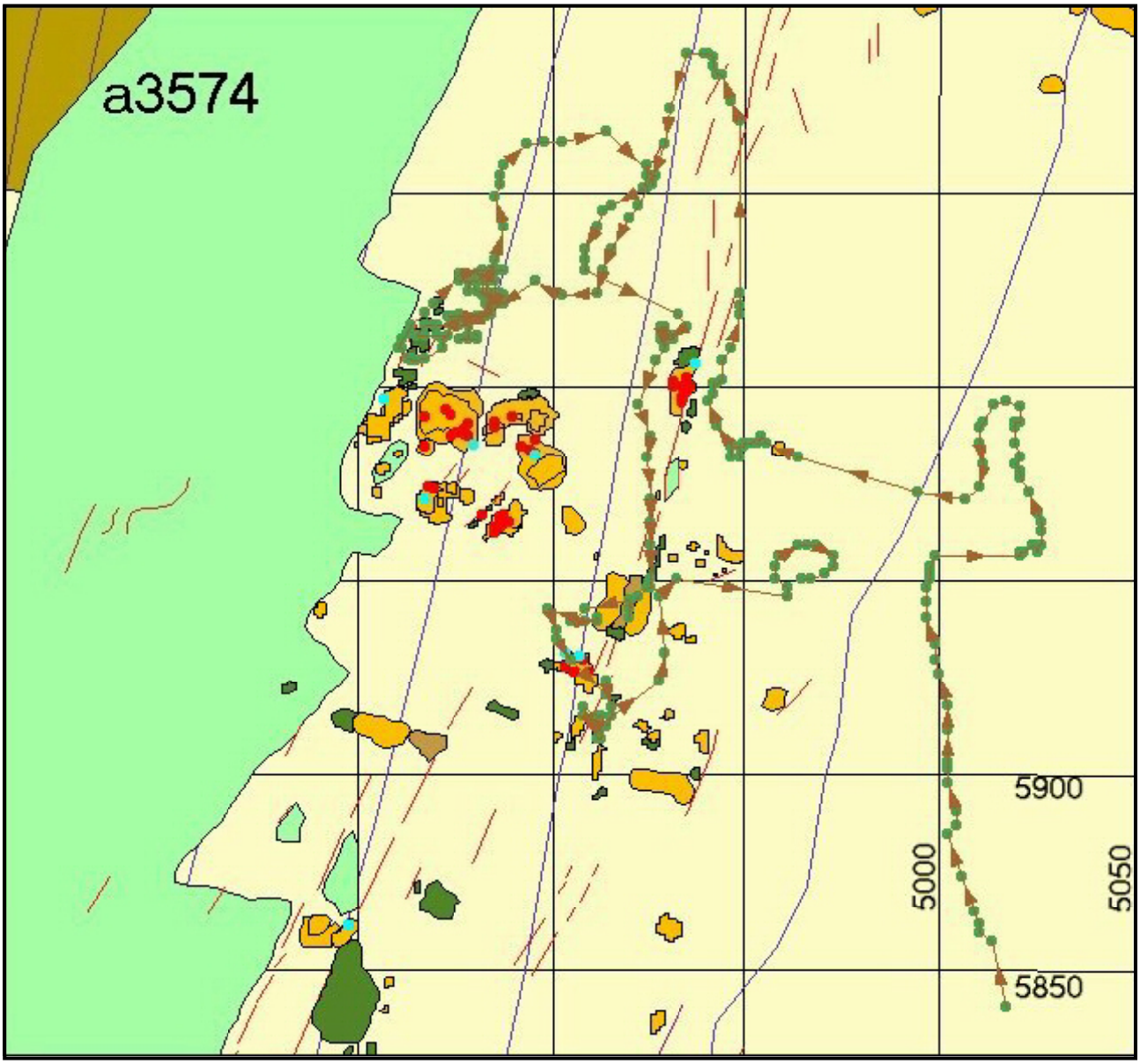
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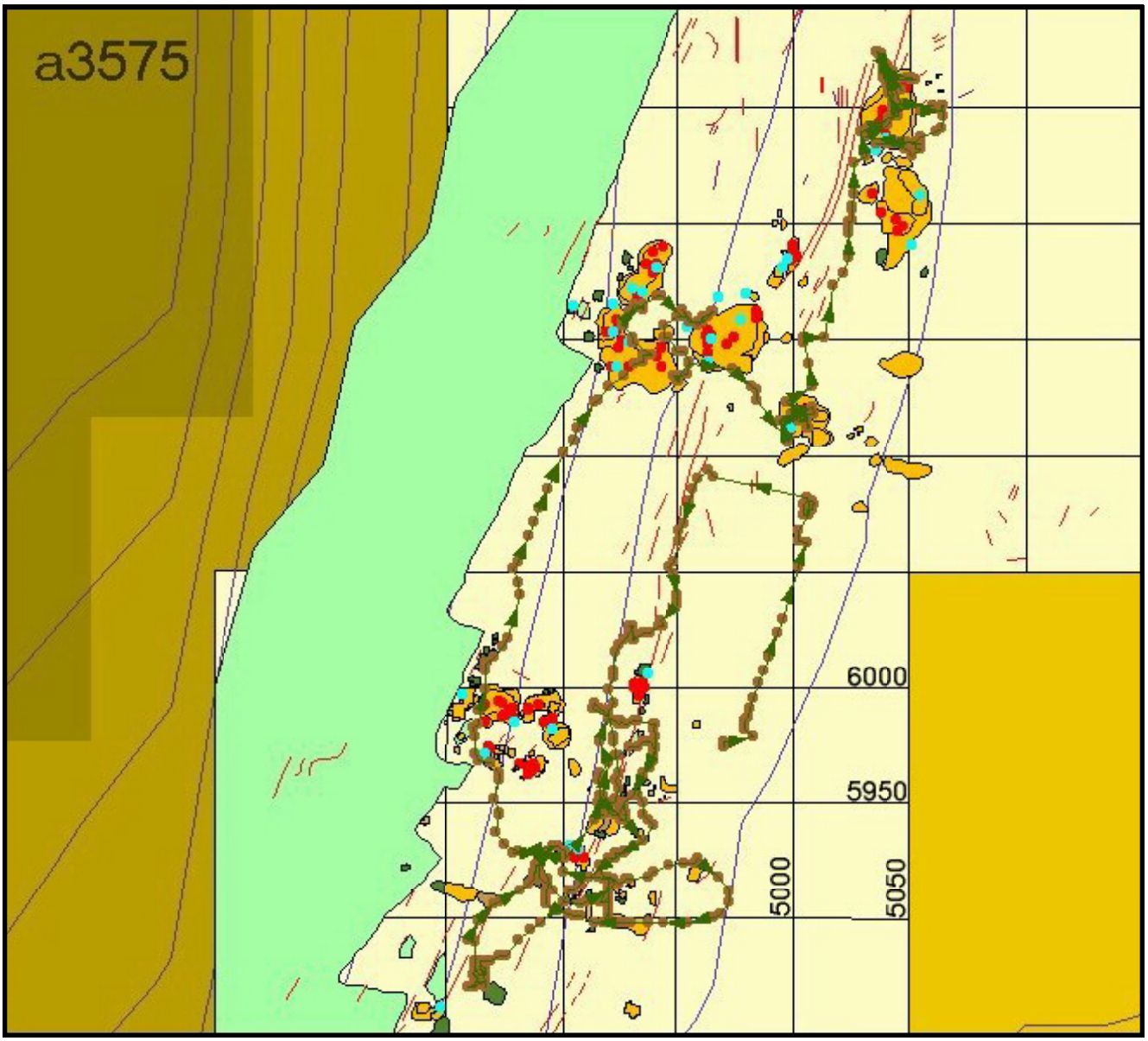
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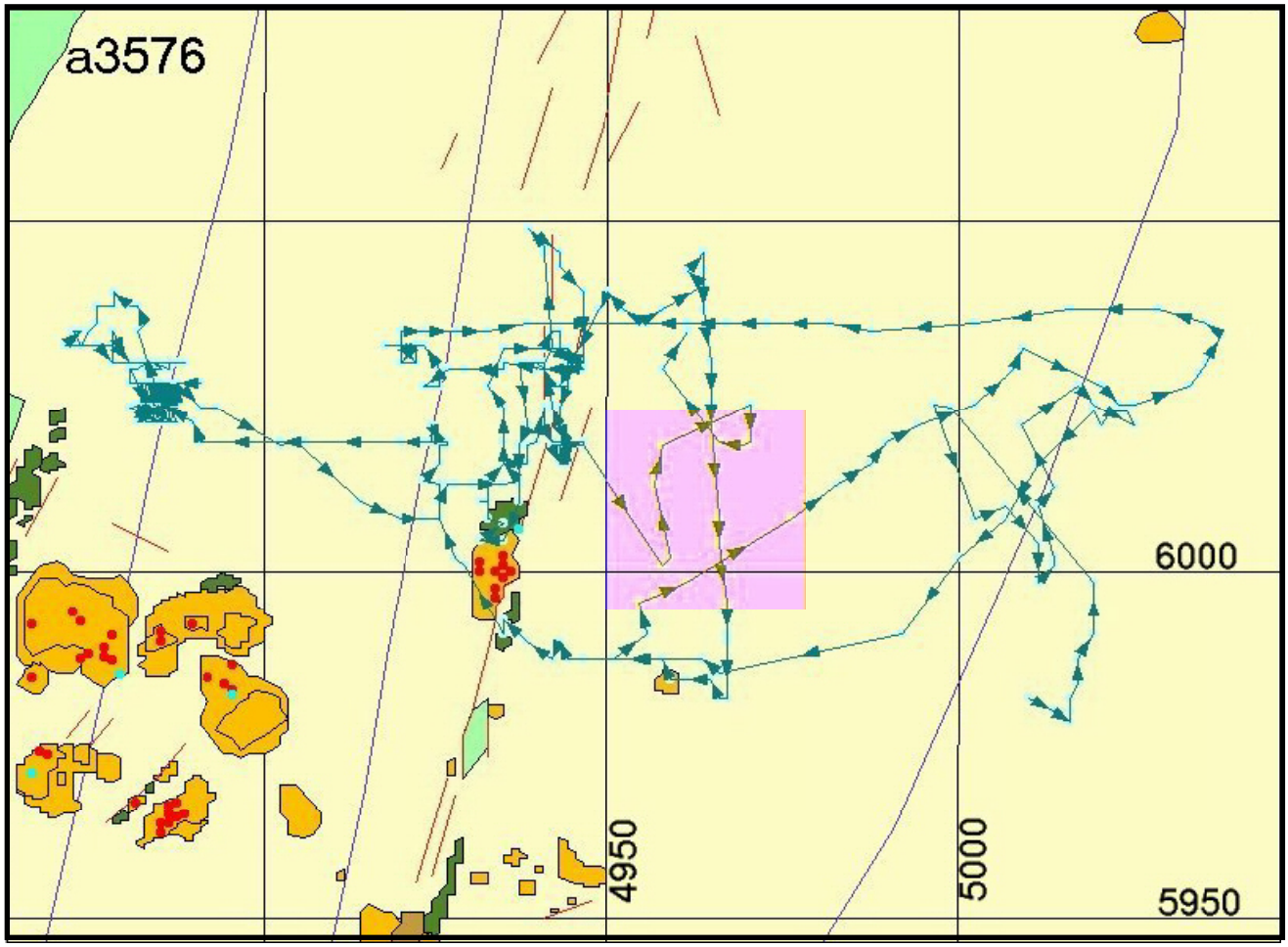
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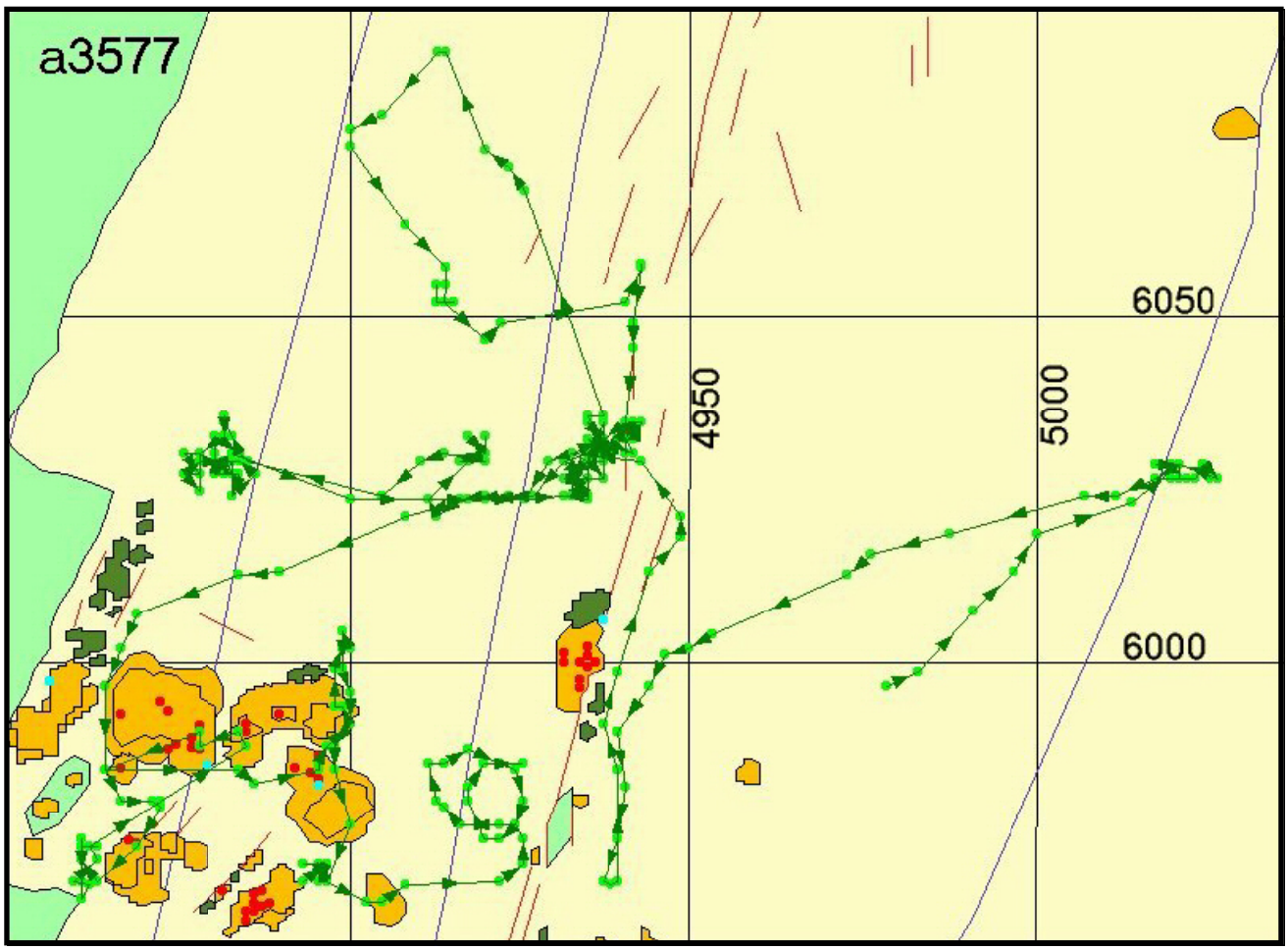
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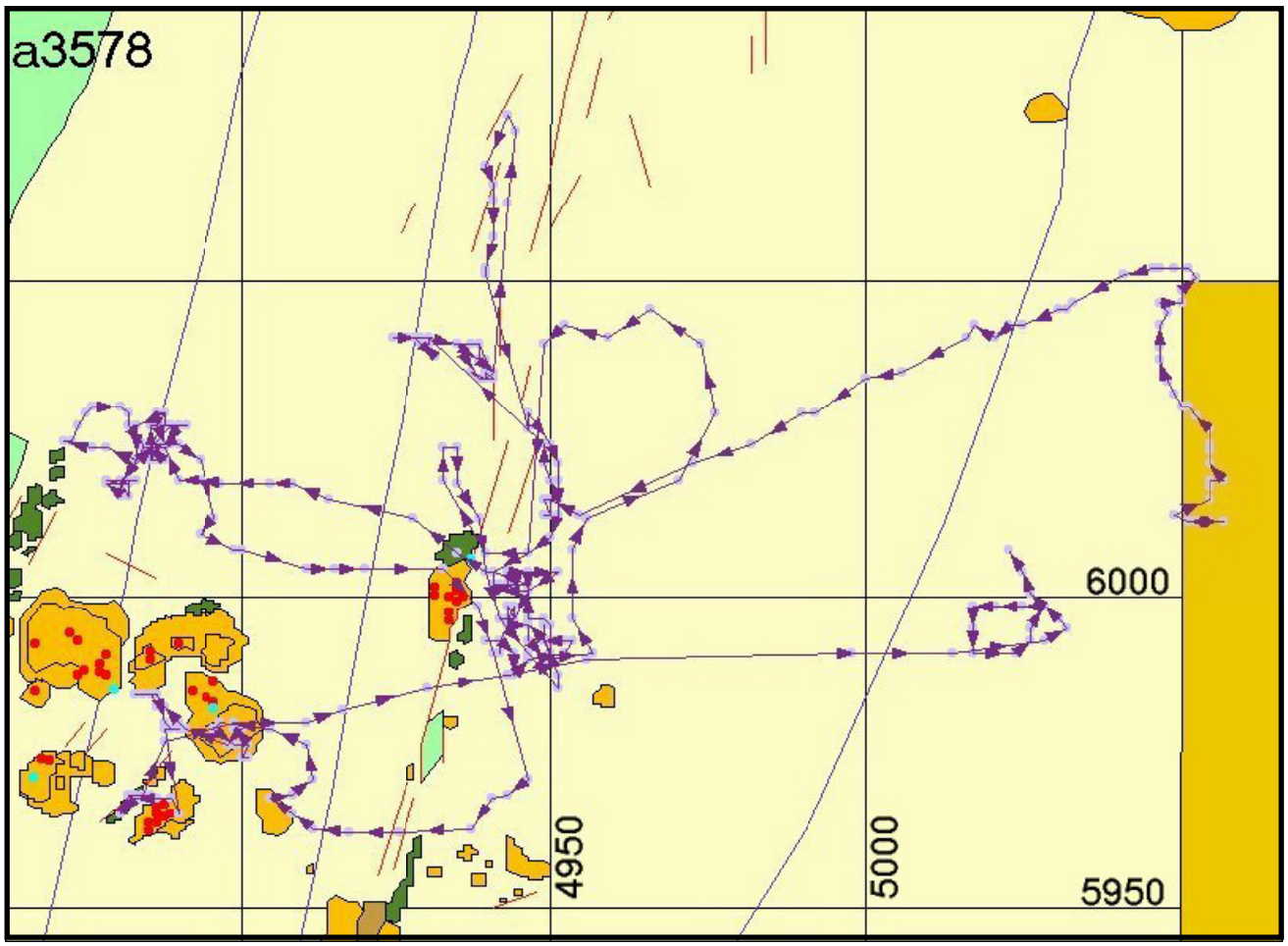
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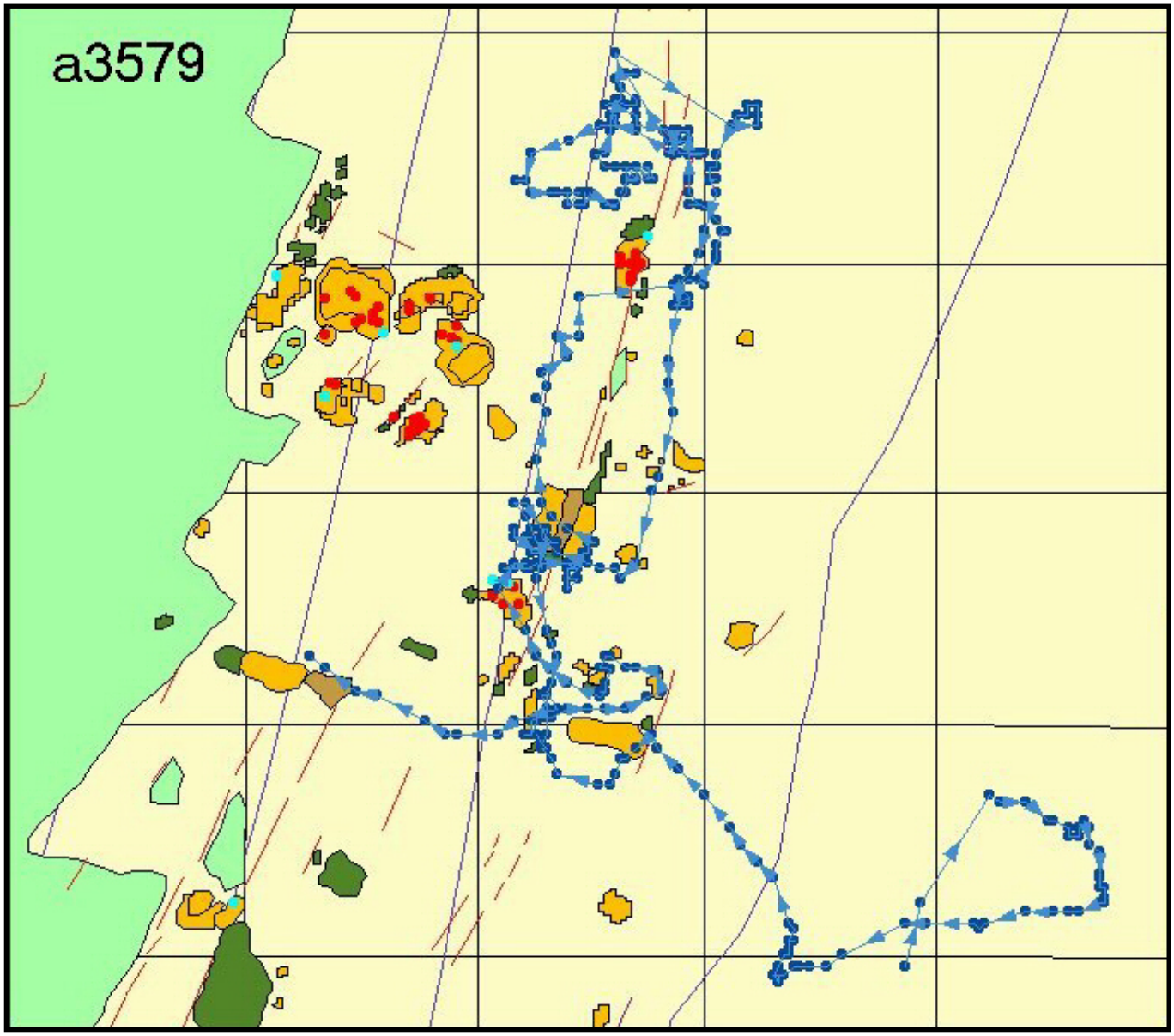
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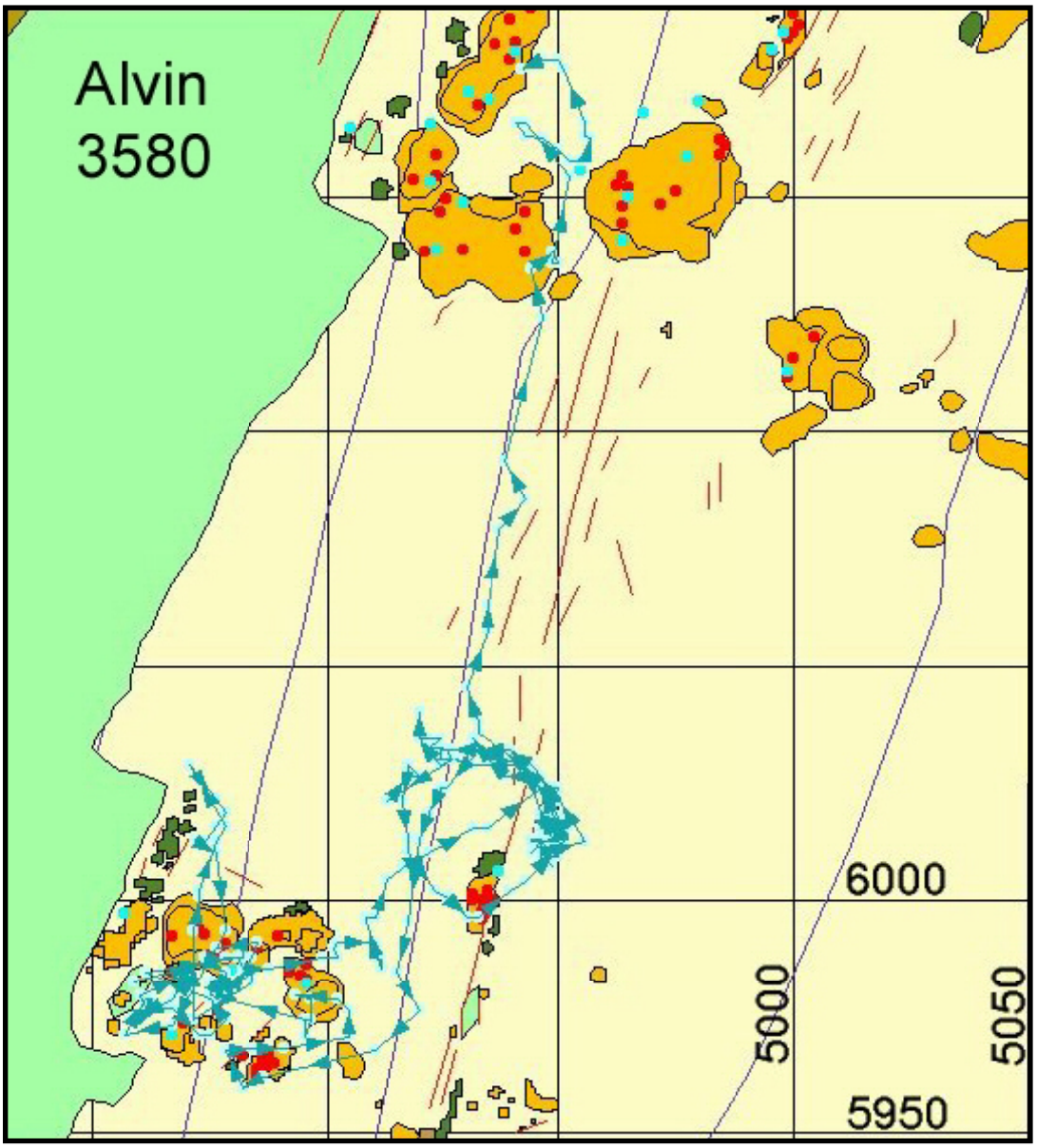
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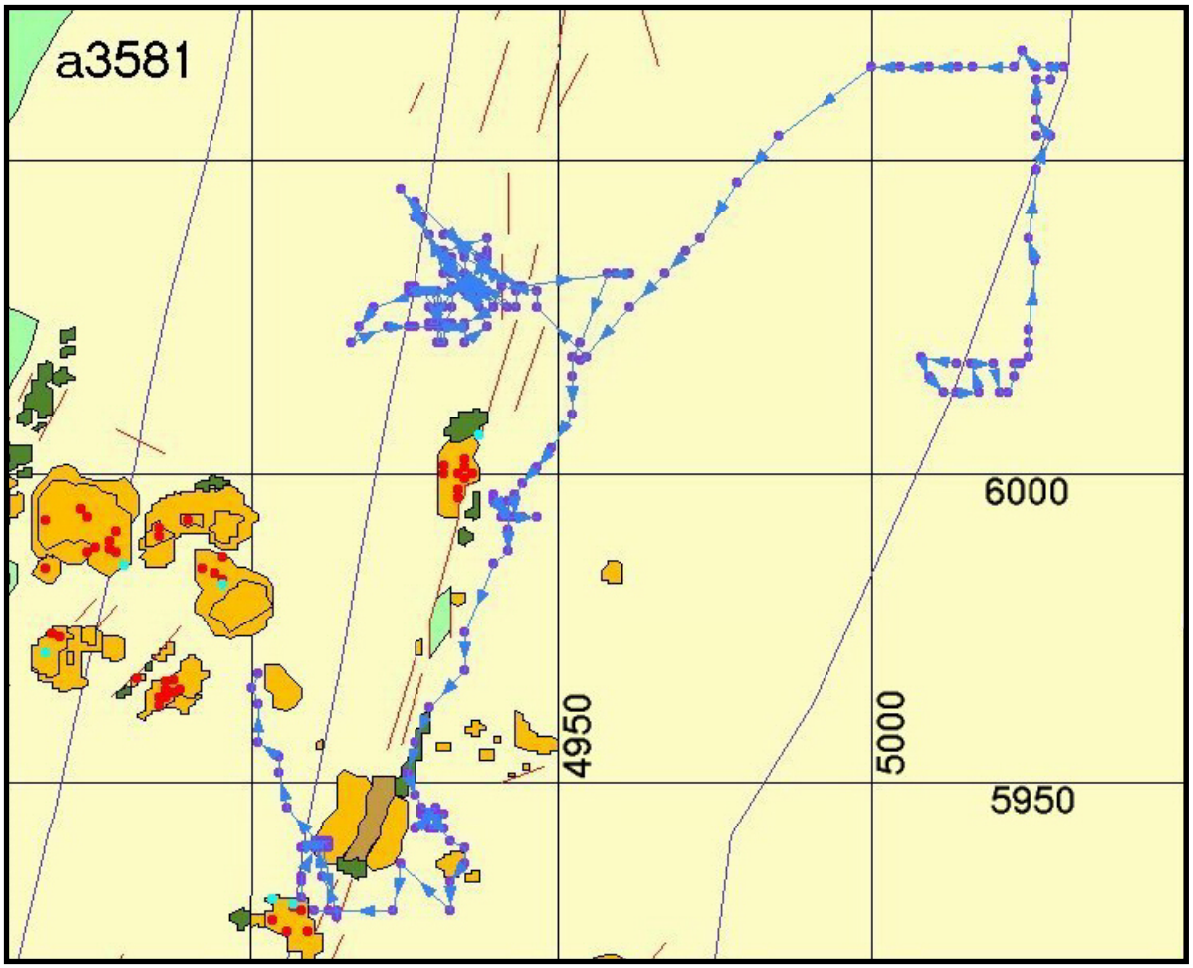
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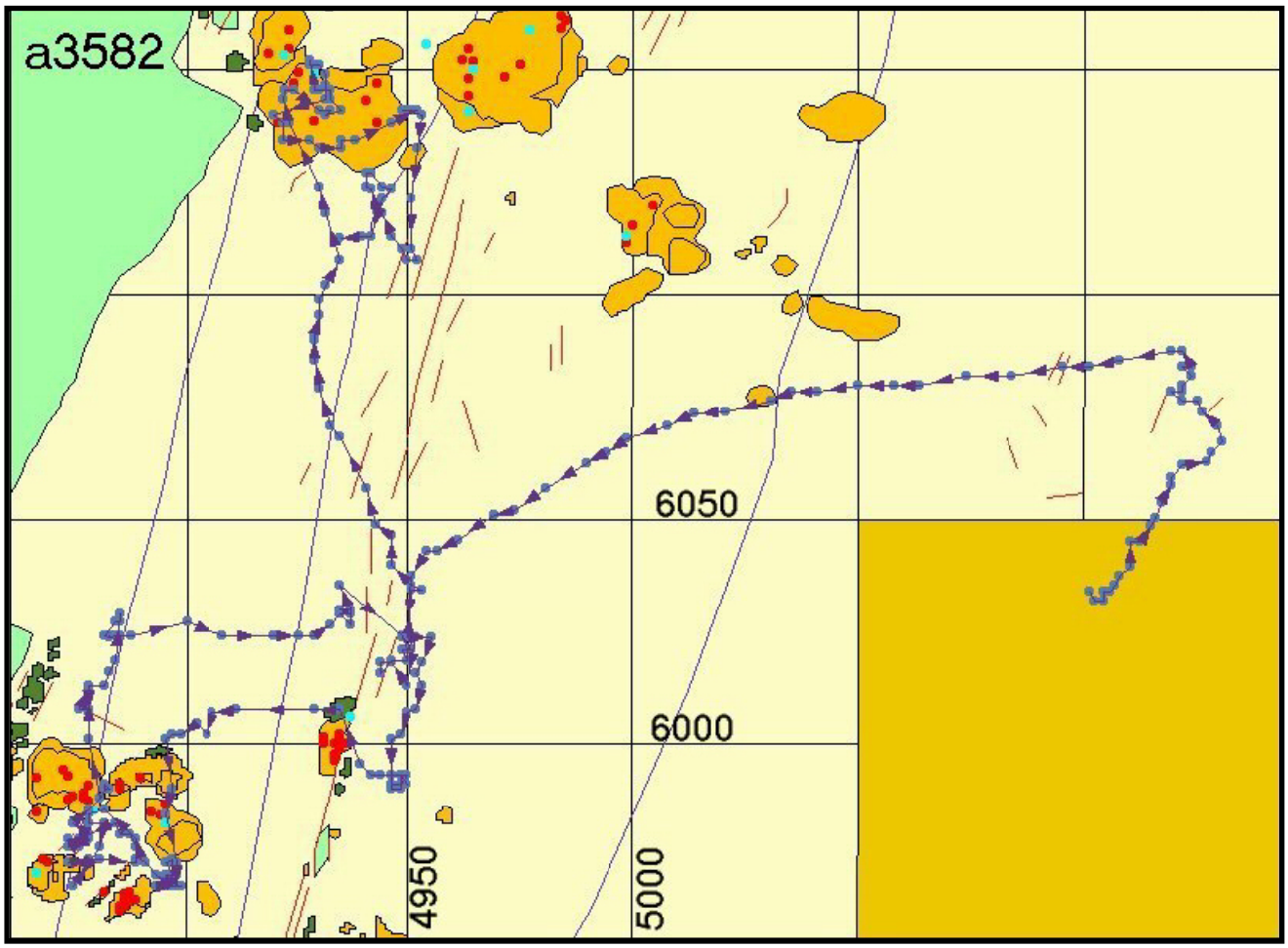
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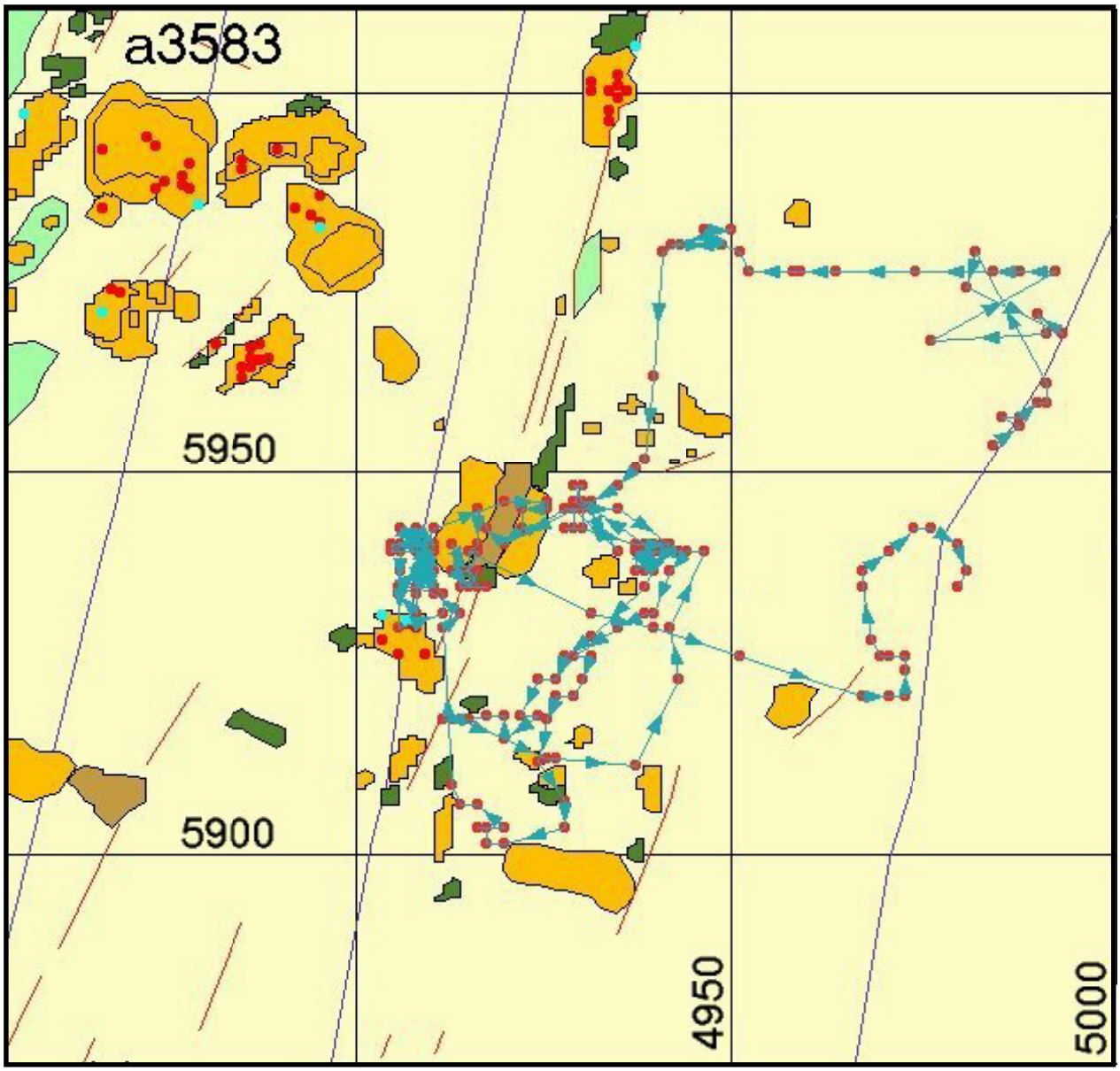
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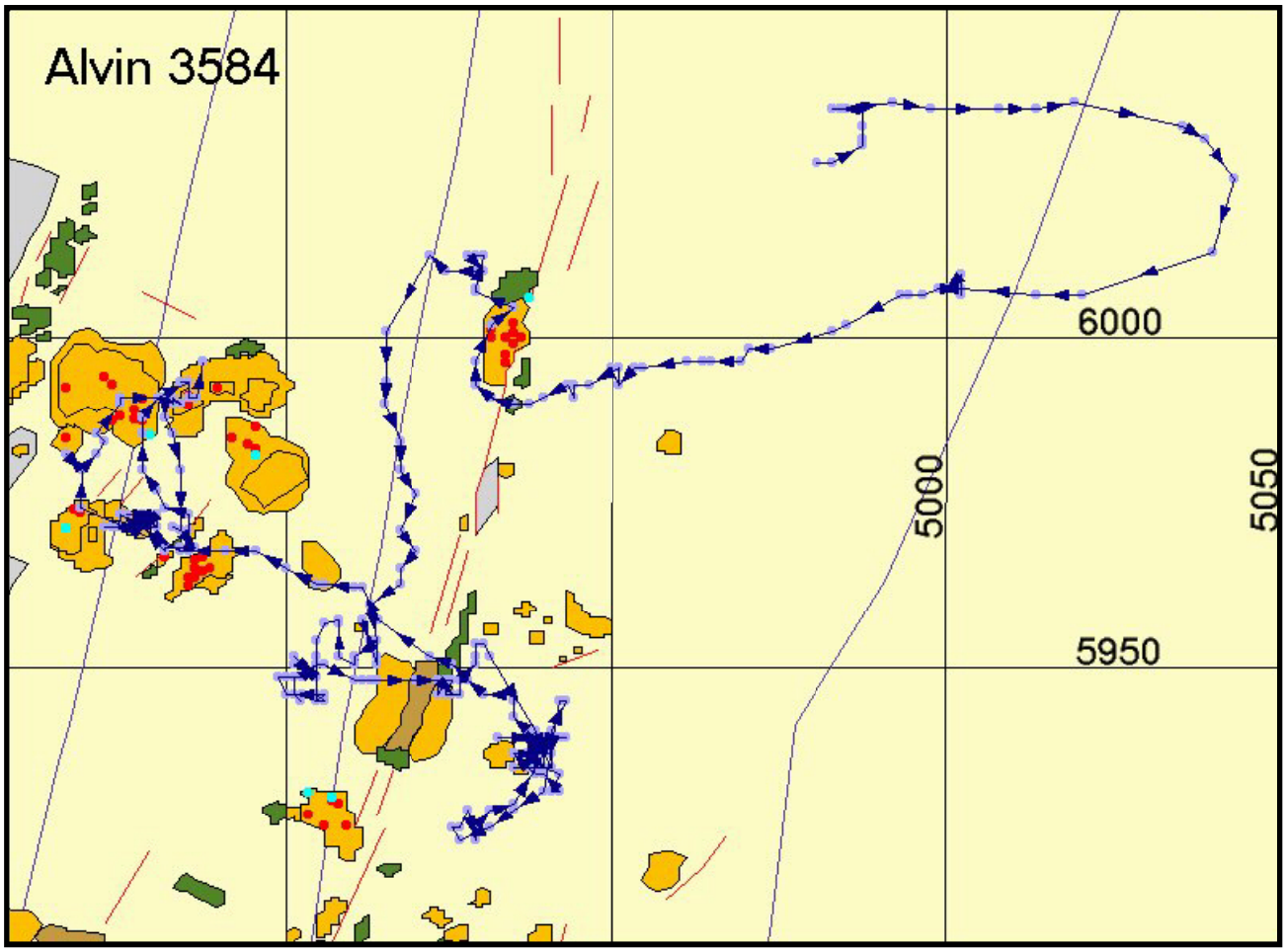
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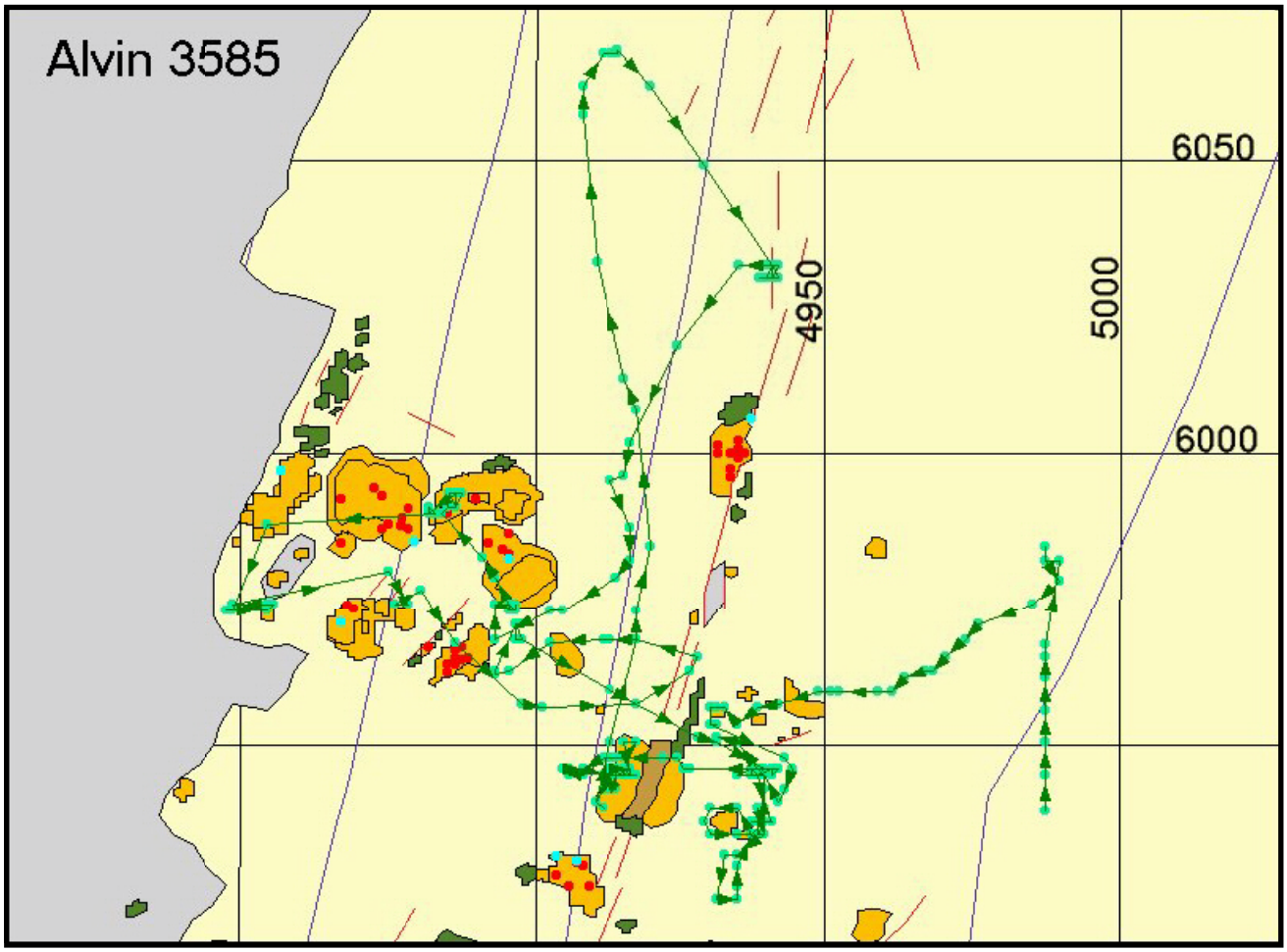
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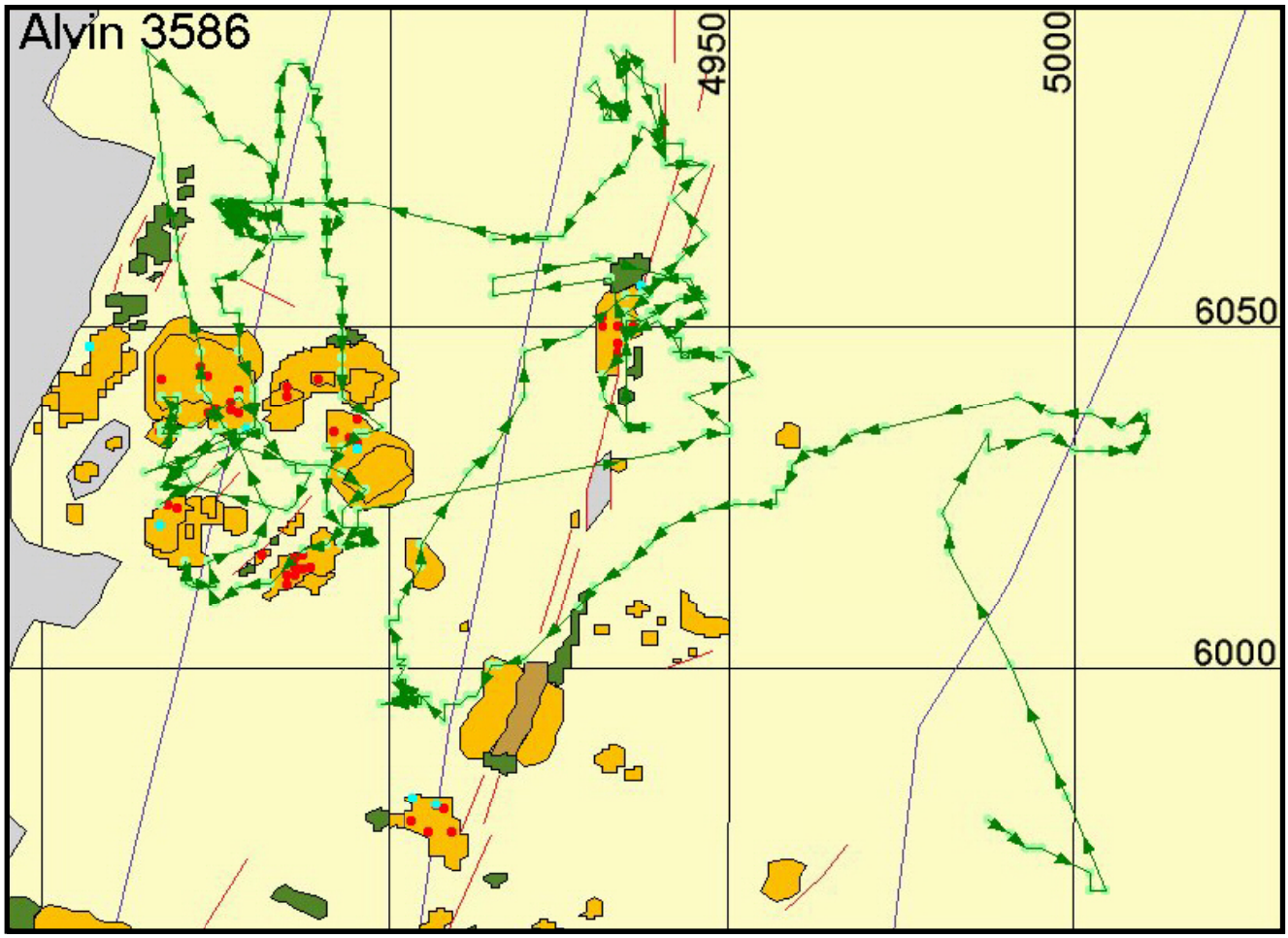
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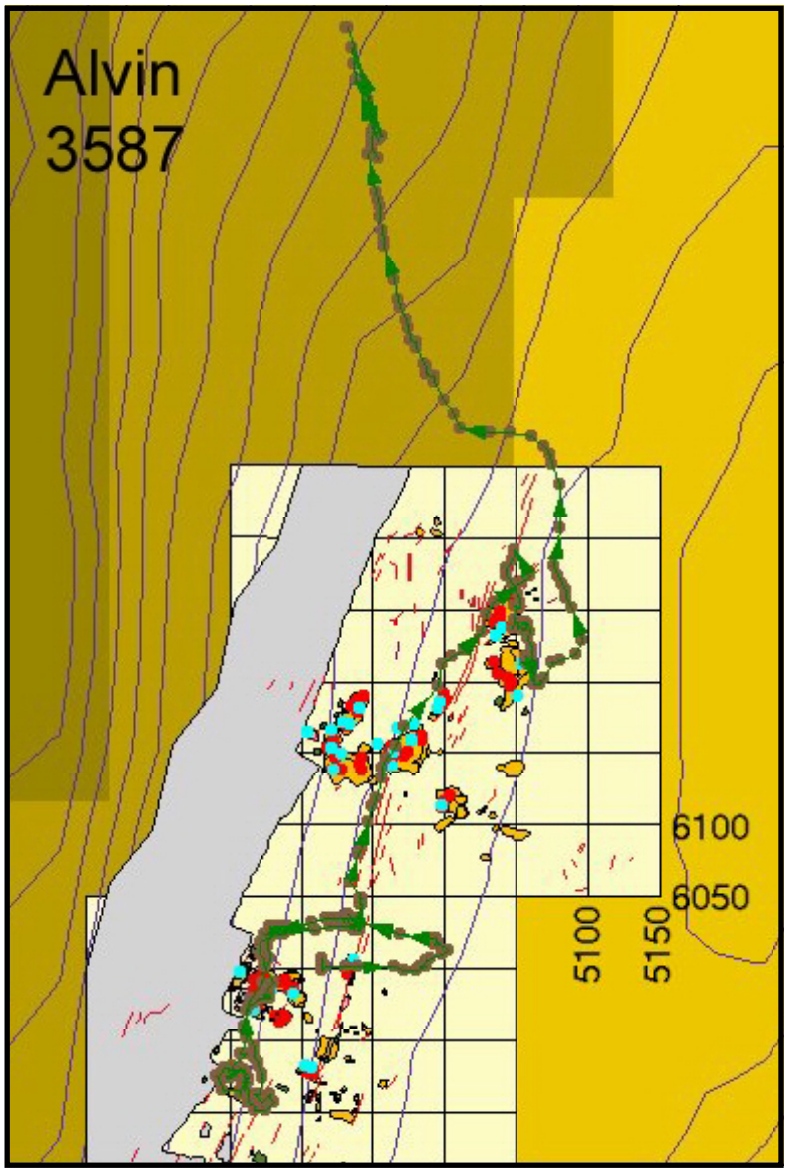
6050
6000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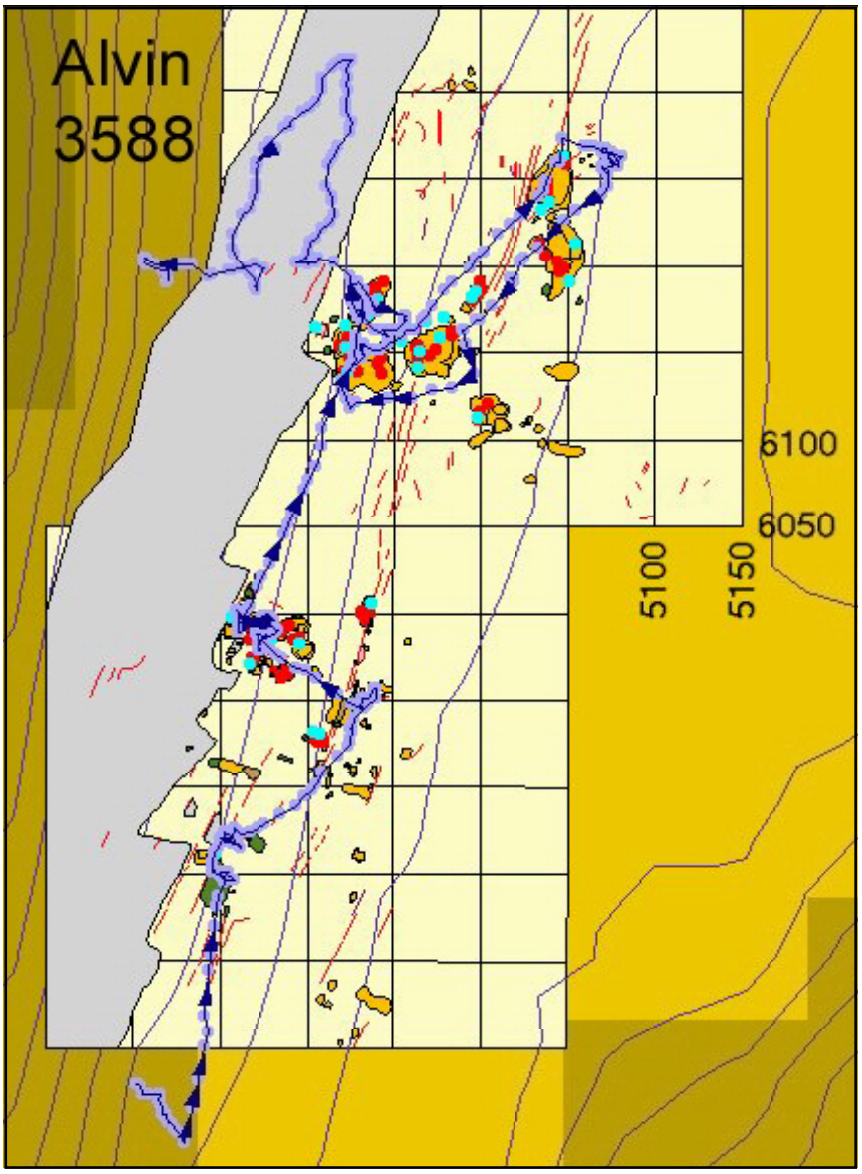
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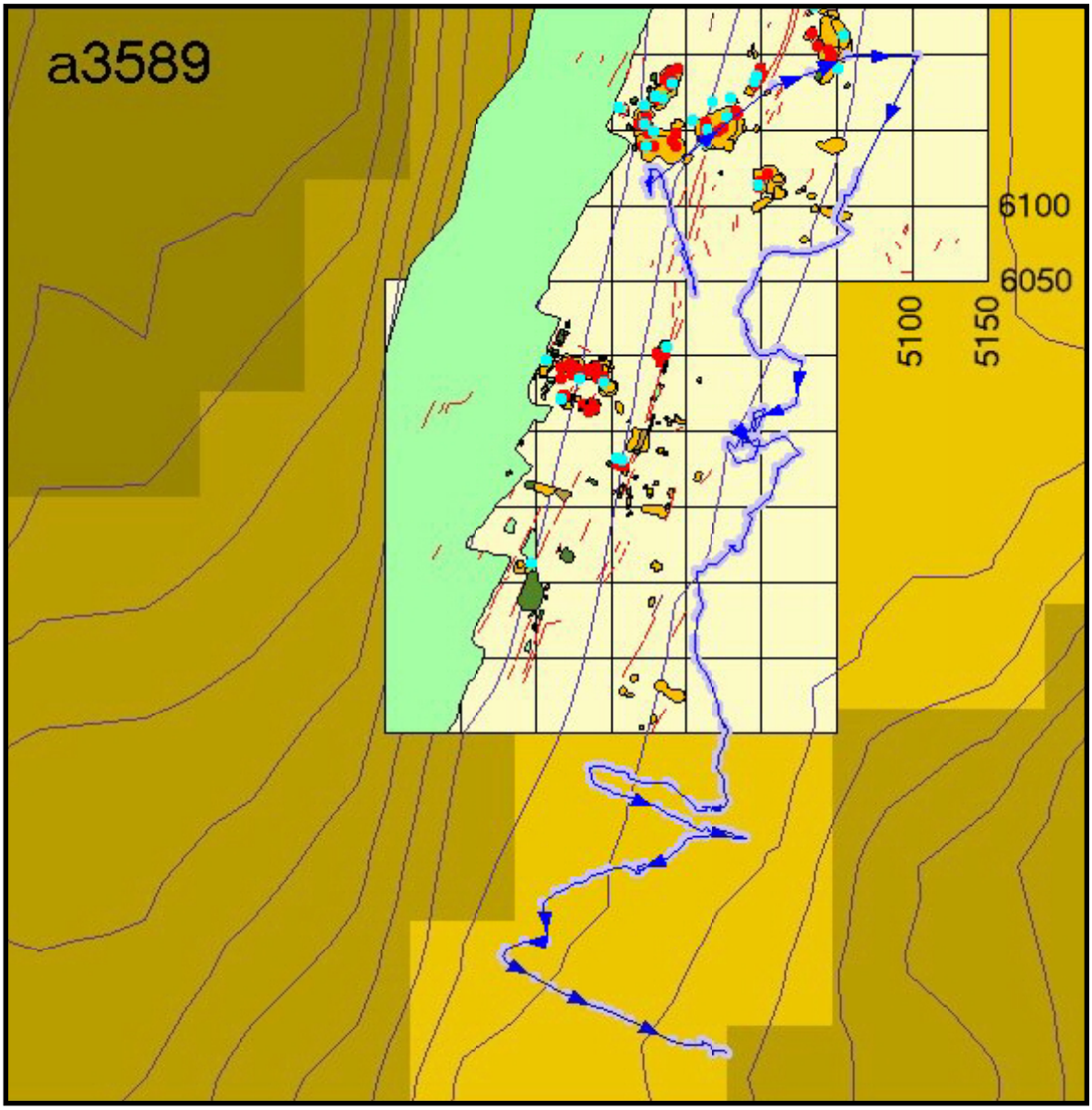
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6100
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Main Endeavour Field, Perturbed 2000 Leg 2, Atlantis 03-56

September 2 – September 19, 2000 (Seattle, WA – Astoria OR)

Summary of Cruise AT03-56, Main Endeavour Field Perturbations Cruise

Table 5. Summary of Leg 2 Dives and Night Operations

Date	Alvin Dive	Dive Summary	Night Operations	Night Summary
9/2/00	Leave Seattle		CTD	CTD test and determination of background T, S
9/3/00	Dive 3909: Steve Faluotico, Marv Lilley, Meg Tivey	Deploy CM, move GD, do RP survey, recover RP and M	CTD	Reidentify T anomaly found in June (cast 13, U31)
9/4/00	Dive 3610: Bob Waters, Debbie Kelley, John Frantz	Test H2 probes, recover Hobos, recover M	Elevator Remote Access Sampler; Sea Beam survey	Elevator, then Sea Beam of "hole" near 47°55.41'N, 129°1.22'W
9/5/00	Dive 3911: Bruce Strickrott, Dave Butterfield, Meg Tivey	Use Beast to sample diffuse fluids; deploy RAS, recover CM	CTD	Further delineate anomaly near 47°49.83'N, 129°03.9'W
9/6/00	Dive 3612: Dudley Foster, John Delaney, Dan Schuller	Survey N of Hulk, sample fluids in N field, use H2 probe, recover GD	CTD; Sea Beam survey	CTD near 48°0.95'N, 129°02.00'W to examine T anomaly; Sea Beam east of axis
9/7/00	Dive 3613:	Battery leak	Sea Beam on way in	14 knots
9/8/00	In Astoria		and out	14 knots into wind
9/9/00	Dive 3614: Steve Faluotico, Deb Kelley, Ben Larson	Recover Edwards' samples, deploy 2 Hobos and 1 RP, recover M and move CM	Sea Beam survey	Sea Beam west of axis
9/10/00	Dive 3615: Bob Waters, Véroniqu Robigou, Kevin Roe	Sample diffuse fluids and video fauna, recover CM	CTD	Tow-yo up rift valley starting at 48°03'N
9/11/00	Dive 3616: Bruce Strickrott, Debbie Kelley, Tim Cron	Release RAS, use H2 probe, take fluids, recover/deploy Hobos, recover RP and GD	Sea Beam survey	Sea Beam west of axis
9/12/00	Dive 3617: Dudley Foster, Jozee Sarrazin, Steve Liberatore	Sample fauna, move CM, video TS arrays, recover TS array, Osmo, and PS	Sea Beam survey	Map area east of area mapped 7/5/00
9/13/00	Dive 3618: Steve Faluotico, John Delaney, Susan Lang	Sample diffuse fluids using Beast, use H2 probe, recover RP	Remote Access Sampler deployment, then Sea Beam survey	Sea Beam: areas between 129° 25' W and 129° 15 W, and as far north as 48° 20' N
9/14/00	Dive 3619: Bob Waters, Marv Lilley, Brian Kristall	RP survey and fluid sampling, use H2 probe and PS, deploy RAS, recover Osmo and GD	CTD	Tow-yo N of 48°03'N
9/15/00	Dive 3620:	Recover remaining	CTD	Tow-yo N of

	Bruce Strickrott, Meg Tivey, Jozee Sarrazin	instruments (ts arrays, CM, RPs) and take faunal and fluid samples		48°03'N
9/16/00	Dive 3621: Dudley Foster, Deb Kelley, Sher Bolton	Recon to N of Hulk, fluid sampling, RP calibration, use H2 probe, release RAS	Transponder deployment; Dredge of The Hole	Lay transponders, then dredge the Hole at 47°55.1'N, 129°01.06'W
9/17/00	Dive 3622: Steve Faluotico, Deb Kelley, John Delaney	Mapping and sampling of new vent field	Transponder recovery; Sea Beam survey	Sea Beam of N part of West Valley
9/18/00	Dive 3623: Bob Waters, Dave Butterfield, Mark Fox	GT valve test, fauna and fluid sampling, recover vemco, deploy vemco tripod, survey old sulfide	Sea Beam on way in	
9/19/00	To Astoria			

CM, current meter; GD, gamma detector; GT, gas tight; M, Medusa; RP, resistivity probe.

Table6. Instrument placement and recovery from June through September, 2000

Instruments	Structure	Depth	Hdg	x	y	Altitude	On bottom
H®**?**	Hulk	2186	017	5055	6239	15.4, MT	7/9-**9/9?**
H	Hulk	2186	155	5054	6252	Red	9/6-
H (M) - MQ	Dudley	2192	263	5017	6121	MT	9/6-9/15
RP®	Grotto	2188	320	4948	6137	6.1	6/16-6/26
RP®	Grotto						9/9-9/15
H ®	Grotto	2184	047	4931	6154	9.7	7/10-9/4 m&m
H ®**?**	Grotto	2184	047	4931	6154	9.7	6/28-**9/9??**
RAS ®	Grotto	2186	101	4938	6137		9/13-9/16
H lo T ®	Grotto	2187	101	4938	6137		9/13-9/16
H	Grotto	2184	235	4933	6145	T marker	9/4-
CM ®	N of S&M	2193	150	4929	6032	1.6	6/16;7/9-9/10
O ®	N of S&M	2193	247	4940	6027	2.5 red	6/23-6/28
CM ®	N of S&M						9/12-9/15
O ®	N S&M	2193	247	4140	6027	green	7/9-9/14
TA ®	N of S&M	2193	172	4934	6027		6/23-9/15
GD ®	MT2 (S&M)	2193	271	4934	6029		9/3-9/14
WB ®	DK3 (S&M)	2192	243	4939	6032		7/7-9/14
RAS ®	N of S&M	2193	212	4935	6028		6/23-6/27
RAS ®	N of S&M	2192	243	4939	6032		7/7-7/9
RP ®	S&M	2183	267	4944	6011	24.4	6/26-9/3
H	S&M	2186	212	4945	6016	7.7	9/11-
H ®	S&M	2186	212	4945	6016		**Ja?**-6/28
H ®	S&M	2186	212	4945	6016	7.7	**Ja?**-9/4
PS ®	MD	2193	076	4919	6031		6/13-22; 23-9/12
M ®	E of S&M	2201	202	4940	5998		6/28-9/3
O ®	Easter Island	2195	211	4878	6026	1.9 blue	6/23-6/28
CM ®	Easter Island	2194	255	4883	6027	3.5	7/6,8;7/9-9/5
GD ®	Easter Island	2194	215	4883	6021		6/22(24)-9/6
M ®	Easter Island	2194	016	4878	6018	6/22-24	6/24-26
M ®	Easter Island	2194	016	4878	6018		7/8-9/4
TA ®	Easter Island	2195	024	4874	6020		6/23-9/12
CM (M)SM	Easter Island						9/9-9/12
O ®	Easter Island	2195	211	4878	6026	orange	7/9-9/12

RAS ®	Easter Island	2195	256	4883	6002		9/5-9/11
Collander ®	Easter Island	2195	257	4880	6024		Old-6/20
H ®**?**	Peanut	2191	154	4851	6019	ML	6/16-**?**
RP ®	Bastille	2194	013	4883	5989	4.1	6/15-7/7broke
H	Bastille	2193.2	126	4877	5995	4.1	9/11-
H ®	Bastille	2193.2	126	4877	5995	4.1	6/14-15 ML
H ®	Bastille	2193.2	126	4877	5995	4.1	7/10-9/3, UW1
V ® but 1®	Puffer	2194	136	4876	5971		7/6-9/12;9/19
H ®	Puffer	2193	118	4868	5979	4.5 m&m	6/26-7/7
H ®	Puffer	2193	118	4868	5979	4.5 uw	6/14-6/24
H ®	Puffer	2193	118	4868	5979	4.5	7/7-9/3
H	Puffer	2193	118	4868	5979	4.5	9/11-
RP ®	Puffer	2193	118	4868	5979	4.5	6/28-9/11
RP ®	Sully	2189	148	4892	5973		6/14-6/23
RP ®	Sully	2189	148	4892	5973		6/26-9/13
H ®	Sully	2189	148	4892	5973		6/14-6/24
H	Sully	2189	148	4892	5973	PP	6/26-9/3
Instruments	Structure	Depth	Hdg	x	y	Altitude	On bottom
H ®	Sully						Old?-6/14
RP ®	Cannaport	2196	273	4862	5969	2.6	6/16-6/23
H ®	Cannaport	2195	273	4835	5969	2.6, MT	6/26-9/4
V ®	DK1	2190	335	4936	5936		7/6-9/12
GD(M)MT3	DK1	2190	335	4936	5945		7/7-9/3
H ®**?**	MilliQ	2185	253	4923	5937	PP	6/16-**?**
RP ®	MilliQ	2186	177	4911	5946/5936	8.3	7/7-9/15
RP ®	MilliQ	2186	177	4911	5946/5936	8.3	6/16-7/5
H	MilliQ	2186	138	4918	5936	8.3 MT	9/15-
GD ®	DK2	2194	077	4909	5936		7/5(7)-9/11
M ®	DK2	2193	170	4904	5945		7/8-9/9
CM (M) - EI	DK2	2193	154	4907	5942		9/3-9/9
WB ®	DK2	2194	077	4909	5936		7/5-9/11
V ®	Cathedral	2180	176	4847	5923	4.7	7/9-9/15
H ®	Salut	2191	248	4866	5872	3.1, ZO	6/21-9/11
H	Salut	2193	243	4869	5866	ZO	9/15-

*Vemco on T handle was lost in crack at N of S&M. Can still see it (see Dive 3611 at ~1016h), but have not yet been able to recover it.

Cruise Operations

September 1-2: transit

September 2-3:

The CTD was put in at 48° 00.0012' N, 128° 30.0002 W at 02:28 GMT (09/03/00). This was done in order to determine the background temperature and salinity profile to obtain coefficients for determining the temperature anomalies. Technical difficulties with the software program and obtaining line out, tension, and speed from the winch however prevented us from attaining this data. The coefficients from the first half of the perturb cruise in June would be used instead.

September 3: Alvin Dive 3609

The goal of this dive was to deploy a current meter, use a res probe at multiple sites for calibration, move the gamma detector at DK1 to MT2, and recover some of the instruments in the MEF.

As Alvin descended, the ICL loop was used to check that both the resistivity probe and the current meter were working. Alvin reached the bottom at 0931, and transited west to the DK1 site where we checked out the position of the gamma detector. We then moved over to the DK2 site, and deployed the current meter ((4901, y5942, z2192.7, hdg 154). We then moved up to a smoker on the northeast side of Milli-Q and used the resistivity probe, putting the tip into and out of the orifice 3 times. At 1054 to 1056, the red major bottle was taken. We then moved to DK1 (X4937, y5939, z2190.4, hdg 301) and took video and stills of the gamma detector and did a high temperature survey around the sensor head. Temperatures were very low (0.1 to 1.1°C), and 11°C in the palm worms and tubeworms below the sensor. The black major sampler was used to sample fluid, and the gamma detector was picked up and carried north to the area north of S&M (Z2193m, x4942, y6025, hdg 273) where it was placed near marker MT2. Temperatures were measured near the sensor head (2 to 13°C).

Alvin then moved over to the current meter and picked up the stack of Alvin weights that had been left there from the RAS deployment. They were carried ~20 meters north and dropped. Alvin then transited over Easter Island and to Bastille (X4860, y5992, z2193, hdg152), which was difficult to recognize because 4 meters of chimney had grown above the Hobo. We knocked over the growth, recovered Hobo UW1 at 1246, and tested the resistivity probe. We then sampled fluid using the green major at 1308 to 1311, and picked up a piece of sulfide that had been knocked over during sampling. We then moved to Puffer (x4878, y5975, z2193.4, hdg 129) and recovered the Hobo with 2 black stripes. We then moved to Sully and recovered Hobo PP (X4899, y5969, z2189.4, hdg 161). We excavated a nearby smoker, but the highest recorded T was ~300C, so we decided to move on to the S&M resistivity probe site. We tried to approach the S&M Res probe, but the strong currents resulted in 2 crashes (one affected pan and tilt) and a final 3rd approach to set up (X4944, y6002, z2185, hdg 325). At 1427 the resistivity probe was recovered, but we were unable to take a temperature or gas tight sample. We then moved east then south to the Medusa located southeast of S&M (x4945, y5990, z2202.5, hdg 191). We took video of the flow out of the Medusa, then of the rest of the Medusa, and also took 3 digital still pictures. Temperatures were taken (17C in throat), and then the Medusa and logger were recovered. The temperature inside donut after the Medusa was recovered was 15.8 to 27C. We dropped weights at 1520 and headed up.

Night Operations: The CTD was put in 47° 59.8244' N, 129° 04.1345' W at 01:47 GMT (09/04/00). This site was selected as a significant temperature anomaly was identified at this location on the first half of the perturb cruise in June (Cast 13, U31). The goal for this CTD run was to reidentify the temperature anomaly and search around in pogo mode to find the extent of temperature anomaly in order to estimate a possible source region for the plume. The ultimate goal

is to dive with Alvin within a well constrained estimated source region to identify a new vent site. Samples were also taken for analyses for He, H_2, CH_4 and N_2O.

The temperature anomaly found on the cruise in June was reidentified. The center of the anomaly was at a depth of 2050 m and spread about 25 m in both directions. The Dq = 0.025-0.04 and the change in the transmissometer was .109. A bottle was taken within this anomaly and sampled for He(TBDL) and H_2, CH_4, and N_2O by gas chromatography. The results for H_2 and CH_4 were extremely large 166.07 nM and 1128.47 nM, respectively. We then plotted a regular hexagon with a radius of 100 m around this point stopping at the corners to do a down and up cast.

The right apex of the hexagon, 100 m directly east of U31 (H3), also had a significant temperature anomaly of 0.02-0.028. The bottom portion of the hexagon as well had temperature anomalies (H4, H5) while the left apex (H6) and the top of the hexagon (H1, H2) did not have temperature anomalies. A point 100 m directly east of H3 (H7) was also done as the signals were strongest in this direction. This point had the strongest temperature anomaly of 0.046. Samples were taken within this plume showed significant CH_4 content ranging from 144 – 412 nM.

September 4: Alvin Dive 3610

Alvin went into the water at 0800 with a dive target of X = 5000, Y = 6025. There were three main objectives of this dive, which included 1) to test the newly developed hydrogen probes in a series of high-temperature vents; 2) recover a series of hobos deployed during the first perturbations leg; and 3) recover a medusa from the experimental site at Easter Island. Alvin landed at 0915 east of S&M at the dive target and transited to the 020 trending fault bounding S&M. Alvin reached S&M and recovered the hobo GP from the northern orifice and measured a temperature of 376.7°C. Alvin then transited to a second vent on the eastern side of the structure from which the temperature-resistivity probe was recovered the day before. A gastight green bottle was fired and a temperature of 375.6 °C was measured.

Following completion of work at S&M, Alvin transited to Sully. A small chimney from a parasitic orifice was broken off to make adequate working space for the hydrogen probe tip. A temperature of 379.2°C was measured at the second vent over from the Star maker. A gastight bottle yellow was fired and the hydrogen probe was deployed. Alvin then transited to Bastille and attempted to deploy the second hydrogen probe near Marker B2. The chosen vent was too small however for deployment and other available vents were blocked by smoke. Because of this a decision was made to deploy the second probe in Sully. Before leaving Bastille, however, gastight bottle black was triggered and a temperature of 380°C was measured.

Alvin transited to Cannaport and recovered Hobo MT, then drove to Sully. At Sully, the first hydrogen probe was recovered and the second one was deployed. Alvin transited to Grotto to the initial temperature-resistivity site to test the hydrogen probe in a different temperature vent. The orifice was too small to deploy the probe, but a gastight sample was taken (red), a temperature of 363.8°C was measured and marker T was deployed. A site one meter above this area looked to be good for deployment of the RAS sampler. A second vent was measured with a temperature of 360.1°C on the north side of the structure.

Subsequent to surveying of Grotto, Alvin transitted south to Sully and recovered the second hydrogen probe. Alvin then drove west to the wall and north between Peanut and the axial wall to Easter Island. With power running low, flow out of the central portion of Medusa was imaged and a temperature of 13.2°C was measured from the central conduit. Video imagery was collected of the base and sides and a temperature of 26.5°C was measured at the interface between the cement base and the basaltic substrate. The Medusa was out of power, so the weights were dropped and Alvin came to the surface.

Night Operations: A detailed Sea Beam Survey of the off-spreading-axis "hole" (center coordinates 47° 55.4085' N, 129° 1.2222' W) was conducted. A course was laid that would cross the depression from 3 different directions around a 6-km wide circle at 8 knots and with 15 degree per minute turns. The course was completed without incident or revision.

September 5: Alvin Dive 3611

The goal of this dive was to sample diffuse fluids, with an emphasis on taking samples where instruments had been placed, and to deploy the RAS.

Alvin reached bottom at 0931 and headed west to the area North of S&M. (X4934, y6027, z2193, Hdg 172). The ICL loop was placed on the cone of thermistor array Log 1, and two sets of data were recorded. There was no visible flow exiting near thermistor array TM1, so we took some video, spent some time taking video of the T handle lost down the crack (with the vemco attached) and then moved to TM2 (X4938, y6026, z2193, hdg 249). We tool unfiltered bag sample #14, ,gas piston #4, DNA filter #10, and Filter #15. We also took some nice video of the thermistors. At 1138 we moved to the gamma detector nearby (x4939, y6027, z2193, hdg 189) and took filtered bag #11. We then headed west to Easter Island (X4874, y6020, z2195, hdg 024) where we took video of the arrays before sampling. At TM3 we took unfiltered Bag #8, Gas piston #5, and then moved the nozzle about 1 foot and took Filtered bag #17. We then took Unfiltered Bag #18 and gas piston #20 from in front of the gamma sensor head. A gas tight (and some worms) was then taken at the first fluid sample location, and a major bottle at the 2nd fluid sampling spot. We also took pan and tilt video of the thermistors of TM4, but the flag was in the way so we could not get good 3-chip video. We then moved the current meter out of the area, and went to look for the RAS. The search took over an hour, and the RAS was finally found down in a hole (X4985, y6134, hdg 179, 2192m). We picked up the RAS and headed for Easter Island, where it was deployed with the tip laying across the TM4 thermistors (X4883, y6022, z2194.9, hdg 256). We moved back over to the current meter and loaded it in the basket (breaking the sensor tip in the process), and released weights and came up.

Night Operations: The CTD was put in at 47° 59.8267' N 129° 03.8929' W at 02:05 GMT. This point is 100 m directly east of the point H7 from the previous nights CTD which had the strongest signal. We were trying to pin down even further the location of the suspected new vent site. Again samples were taken for analysis of He, H_2, CH_4 and N_2O. Upon finding a significant temperature anomaly at this site we planned at regular hexagon of 150 m radius around this point. Temperature anomaly signals were seen at the right apex of the hexagon (WP2) and along the bottom of the hexagon (WP3, WP4). The strongest signal was seen at the left apex of the hexagon (WP5) with a temperature anomaly of Dq = 0.08 and a significant density reversal. The density reversal signifies a buoyant plume as the plume is less dense than the surrounding water and still rising, which means you are close to source. The top edge of the hexagon (WP6, WP7) also had significant temperature anomalies although not the density reversal seen at WP5.

Upon completion of the hexagon a small circle of 25 m radius centered around WP5 was planned. The first point of this circle 25 m directly east of WP5 (WP15) had a maximum of 0.1 and significant density reversals. The next point 25 m directly south of WP5 (WP16) had a temperature anomaly that shot off our screen of view so > 0.2 and there was significant density reversal as well. The signals at the other two waypoints (WP17, WP18) west and north of WP5 did not have nearly as significant signals as the others. With the results from WP5, WP15, and WP16 we are fairly confident that we have pinned down the location of a new vent site and ready to dive on the site.

September 6: Alvin Dive 3612

The goal of dive 3612 was to locate possible new hydrothermal activity north of north Endeavor field and gas tight and major water sampling in northern portion of Endeavor field. We touched down at north of Hulk at 0920 (5634x, 6394y, 2098z, 133h) and located the north-south

fissure at 0942 (5090x, 6400y, 2198z, 187h). We proceeded to motor south in a zig-zag pattern, repeatedly crossing the fissure. The surrounding water was slightly smokey and we saw some sulfide fragments, tube worm fragments and spider crabs. At 1001 (4985x, 6313y, 2190z, 340h) we had not spotted any vent activity and headed back north in a zig-zag pattern over the fissure. At 10014 (5010x, 6318y, 2150z, 180h) we once again turned south and repeated the southern zig-zag pattern over the fissure. Fractured sulfides, basalt and sediment were all seen during this search. At 1032 (5030x, 6270y, 2180z, 180h) we had not found any hydrothermal activity and thus abandoned the search. We continued to motor south and landed at Hulk next to marker XX. High-T probe gave a temperature of 341.2 C. The green major did not fire so we took a red major instead. A yellow gas tight and toaster were taken as well. Moreover, a red hobo was deployed and the H_2 probe was deployed for twenty minutes.

Alvin continued south for Crypto. Temperature at Crypto was 344.0 C as taken by the high-T probe. There was a vigorous black smoker bathing a ledge of downward hanging tubeworms. We fired a white gas tight and yellow major (part of double). We deployed marker I to mark the interesting tubeworm field. We then headed for TP. Temperature using high-T probe was 352.4 C at TP. We fired a white major (part of double) and black gas tight. We then headed for Dante where the high-T probe gave a temperature reading of 360.7 C. We fired a yellow major and a red gas tight. Dudley noticed that the red gas tight had a loose snorkel. We deployed the H_2 probe and left for Dudley which had a temperature of 350.4 as taken by the high-T prove. A blue major and green gas tight were taken. The MT Hobo was deployed and we returned to Dante to pick up the H_2 probe. While waiting to pick up the H_2 probe we took an orange gas tight in order to compare with the loose snorkel red variety. We shot video and digital stills of the H_2 probe tip 2-3 inches inside the orifice and then retrieved it after a total of fifty minutes. We proceeded to Easter Island where we promptly located the RAS and moved it so that the snorkel was not fully extended. We moved over to the gamma detector and characterized the temperature around the sensor. There was quite a bit of drift in the high-T probe but 6-9.6 C seemed to be the most accurate range of temperatures. The gamma detector was recovered and we dropped weights at 1500.

Night Operations: The CTD was put in at 48° 04.9510' N 129° 02.0000' W at 02:40 GMT. This new site was selected based on data from the first half of the perturb cruise in June. Marv believes he caught a wiff of a plume near this site. Samples again were taken for analysis of He, H_2, CH_4 and N_2O. A circle of 100 m radius was planned around this point. The results at all 5 points were the same. At about 2200 m depth there was a =0.025 which was maintained for the remaining 200+ m to the seafloor. If looking at the graphs at 90° turn the temperature anomaly almost appears as a step function It was then determined that we should plan a tow-yo through this region. Therefore the CTD was pulled up and a tow-yo was planned for another nights run.

A Sea Beam Survey was then performed just East of the spreading axis to fill in some of the gaps in the existing bathymetry map. The course was laid at 8 knots and with 15 degree per minute turns. The course was completed without incident or revision.

September 7: Alvin Dive 3613

Battery leak – need to go into Astoria to change out batteries.

A Sea Beam Survey was performed during transit to Astoria. This was a lower quality survey due to the ship's speed being in excess of 14 knots at times. The seas were not very rough. The survey runs from lat/long of 48° 50'N, 128° 50' to lat/long 46° 11' N, 123° 52' (approx.).

September 8: In Astoria

***September 9:* Alvin Dive 3614**

A Sea Beam Survey was performed during transit from Astoria. This was a very low quality survey due to the ship's speed (around 12 knots) and rough seas causing pitching and air beneath the hull. The survey runs from lat/long of 46° 11' N, 123° 52'to lat/long 47° 56'N, 129° 06' (approx.).

Alvin Dive 3614

Alvin landed just Northeast of Hulk. We recovered Hobo 144* at Hulk (3614_001.jpg and 3614_002.jpg). The temperature here was ~330 °C. We then searched around a bit until we found the Edwards Experiment, which was on the opposite side from the Hobo location. We recovered the Edwards Experiment (3614_003.jpg, 3614_004.jpg, 3614_005.jpg), and then transited to Grotto. At Grotto, we recovered Hobo 121* because it was no longer in the orifice. The temperature here was 360 °C, but the temperature record drops sharply to 0 °C, indicating the point at which the Hobo fell out of the orifice. The Resistivity Probe was then deployed at the orifice where the Hobo had fallen out (3614_006.jpg). Again, the temperature here was 360 °C. After this, we headed for DK2 at Milli-Q to recover the Medusa. After some difficulty setting up due to the currents, we recovered the Medusa (3614_008.jpg, and 3614_009.jpg) just after taking temperature measurements at the top (6.6 °C) and at the base (15.9 °C). After a time extension from the top lab, we moved the current meter from Milli-Q to Easter Island (3614_010.jpg). We then dropped weights and came up.

*There was some confusion as to which Hobo was recovered from which vent, but the temperature records for the two Hobo's were distinct enough to clear up this confusion. However, the numbers in the above dive summary may be reversed due to the original confusion, but the temperature record that drops to 0 °C belongs to the Hobo recovered from Grotto on this dive.

Night Operations: The RAS was deployed using an elevator. Then, a Sea Beam Survey was performed on a section immediately west of the spreading axis mapped on the July Atlantis 353 cruise (GMT 07 05 2000). This was done to begin the construction of a complete map of the portion of the spreading axis bounded by 48°N, 129° W, 47° 20' N and 129° 25' W. The survey was performed at 6 knots and the seas were moderate. The course was completed without incident or revision.

September 10: Alvin Dive 3615

At 8:04 am the sub was deployed in the water and reached the bottom at 9:26 am at coordinates 4990 and 6153 just East of Grotto. The principal goal of the dive was to sample hydrothermal fluids mostly from diffuse flow sites in the Main Endeavour Field.

At 9:47 am we were positioned by marker T to sample a diffuse flow site at top of the structure in a potential area for a RAS deployment. Positioning the sub and keeping it stable turned out to be difficult as southwesterly currents kept pushed the sub into a venting spire at the southwestern end of Grotto. During the third attempt to stabilize the sub against the ledge of the sulfide structure, the current rafted Alvin into the sulfide to the west and the port weights were torn way from the sub. At 10:00 am we started rising and to counteract our ascension, bob started filling the sub with water to recover our neutral buoyancy state and continue the dive. We rose 111 meters above the seafloor and drifted northeast of Grotto.
At 10:33, we started descending at the location 4995 and 6183 right on top of TP. At 25 meters altitude we encountered a tall, skinny venting spire probably on the western side of TP. Very tall compared to the last map (1995) of TP.

10:39 We are back at Grotto in front of Marker T and positioning to sample the first suite of fluid samples from the area just East of marker T. See details in Station #1. Very nice assemblage 3 covers this area and the temperature of the diffuse flow is 15.16°C. Flying to Easter Island and Bob flies high in the water column. Found the RAS with the flasher which helped find Easter Island very fast. We took a while looking for the right location to sample diffuse flow on the basaltic floor in an area with no established hydrothermal communities. We settled for an area approximately at 045 North of the RAS. 11:42:35 start sampling with "the beast". See details in station #2 12:10 Flying to Milli-Q and at 12:23 in position to sample at DK1 where we sampled around assemblage 2 0r 3 formally described as 1 in June 2000), and in assemblage 5 of tube worm. See details on stations 3 and 4. 13:06 en route for Cathedral, where we sample the diffuse flow on the flange by the tripod. And high temperature fluid in one if the white smokers close to marker XS (maximum temperature of white smoker was 314.7 C and we collected fluids with one Major and two Gas Tights (major blue, GTs white and red). See sampling details in stations 5 and 6. Ended dive at S&M picking up the current meter for Meg Tivey at 14:21-14:22.
14:24 Clear to surface.

Night Operations: The CTD was put in at 48° 03.00' N 129° 02.12' W at 1:30 GMT. This point was the center of a long zig-zag tow-yo up the rift valley. The southern point of the whole planned tow-yo was a little north of the new site that was pinned down earlier in the cruise and the northern endpoint was further north of the far north area that was explored on 09/06-07/00. Samples were taken for analysis of He, H_2, CH_4, and N_2O. This night's beginning point was near the eastern wall of the rift valley. During the night we were able to do 2.25-2.5 zig-zags (E-W, W-E, E-W partially) at a length of 0.8 nautical miles and a speed of 0.3 knots. We were unable to finish the third zig-zag due to a 2.5 hour delay with winch problems.

On the first down cast (D1) we saw a temperature anomaly of =0.045 at about 2025 m depth. As the CTD was heading westwardly the signal began to decrease and a second signal at a depth of 2125 took more shape. On the second down cast (D2) the first temperature anomaly had decreased to Dq = 0.035 while its depth had increased to 2050 m. The second anomaly was at a depth of 2125 m with a = 0.02. Like the first temperature anomaly the second one increased its depth to 2150 m. The first anomaly disappeared completely by U4 while the second anomaly lingered along the entire westerly transect and through the turn to U8. As we approached the eastern wall (D13-U14) a temperature anomaly appeared at 2075 m depth and decreased its depth to 2050 m. It is possible that this is the same plume that was spotted on the first down cast. The temperature anomaly on this plume was less though than the first one as the maximum = 0.025. The tow-yo was stopped in the middle of the third zig-zag at 48° 03.7395' N 129° 02.3970' W.

September 11: Alvin Dive 3616

The purpose of Dive 3616 was to send the previously deployed RAS to the surface, deploy the hydrogen probe at Bastille for approximately 2 hours for testing, collect several water samples, recover and deploy several Hobos, toast a single toaster, recover a gamma detector and a whale bone, and explore the Cathedral vent complex.

We reached the seafloor at 0906, about 60 m north-east of S&M. We transited west to intersect the fissure that runs north of S&M, then south to the structure itself. We shot several photos with the 35mm, used the hi-temp probe to measure the temperature in one of the vents (376.4°), then deployed the Yellow Hobo MT in the north side of S&M. We moved north and west to the area just north of Bastille, and released the RAS probe at 0952, after taking good three-chip video of the RAS deployment configuration, including the sampling wand and thermistor array. Next we transited south and around Peanut to the west, then east into the area between Bastille and Puffer. Here, looking north, we attempted a high-temp probe, but the instrument failed and would no longer be used on this dive. At 1028 we inserted the hydrogen probe in one of the vents, then turned to the south for work at Puffer.

At Puffer we recovered a temp-resistivity probe (1035), and sampled water with a Blue Major (1105) and a Yellow Gas-Tight (1116). We then deployed the Black Hobo MM at 1120.We moved over to Cannaport, sampled water with the Red Major and Blue Gas-Tight at 1155, then transited to Peanut. The currents at Peanut were too strong to take water samples, so we moved on to recover the hydrogen probe at Bastille. Here, we recovered the hydrogen probe at 1235, then sampled water with the Orange Gas-Tight at 1237. We toasted one of the toasters for four minutes at 1240, then deployed the Yellow Hobo FO at 1245. Next we were off to the newly discovered Cathedral complex to make general observations, make a preliminary map, and collect a sulfide sample. At 1300 we arrived at Cathedral, took some good three chip video, then recovered a small mushroom-shaped sulfide chimney.

At 1343 we headed for Salut, and at 1349 we recovered a Hobo there. Moments later, we attempted a sulfide recovery at Salut, but it was unsuccessful, so we moved on to Marker DK2 at 1355. At 1410 we recovered a gamma detector at DK2, then a whale bone at 1420. The marker DK2 was also recovered during this operation. At 1421 we dropped weights and made our ascent.

Night Operations: A Sea Beam Survey was performed west of Misty 4 to complete the detailed mapping of the portion of the spreading axis bounded by 48°N, 129° W, 47° 20' N and 129° 25' W. The survey was performed at 7.5-8 knots and the seas were calm, winds only at 3-4 knots. The course was completed without incident or revision.

September 12: Alvin Dive 3617

The goals of Dive 3617 were to sample different faunal assemblages on two sulfide structures (DK1 marker & Puffer) as well as to take video imagery and temperature measurements within a series of faunal assemblages. Some Vemcos also had to be picked up and the Easter Island thermistor array had to be recovered.

Alvin reached bottom at 0938, landing on dead sulfides and transited south west to marker DK1 located north of Milli-Q (x: 4927; y: 5942). At 1007, a stainless steel ring was deployed over a sulfide worm Assemblage (I) and temperature measurements were taken inside the ring, within the assemblage. A slurp sample was taken, slurping all organisms covering the surface marked by the ring. A video of the bare area was done at around 1028. Then, Alvin took some video imagery of Assemblage V-low flow, a tube worm assemblage where two Vemcos (V3 & V8) were previously deployed. Temperature measurements were done in this assemblage and both Vemcos were recovered. At 1107, the biological sampler was used to sample assemblage V-LF but was not efficient to clear the sampled surface. Then, video of Assemblage III, in which Vemcos V9 and V10 were deployed, was taken. Video imagery of Assemblage VI, marked by Vemco V2 was also done. At 1137, temperature measurements were done in Assemblage VI and Vemco V2 was recovered. At 1143, temperature measurements were done around Vemco V10, among Assemblage III and the probe was picked up. Temperature around V9 were taken at 1147 and the probe was picked up at 1156.

Alvin left DK1 and arrived at Puffer (x: 4878; y: 5969) at around 1208. Video and temperature measurements were done in both Assemblage III and VI where several Vemcos were deployed. Three of the four Vemcos (V4, V5 & V6) were recovered and V7 was left. Alvin arrived at Easter Island (x: 4958, y: 5920) at 1223 and the ICL reader was put on both the current meter and the thermistor array data logger to verify their status. Both instruments were working. At 1304, a video survey of the thermistor probes was done to identify their relative positions (marked with different colored tape) and the fauna present around the probes. A video survey of the Osmo sampler was also done (1315). At 1324, the current meter was picked up and moved to the northern end of S&M (x: 4948; y: 6008). A video survey of the second thermistor array, located in this area, was done at 1400. At 1415, Alvin was trying to locate a pressure sensor, located at MD marker and the instrument was picked up 10 minutes later. At 1435, Alvin was back at Easter Island (x: 4997; y: 5886) where the presence of newly formed sulfides and Assemblage I was

noticed. Some video and a piece of sulfide were taken at 1440. A monkey fist marker was deployed at 1448 to indicate RAS probe previous location. The Osmo sampler and the thermistor array were picked up at around 1450 and weights were dropped on the west wall at 1504.

Night Operations: A Sea Beam Survey was performed after CTD operations were suspended for the evening. The section mapped is immediately east the section mapped on the Atlantis 353 cruise (07-05-2000). This was done in continuance of the construction of a complete map of the portion of the spreading axis bounded by 48°N, 129° W, 47° 20' N and 129° 25' W. The survey was performed at 9 knots and the seas were calm. The course was completed without incident or revision.

September 13: Alvin Dive 3618

We landed east of S&M on a big dead sulfide. We headed straight for Sully (4943, 5998; head 249) and deployed the hydrogen probe at 10:06 with no problems. We made a beeline for Puffer to sample diffuse flow. We got to Puffer (4830, 5969, heading 195) and set up to sample diffuse flow coming out of the sulfide. Took the following BEAST samples, all at about 6.5 degrees: Bag #8, Piston#4, Filter#10. All were 600 mL. Next we looked for diffuse flow coming through basalt at the base of puffer (5986, 2197). We tried to stay as directly under our previous sampling site as possible. With a temperature starting at 40 degrees and slowly declining, we took the following samples: Bag #9, Piston #5, Filter #3, Filter #12. All were 600 mL. The final temperature was about 22 degrees.

Next we headed over to north east of Easter Island. We were looking for five holes in orange sediment from a previous sample site. After looking around for a while, we settled on diffuse flow coming out of orange sediment, although it was probably not the exact site we were looking for (4848, 6082). At this site, we took BEAST samples Bag #11 and Filter #17. Both were 600 mL and both had a temperature of about 14 degrees. We went north to Grotto to look for a possible RAS deployment site(4940, 6136). We set up on the Grotto flange and found a temperature of 15 degrees. At this site we took Bag # 14 and Piston #20. In order to make sure that the flow was hydrothermal in origin, we poked a hole in Grotto. Immediately, black smoke started coming out. We got a temperature of 320 degrees and took BEAST bag sample #16, 600 mL.

Alvin headed south to S&M to do a comparison between sampling with the BEAST and sampling with the gas tights and majors. At S&M (4947, 6023) we got a temperature of 358 degrees and took BEAST samples Bag #18 and Piston #23. We also took the red gas tight and the red major. We also took a temperature reading with the Alvin high T probe, which read 359 degrees. Moved over to Sully (4905, 5968) to continue the comparison. First we recovered the Hydrogen probe (14:12) and took the black gas tight and the blue major. With Alvin's high T probe, we were getting a reading of 379 degrees. With the BEAST, we got a steady reading of 377 degrees and took Bag #19 and Piston # 24. We recovered the resistivity probe. Finally, we headed to Salut then in a south west direction to fly over some dead sulfides and do some geology.

Night Operations: The RAS was deployed using an elevator. Then, a Sea Beam Survey was performed after Remote Access Sampler deployment. The section mapped is north and west of previous maps of the Endeavor Segment. This was done to try and extend the complete map northward of 48° N. The map filled in some areas between 129° 25' W and 129° 15 W, and as far north as 48° 20' N. The survey legs of the course were performed at 9 knots and the seas were calm.

After passing Waypoint 2, it was determined that the parallel track back south toward the dive site would be too wide to overlap well. At that time the southward track was changed to 129° 18' W from 129° 16' W. Additionally, the course laid to 48° 15' N would leave some holes in the map

if the Sea Beam track was discontinued there. For that reason, it was decided to continue the course to 47° 57' N then to return to the dive site.

September 14: Alvin Dive 3619

The goals of dive 3619 were to 1) to do resistivity probe surveys and take corresponding water samples (gas tight and major) at Sully, Puffer, Cannaport, and Hulk 2) deploy the H_2 probe and pressure sensor at Sully 3) locate and redeploy the RAS on Grotto 4) take a toaster sample 5) test Marv's plastic and 6) recover the osmo sampler, gamma detector and whale bone at S&M.

Alvin landed at the dive target of x5000, y5975 at approximately 9:10. Upon reaching the bottom we transited over to Sully. On transit to Sully went over lobate basalt flows as well as broken up blocky basalts. Approached Sully from the southern end and located vent with a hobo in it. We deployed the H_2 probe in Sully in the vent with the hobo. Then located another orifice to burn the toaster, plastic, do the resistivity probe survey and deploy the pressure sensor. The temperature of the orifice was 377.6°C. First we burned Marv's plastic, which was a test to see if the material could survive sitting the orifice to be used in later probes. The plastic was completely consumed by the hydrothermal fluid and hence will definitely not work on future probes. Marv noted that there were more holes/orifices than before and with lots of smoke. We then burned the toaster in the same orifice for approximately 5 minutes. The resistivity probe was put in the same orifice and Marv began with the burst mode which is a set of rapid measurements. The resistivity probe died during the survey and no data was obtained before it died as it was reading zeros. The end of the probe looked okay although part of the tube appeared damaged. The pressure sensor was than deployed into the same orifice.

We then left Sully and moved over to Puffer to take water samples. When we arrived at Puffer the navigation went bad on us and could not get a good reading. We located a nice black smoking orifice at Puffer with temperatures of 379-381°C and took the orange gas tight and yellow major. In gathering the samples the hobo was knocked out of position and replaced. With the death of the resistivity probe the sampling sites were changed. After the samples at Puffer were gathered we moved towards Peanut to take samples. We were unable to get into or find a good spot in Peanut to get a sample so we headed north to pick up the RAS. Rather easily spotted the RAS, picked it up and continued the transit north to Grotto. The RAS was deployed on Grotto with an intake temperature of 19°C. A hobo was also placed within the same intake as the RAS. Several pictures and video were taken of the RAS intake. We then searched for a nearby black smoker vent near the RAS deployment site on Grotto so that we would have corresponding high temperature and diffuse flow. Temperature at the black smoker vent at Grotto was 351°C. The blue gas tight was fired. The red major was fired but was a bit flaky so it was redone with the blue major.

We then returned to Sully to recover the H_2 probe and pressure sensor. The pressure sensor had remained down for 3 hours and the H_2 probe remained for 4 hours. At Sully we took the white gas tight at a black smoker vent with a temperature of 380.4°C. We then headed over to Cannaport to take water samples. The black major and clear gas tight were taken in a black smoker of a temperature of 366°C. After the samples were filled we transited over to S&M to pick up instruments. A bit north of S&M recovered the osmo sampler without disturbing the thermistor array. Then went to recover the gamma detector. The temperature around the gamma detector was 13.2°C. The whale bone near S&M at the DK3 marker was also recovered.

Night Operations: The CTD was put in at 48° 03.00' N 129° 02.12' W at 1:54 GMT. This is WP12 of the large zig-zag tow-yo planned up the center of the rift valley. We began at this point on the previous CTD and found an anomaly. It disappeared as we headed north so we planned this time to head a bit east and the south along the zig-zag plan in order to find the source of what we

saw the previous time. Samples were taken for He, H_2, CH_4, and N_2O analysis. The speed of the tow-yo was 0.3 knots.

We did not see an anomaly at WP 12 again or as we headed eastward. We started heading back west towards WP11 during U5. After the turn as we began heading west on D6 and U6 we saw a = 0.02. The anomaly quickly disappeared. As we neared the western edge of the survey (WP11) a small anomaly began to develop at a depth of 2150 m. On U17 = 0.01-0.015 and grew to about 0.025 on U18. Shortly after this (U19) the weather and currents prevented us from continuing the survey heading back east. At this point the survey was ended and the CTD was retrieved.

September 15: Alvin Dive 3620

The goal of this dive was to recover the remaining instruments from the MEF, and to take some last important samples in case the storm to the west of us moved east and caused the remaining dives to be cancelled.

Alvin arrived near the bottom at 0925h and transited northwest to Dante, then came south to Grotto and set up to recover the Res probe (after 4 tries – the current, pushing north, was very strong throughout the dive). At 1004h we began recovering the res probe (Z2186.5m, x4947, y6137, hdg 308), taking a digital still first. The pilot had to maneuver Alvin slightly to take the temperature of the orifice and to take the red gas tight. Alvin then transited east then south to Dudley, where Hobo MT was recovered (2191m, hdg 314, x5018, y6118). Alvin then went south to Milli-Q and we set up to sample at the DK1 site. While maneuvering to take a slurp sample of Assemblage III within a 20 cm diameter ring, Alvin blew a fuse since it was running on just one battery to save power, and driving hard. At 1123, Alvin was set up to place the ring, and the slurp pump was run from 1148 to 1214. Organisms still remained, so 2 grabs were made from within the ring and placed in the bio box (2191m, hdg 260, x4938, y5939). Alvin then moved up to the Res probe site at Milli-Q. Again, the current was a problem, but the res probe was successfully recovered by 1245 (2186m, hdg 138, x4918, y5936). The yellow gas tight was taken and Hobo MT was deployed, but no temperature was measured since the T probe had fallen from the basket. Alvin then settled down onto the bottom at 2192 m to recover the T probe, and then headed south over sedimented lobate and sheet flows to Salut. At Salut (2193m, hdg 243, x4869, y5866) the temperature in the black smoker sampled was 353C, and the yellow major and green gas tight were taken from 1335 to 1338. Then Hobo ZO was deployed. Alvin then moved northwest up the wall toward Cathedral (2182m, hdg 163, x4851, y5916), where a ring was deployed as the vemco tripod was recovered. Alvin then moved to marker XS (2183m, hdg 167, x4857, y5922) where a smoker of temperature 320.4C was sampled using the black gas tight and red major samplers at 1401 to 1404h. Alvin then headed east and then north to get to the area north of S&M in time to recover the current meter (X4931, y6019, hdg 053), and the thermistor array package Log 1/TM1/TM2. The current meter was secured in the basket and the weights were dropped.

Night Operations: The CTD was put in at 48° 03.60' N 129° 00.78' W at 1:31 GMT. This was the northern point of a 2.7 nautical mile long line segment heading S-SW along the eastern wall. The tow-yo was done at 0.3 knots. Samples were taken for He, H_2, CH_4, and N_2O. On the first down cast a temperature anomaly was seen of Dq = 0.035. This anomaly stayed with us and grew some as we headed south. The anomaly faded significantly by U7 and was completely gone by D9. The anomaly peaked on U4-U5 at a Dq = 0.05. After continuing for a while along the same south-southwesterly heading without any more anomalies we decided to head back north to attempt to pin down the anomaly around U4-U5.

A box pattern was laid out around the line using the locations for D4 and D6 to enclose the peak of the anomaly. The pattern was to head east across the southern edge of the box (D6) then up to the midpoint of the height of the box to head back west and then up to the northern boundary

(D4) to head back east. Unfortunately we could not relocate the anomaly at all. The only signal that we did see was a small sliver of a temperature anomaly along the eastern half of the middle line with a maximum = 0.03 (D4-U6). The currents must have drastically shifted on us from probably heading south-southeast earlier in the evening to heading northward with the source being further north of our box.

September 16: Alvin Dive 3621

Goals of this dive included reconnaissance of the Northern target, completion of water sampling, recovery of Vemco probes at Puffer, resistivity probe high frequency sampling at Sully and Grotto, deployment of the hydrogen probe at Sully, and release of the RAS at Grotto.

Alvin landed NE of Hulk just after 09:00 and began a search for the northern target proposed from CTD findings by Scott Veirs and Fritz Stahr earlier this summer. Our search consisted of five somewhat parallel East-West transects progressing southward but did not reveal any new active hydrothermal sites. The only evidence of hydrothermal activity was a small crack in the seafloor inhabited by small tube worms and emitting diffuse fluid (X 5031, Y 6285). While doing transects we received word from the ship that fog had come in and that we should wait on releasing the RAS. At 10:13 we decided to terminate the search and head to LOBO for water sampling.

At 10:21 we arrived at LOBO but had difficulty finding any black smokers to sample. Debbie mentioned no one had dove here for some time and that perhaps the flow regimes had changed. By 11:05 we were situated at a smoker (X 4946, Y 6181, Hdg 097) and took the orange gas tight, blue major and recorded a temp. of 342ºC. We then headed to GROTTO and called for an OK to release RAS. At 11:20 weather was still not conducive to a RAS recovery so we headed to SULLY for more sampling. After realizing we had incorrect coordinates for Sully in the target file and going too far south we came back north and arrived at SULLY at 11:52. At the star marker (X 4895, Y 5970, Hdg 145) we deployed the resistivity probe for a high frequency sampling and measured a temp. of 393ºC. At the orifice with the HOBO (X 4902, Y 5967, Hdg 270) we did two more resistivity probe high frequency samplings measuring temps. of 380.53ºC and 394ºC. We then deployed the hydrogen probe at 12:23 and headed for PUFFER. At the HOBO orifice at PUFFER (no good fixes, Hdg 122) we took a naked gas tight and measured a temp. of 380.3ºC. At this point we received word that weather had improved on the surface and to proceed with the release of the RAS.

We arrived at GROTTO (X 4940, Y 6140, Hdg 133) at 13:09 and recovered the HOBO near the RAS and released the RAS by 13:23. We went to the orifice where the resistivity probe had been during the first leg of the cruise (X 4949, Y 6137, Hdg 280), performed two more resistivity probe high frequency samplings and measured a temp. of 380.4ºC. We took a black major and did a five minute toaster at approximately 18" above the top of the orifice. We then traveled back to SULLY to recover the hydrogen probe.

At 14:27 we arrived back at SULLY and recovered the hydrogen probe after a two hour deployment. We took the red major, red gas tight and placed a hydrogen probe tip into the orifice to be left for one year. We then headed to S&M to continue water sampling. We arrived at S&M at 14:53 and found and sampled some new small smokers in the basalt (X 4948, Y 6022, Hdg 242). We took the blue gas tight and white double major and measured a temp. of 363.3ºC. Our last stop was PEANUT (X 4872, Y 6007, Hdg 190) where we took the yellow single major and white gas tight and measured a temp. of 355.8ºC. At 15:30 we dropped weights and headed up.

Night Operations: Following the completion of the Alvin recovery we transited north to lay the transponders for the exploration dive the next day. The transponders were deployed and were surveyed for 2-3 hours to get a good fix on their location. Following the completion of the survey we transited over the Hole on the Bottom of the Sea in order to dredge it. The dredge was put in at

47° 55.0964' N, 129° 01.0600' W at 6:52 GMT. The dredge started on the bottom of the hole near the southeaster portion of the wall and was dragged along the bottom, up the wall and up over the rim of the hole. We started the dredge moving at 0.2 knots but early on increased speed to 0.4 knots. For most of the time the tension was around 3500-4000 lbs. There were a few jumps in the tension up to 7000-8000 lbs when we got something big. At one point we jumped up to 10,000 lbs of tension upon which we had the boat stop as we were probably hung up. Rather easily we were able to get it unstuck. We stopped the dredge at 10:50 GMT 47° 55.2179' N, 128° 59.8620'W. We came up with a full heavy load (~1500 lbs) of all basaltic rock with some clay and mud.

July 17: Alvin Dive 3622

The goal of this dive was to explore for a new hydrothermal field near 47°59.812'N, 129° 04.012'W, which had been documented by CTD studies by Marv Lilley and Brian Kristall. Alvin went into the water at 0800 and landed on bottom at ~0900 in a highly sedimented area of basalt and sulfide about 70 m south of the target site. Alvin transited upslope a few meters (7292, 11514) and sampled a large sulfide block, which was subsequently redeployed due to it's weight. At 0930 a new venting site was discovered which was characterize by a weakly venting small sulfide structure with small beehives rich in anhydrite. A temperature of 284-285°C was measured at this site (7312, 11497), a small piece of sulfide was sampled, and naked gas tight and a major red bottle samples were taken. Subsequent to sampling a temperature of 287.7°C was measured. Sampling at this site ended at 0943. A short line was run to the east with the discovery of a second, small venting site named Pico vent, which consisted of one small fragile chimney venting 277.4°C fluid. This site was passed over, but revisited later in the dive. This area is bounded to the east by massive, bacterial mats which coat very steep basaltic ridges. The mats form a light coating over extensive areas. Rare, localized areas of diffuse flow, and some small tube worm colonies at the base of the basaltic ridges was observed. After a brief period of exploration of this site, a series of E-W, and N-S transects were run to determine the extent of this field.

The first line was an westerly trending transect over alternating ridges and gullies of basalt and some highly sedimented areas. In this area, sponges and other non-vent macrofaunal assemblages were observed. During this transect a coral? sample was taken for possible dating (7187, 11487), and two basaltic samples were taken hosting different sponges and animals (7185, 11488 and 7187, 11580, respectively. At 1151, a second venting site was discovered ~20 southeast of the first site at 7326, 11489 with a venting temperature of 286.1°C. Gas tight black and major bottle sample blue were taken, a small sulfide sample was obtained and marker DK2 was deployed. About 10 m downslope from this site a rock sample with tube worms was sampled and tube worms were placed into the biobox for preservation.

Alvin transited back to the Pico vent (7338, 11499) and took a yellow gas tight sample, and a sample with the non black snorkel of the double major sampler. A temperature of 283.6°C was measured at this site subsequent to sampling. Characterization of this area ended at 1257. A diffuse flow site named 'tube worm city' was then characterized (7338, 11500) just down slope from the Pico vent. This site is located on a steep slope with abundant diffuse flow, bacterial mats, and localized dense macrofaunal vent communities. On a small ledge, the slurp sampling ring was emplaced (7340, 11502) and at 1314, a slurp sample covering the area within the ring was obtained. A temperature of 3.3°C was measured near the inner edge of the ring, and a temperature of 5.9°C was measured couple inches away from the outside of the ring. The aft niskin bottle was triggered over a diffuse flow site, just adjacent to the slurp sample. In this same area, at 1332, two small sulfide samples were obtained with tube worms on them.

Following this an extensive transect (to 11,359) was run to the south following the sulfide basalt contact. For over two hundred meters a continuous ridge of sulfide was traversed. The ridge is characterized by massive, inactive sulfide blocks interspersed with smaller sulfide talus,

slopes with thick hydrothermal sediment cover, and massive structures with small parasitic pinnacles and rare inactive flanges. Except for the northern portion of the ridge, the area is not active and appears to have been dormant for some time, as evidenced by the abundance of large sponges hosted on the sulfides. One structure, 'Big Dead' was ~ 25 m tall, characterized by a massive base and extensive ~rectangular shaped large spire. At the top of this, Alvin attempted to sample a small rounded pinnacle, however, when the sample broke off Alvin could not hold it in it's claw and the sample fell. During the transit to the south, we believe we sampled this same piece at 7320, 11446.

With power beginning to run low, the transect to the south was called, having never reached the southern terminus of the sulfides, and Alvin transited back north, to complete sampling at the Pico vent site (7337, 11501). Water samples using gas tight blue and black double major were obtained, a temperature of 283°C was measured, the forward Niskin bottle was triggered over a diffuse area, and marker DK3 was deployed. Alvin continued transiting to the north to determine the northern extent of the sulfides. By about 25 m north of Pico vent, sulfides were no longer observed. This northern area is characterized by very rough topography with large pillow flows, dense deep fissuring, and large talus ridges. Out of power, Alvin dropped weights and started it's ascent to the surface at ~1530.

A summary map of this area shows that the extinct sulfides and venting are localized along an 020 trending ridge, perhaps 25-30 m across. Extension of an east-westerly trending steep faulted area about 20 m northeast of the active venting site, may serve to promote fluid flow in the vent field. The abundance of oxidized hydrothermal sediment and presence of extinct sulfide structures, which host non vent animals, indicates that this area has been inactive for an extended period of time. It is unclear whether the active sites are reactivated or are the final stages of venting. Preliminary analyses of the fluids shipboard indicate that the fluids have elevated salinities, consistent with this area being an older site of venting. Although there are localized zones of extinct sulfide to the west, most of the area is characterized by alternating steep ridges tending ~020 and gullies of basaltic material. About 70 m to the northwest, there is an area of extensive collapse basins and basaltic pillars capped by pillow flows. The basins are bounded by steep talus slopes and pillow rubble.

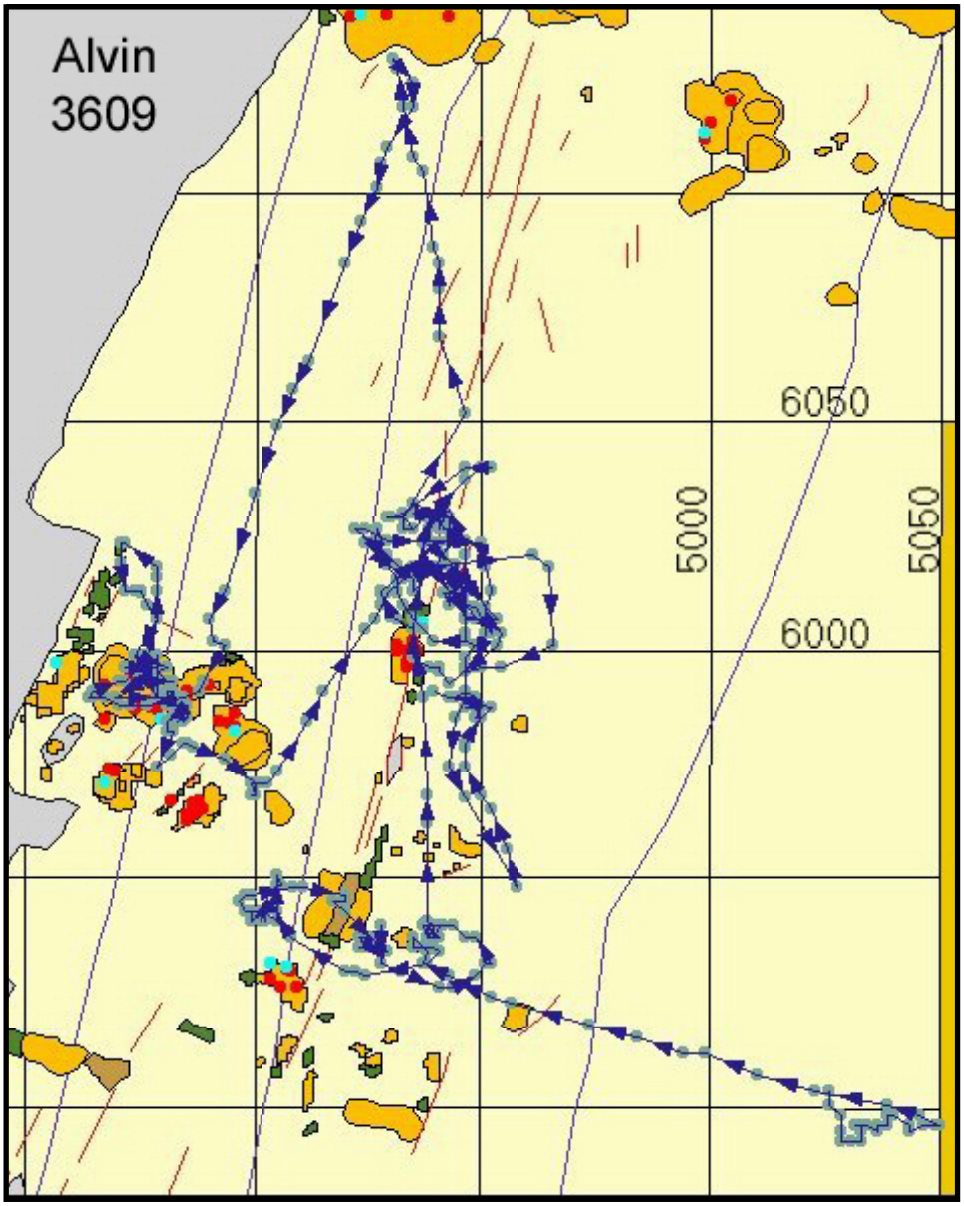
Night Operations: A Sea Beam Survey was performed after recovering two transponders. The section mapped would add a new swath around the northern edge of the pre-existing map of West Valley, north of the Endeavor Segment. The survey legs of the course were performed at 9 knots and the seas were mild. Do to maintenance scheduling on the boilers, a 12-knot speed was not attainable on the non-survey legs of the course. Thus, the course was not completed in entirety to ensure return to the dive site on time. The course was completed with the exception of waypoints 7 and 8. The entire course was completed at 9-10 knots.

September 18: Alvin Dive 3623

Dive objectives included doing a valve test of gas tights, sampling fluids at multiple sites, taking a fauna sample and picking up a vemco, and surveying the large extinct sulfide body south of the main field. With a few minor exceptions, we met all the goals of the dive. The pressure-activated gas-tight valve worked perfectly. We sampled fluids from a 312C smoker SE of MQ. We completed the slurp sampling for Jozee at Cathedral flange. We took a major sample where the gamma detector at DK2 had been, but the temperature was extremely low, and flow was barely visible. We recovered the vemco from Puffer, took a gas-tight, and collected a limpet-covered piece of sulfide. Could not find the vemco probe lost in the crack at the N end of S&M. Deployed the vemco tripod (marked with triangle V5) on Grotto very close to where the RAS-4 deployment intake probe was located. Finally, we conducted a 90-minute survey of the extinct sulfide body south of the MEF. The survey resulted in a better definition of the boundaries of this extinct sulfide.

Brief summary of the sulfide survey: We began at the north end at 13:34 at 4890,5810. Driving S on pillow basalt terrain, we found the sulfide contact at 1336 (4890,5798). Drove SE to 5000,5688 at 13:49. Drove west to 4855,5655 at 13:56. Drove north on basalt, spotting some tube worms at 4860,5680, to 4845,5700 at 13:59. Drove east, contacting sulfide at 4895,5700. Drove further east, lost sight of bottom upon cresting a ridge with drop-off to east, regained sight of bottom on basalt a minute or so later, but navigation was bad. Drifted NE. Drove west again and contacted sulfide at 4975,5750. Drove off sulfide onto basalt at 4895,5750. At 14:30, drove NE from 4855,5755 to approximately 4940,5850. Drove south along eastern contact. At times contact was lost, but generally drove along it, reaching the southern end, and rounding it to the west. Ran out of power and terminated dive at ~ 15:00.

Night Operations: A Sea Beam survey was carried out during the transit to Astoria.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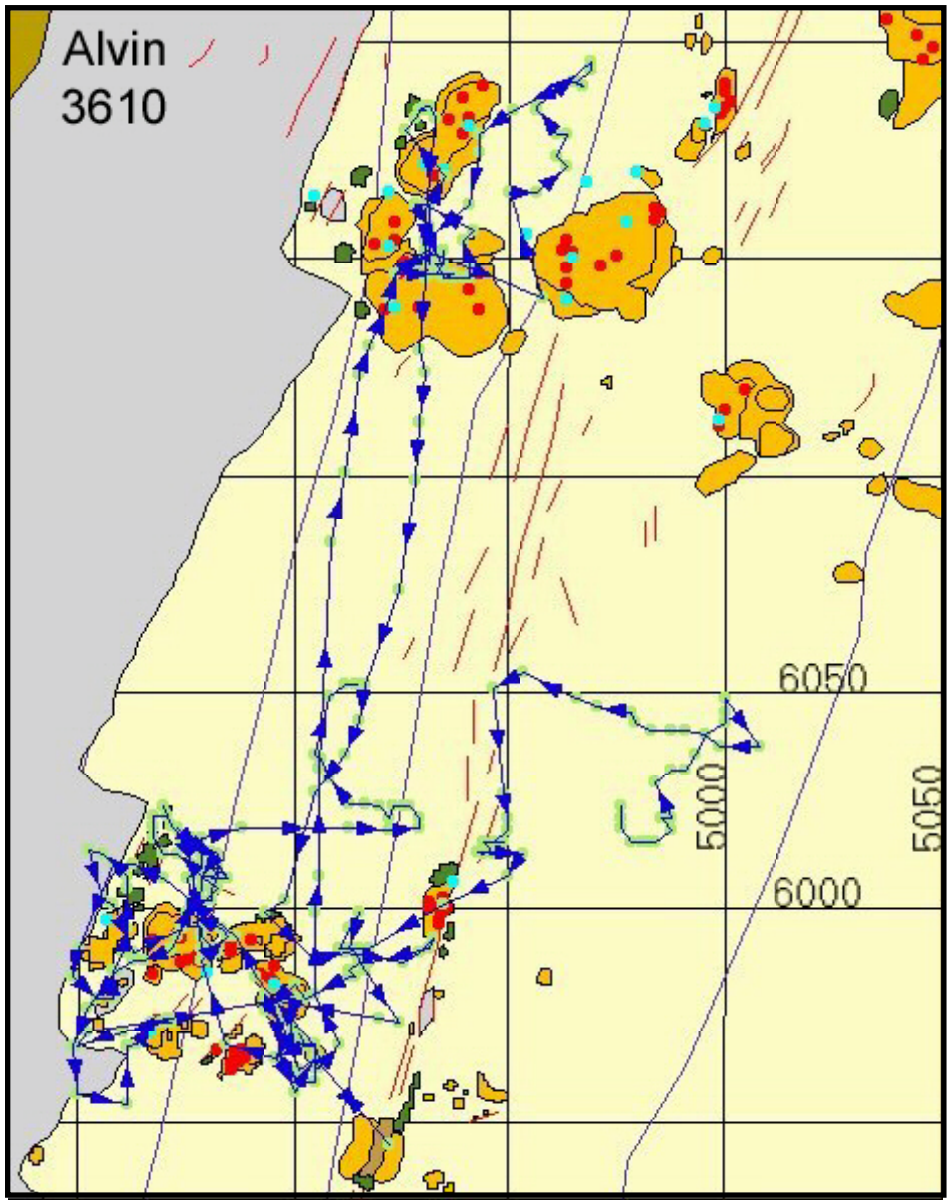
5050
6000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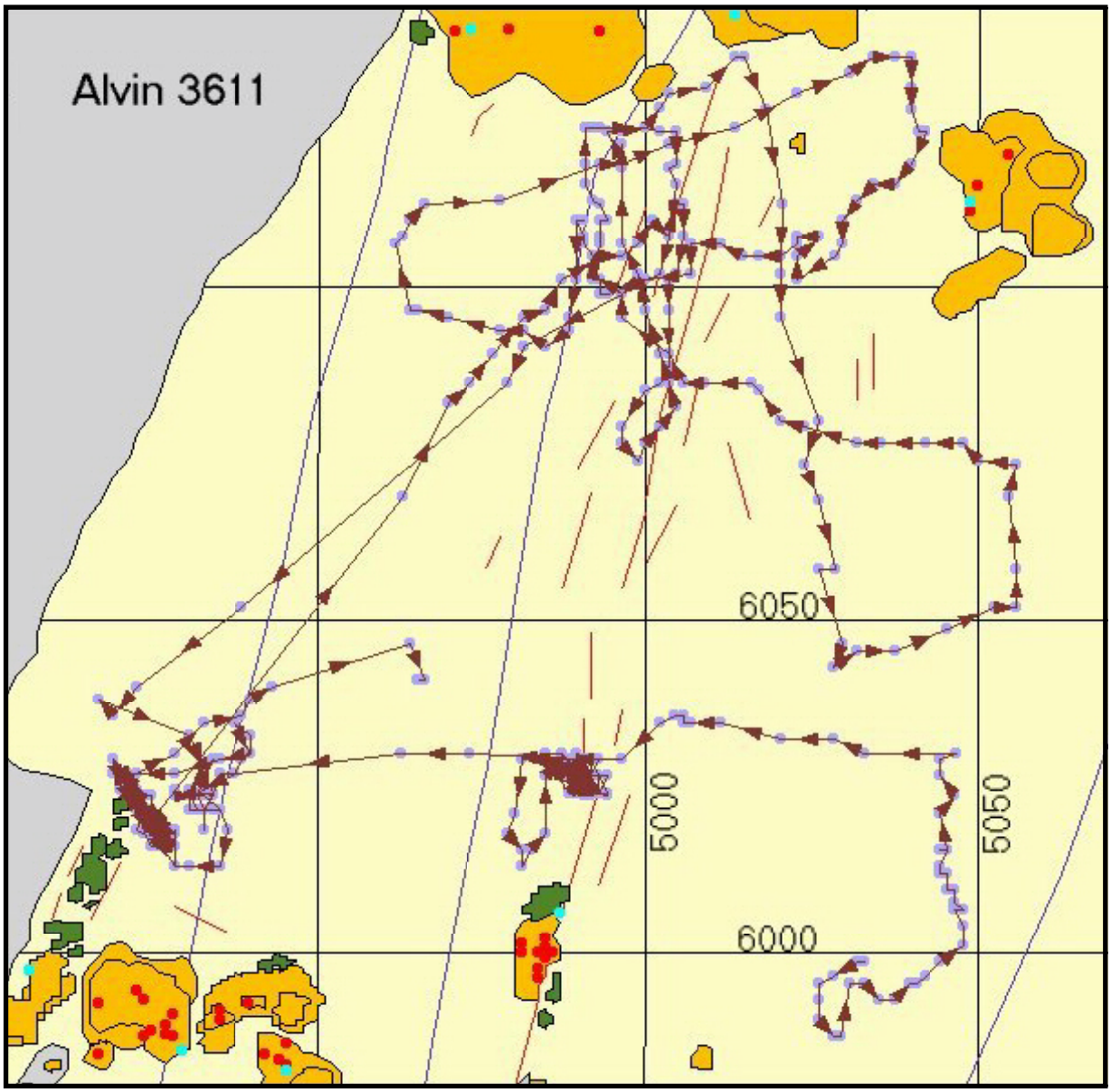
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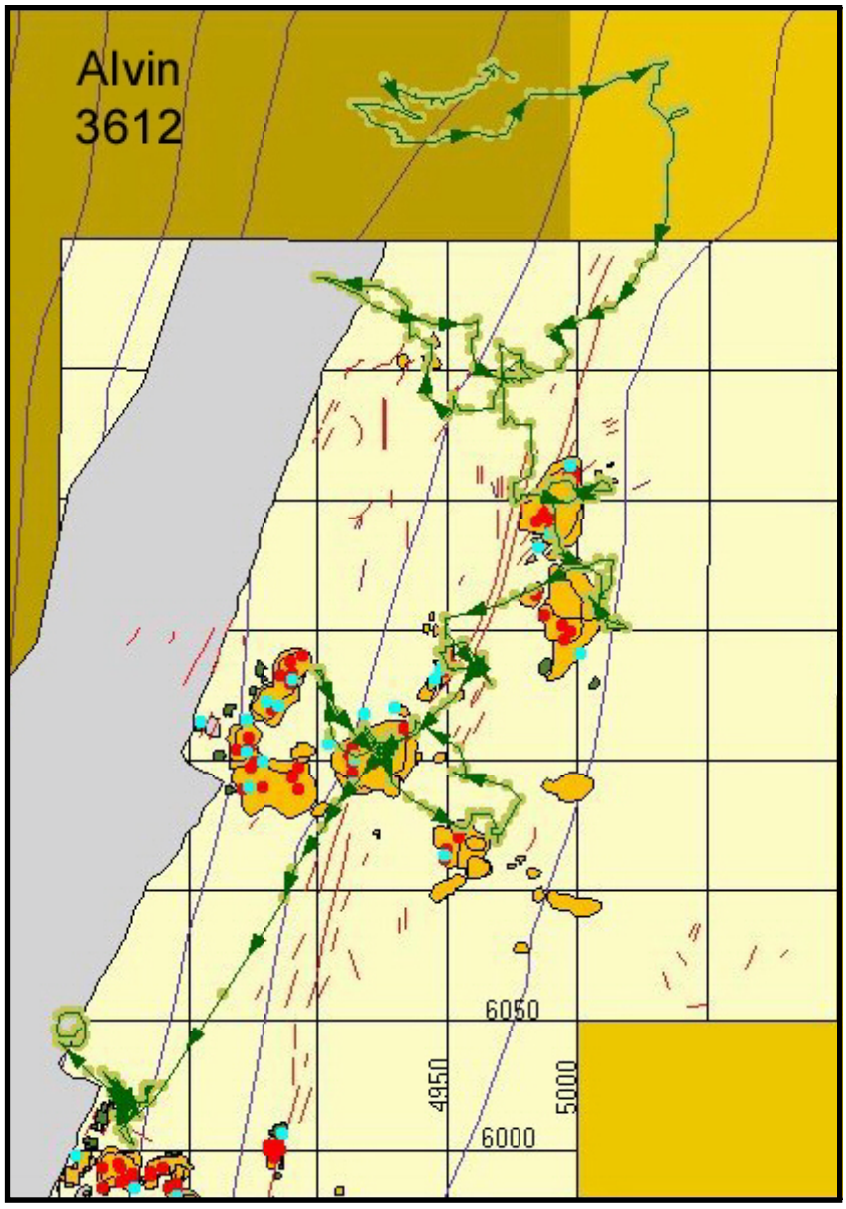
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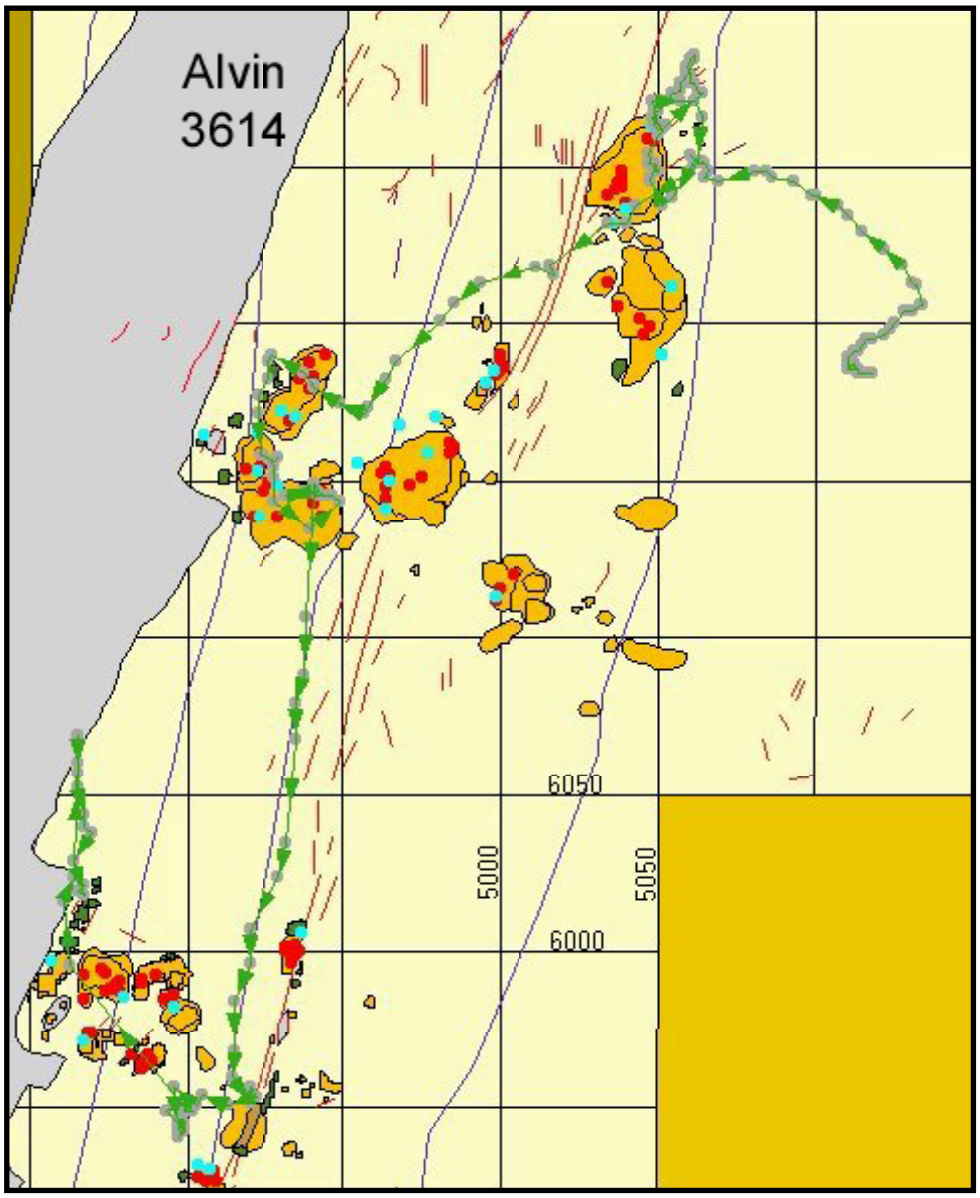
6000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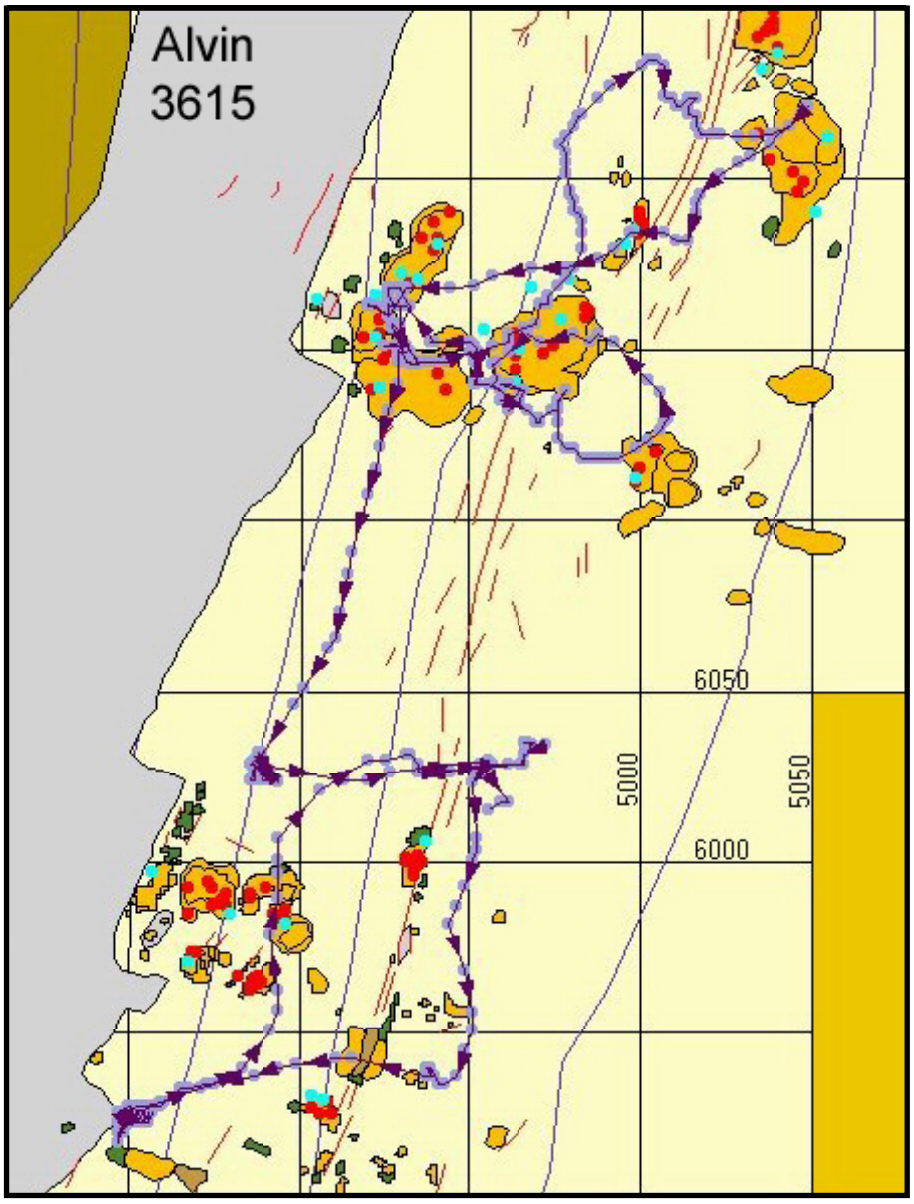
6000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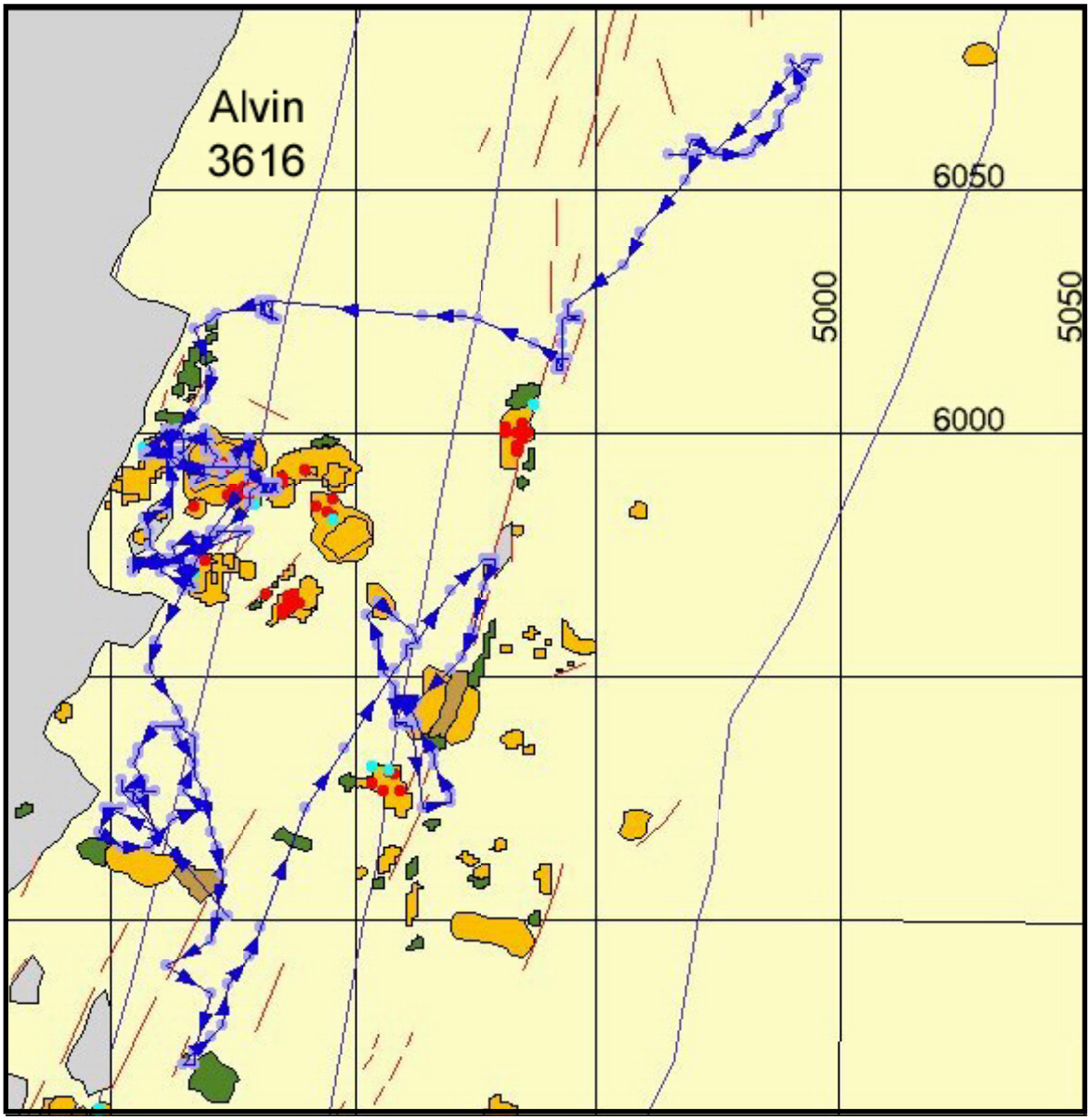
5050
6000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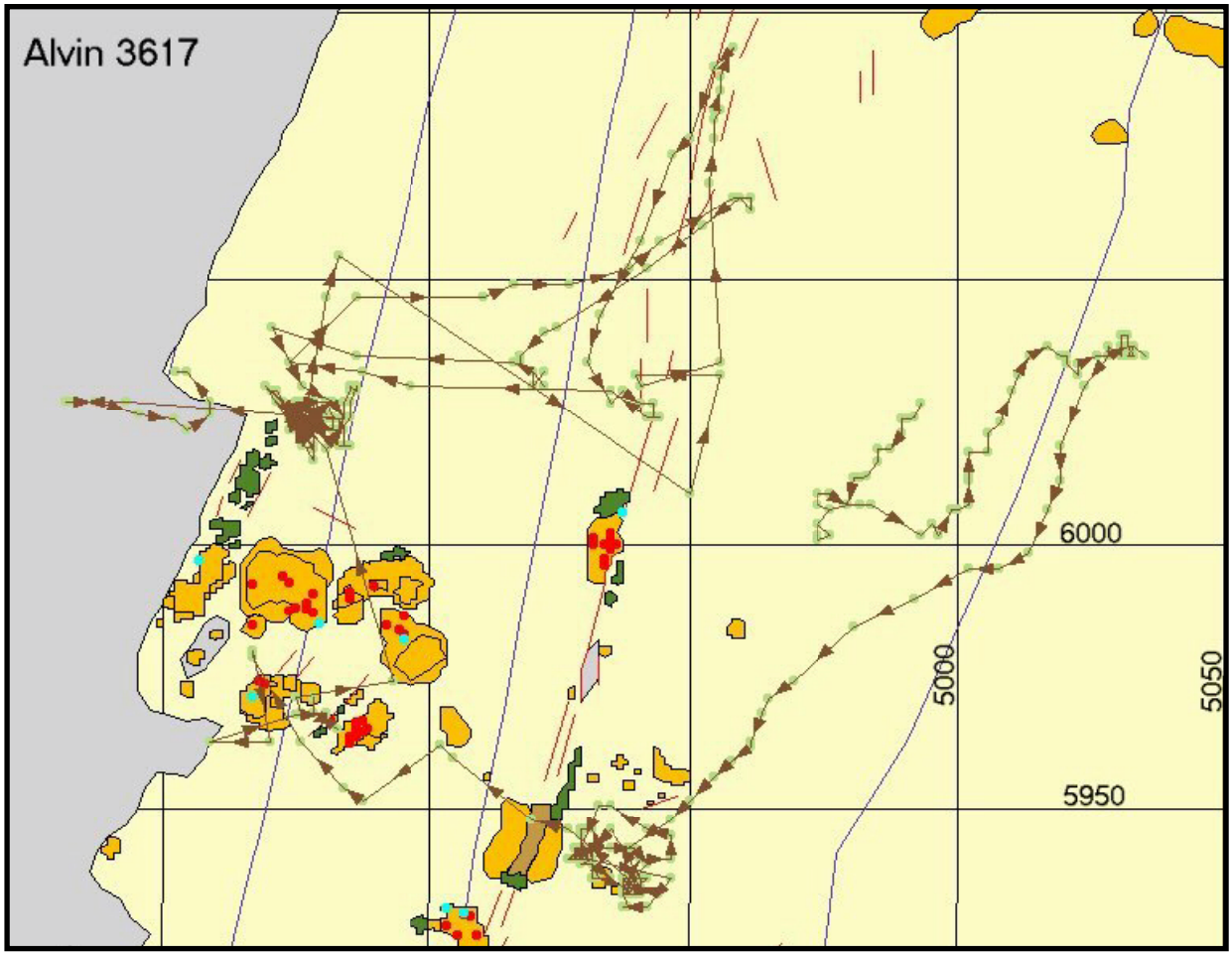
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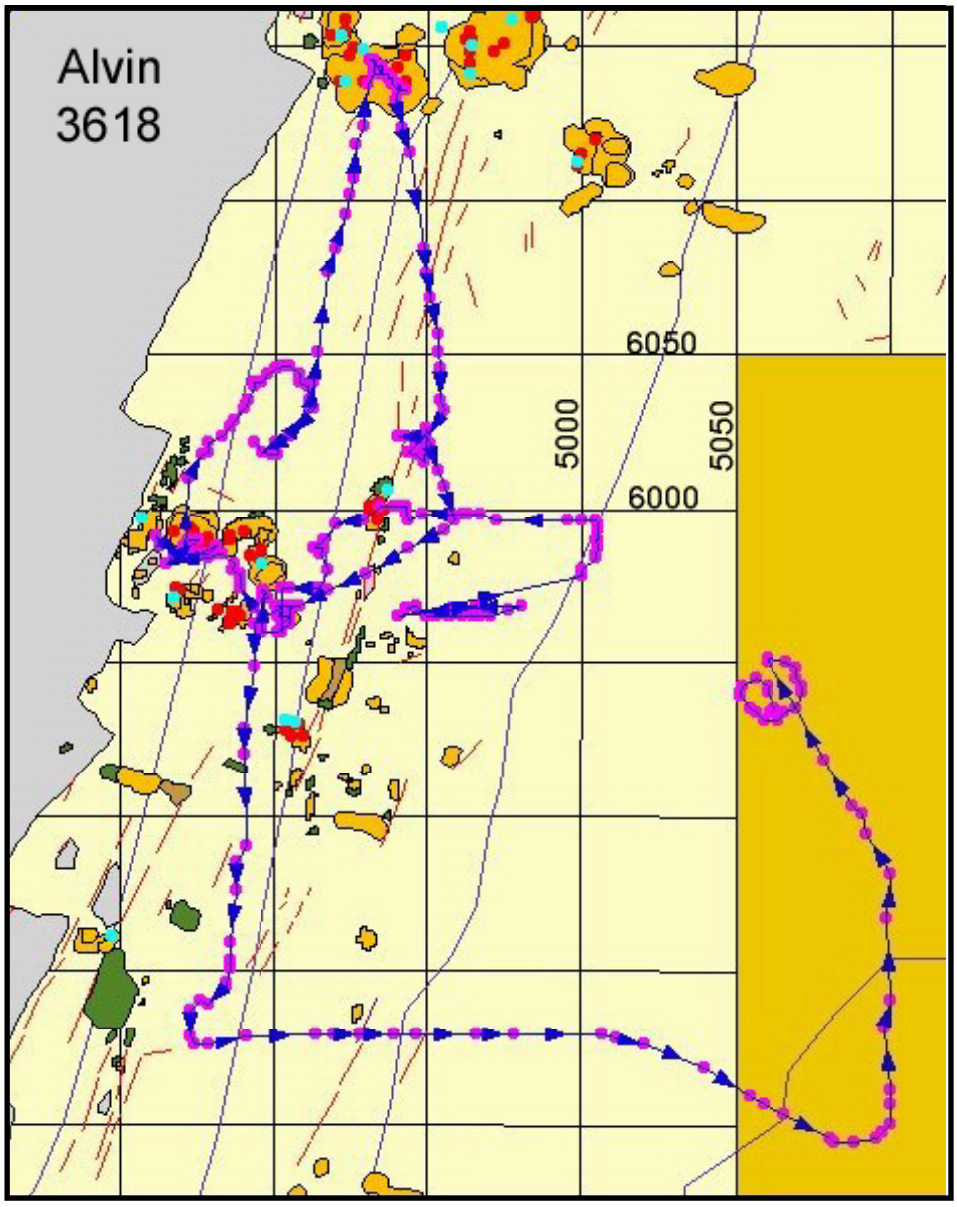
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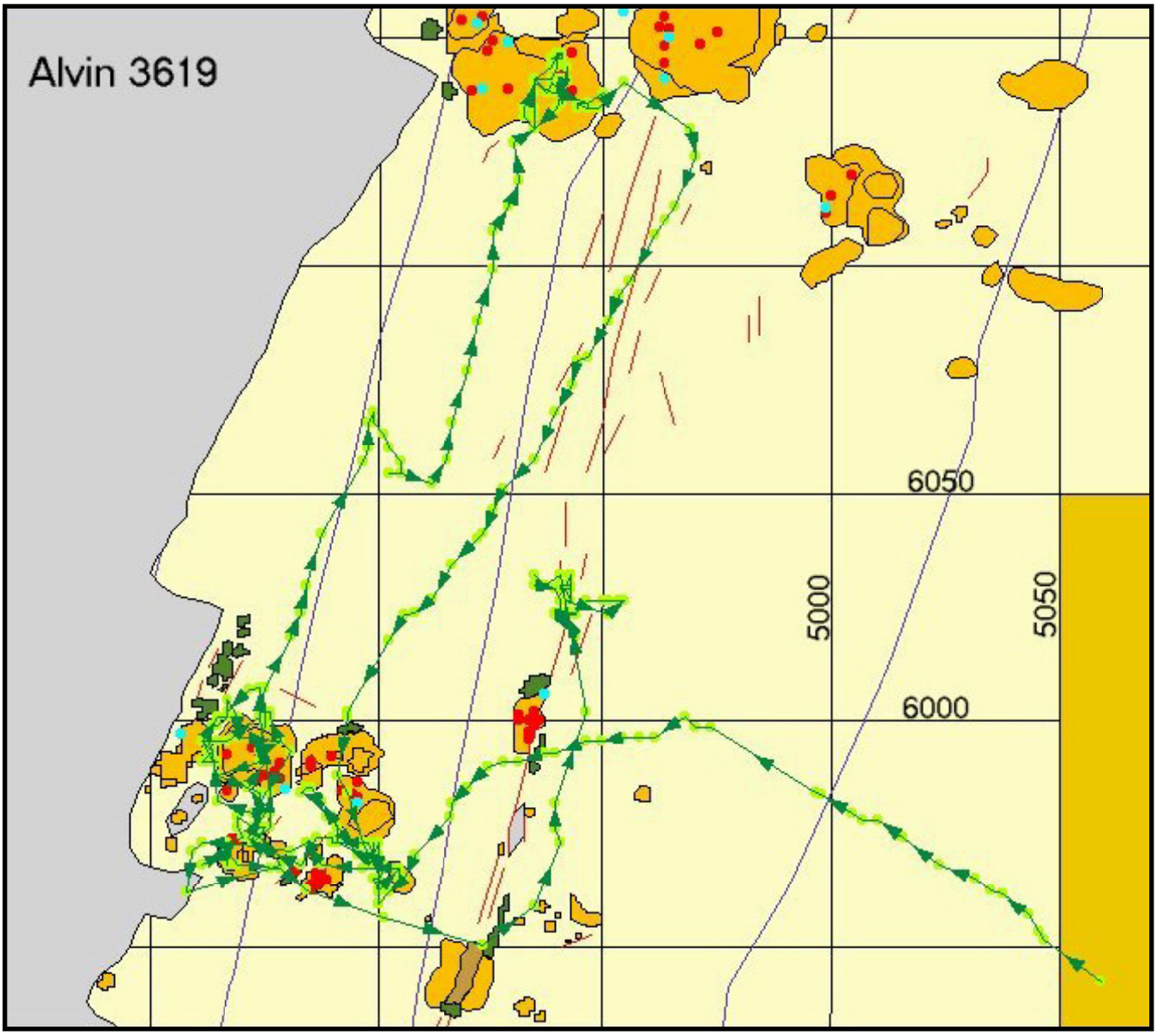
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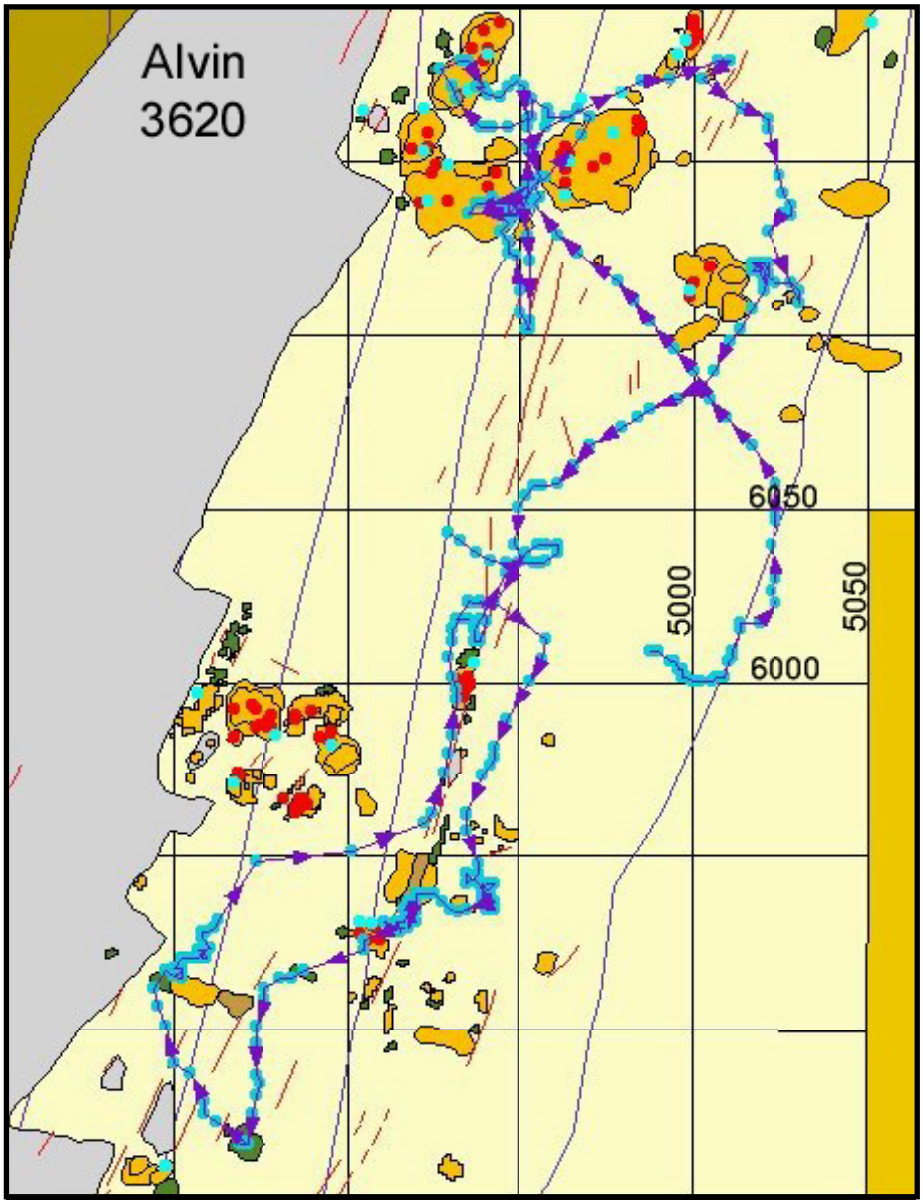
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5050
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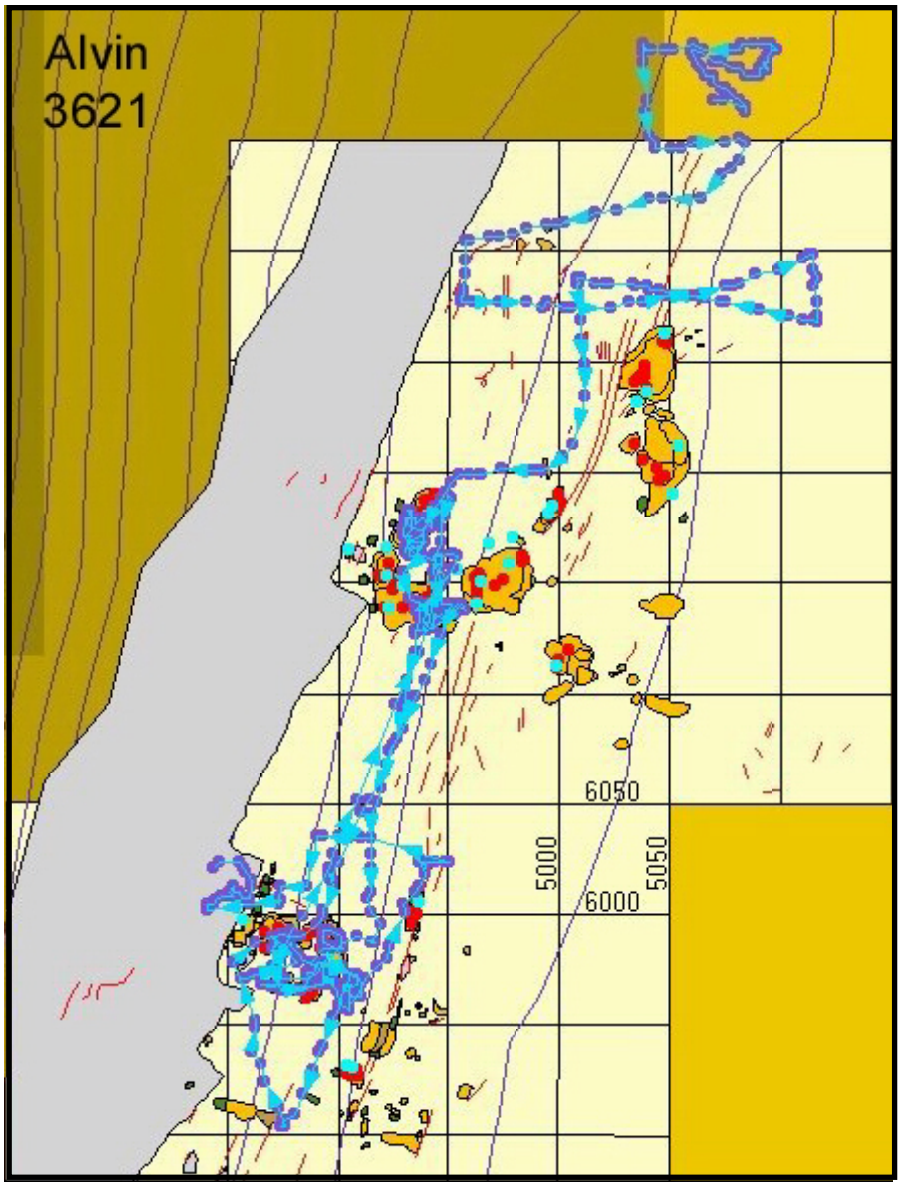
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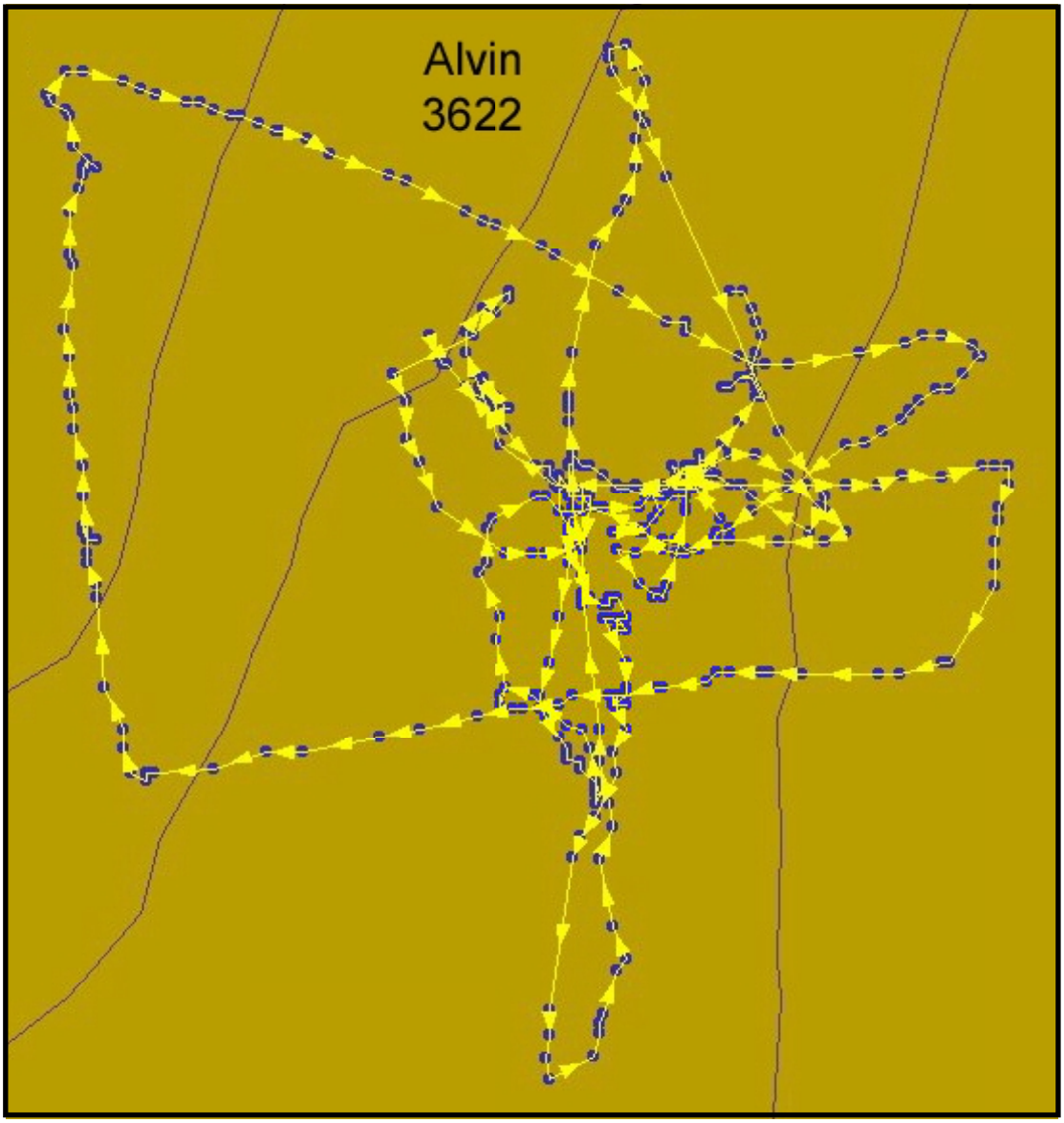
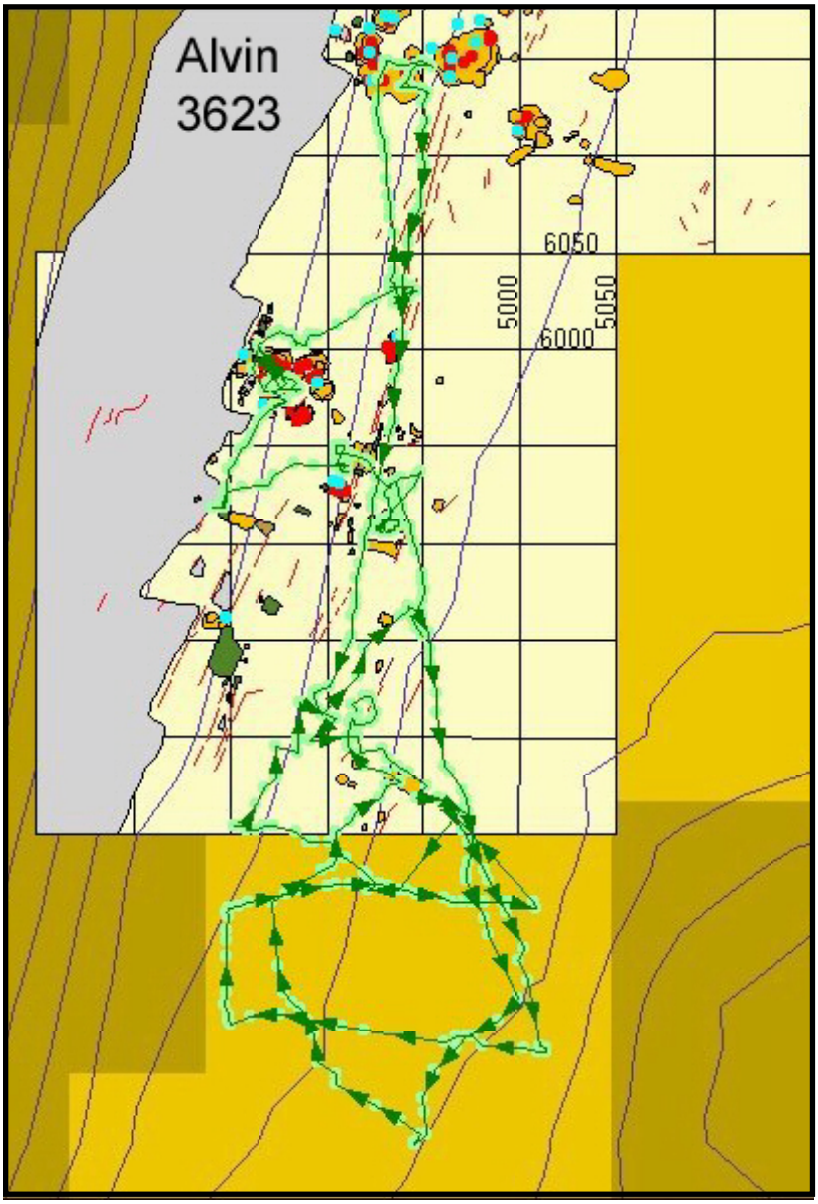
6000
5050


Alvin
3622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