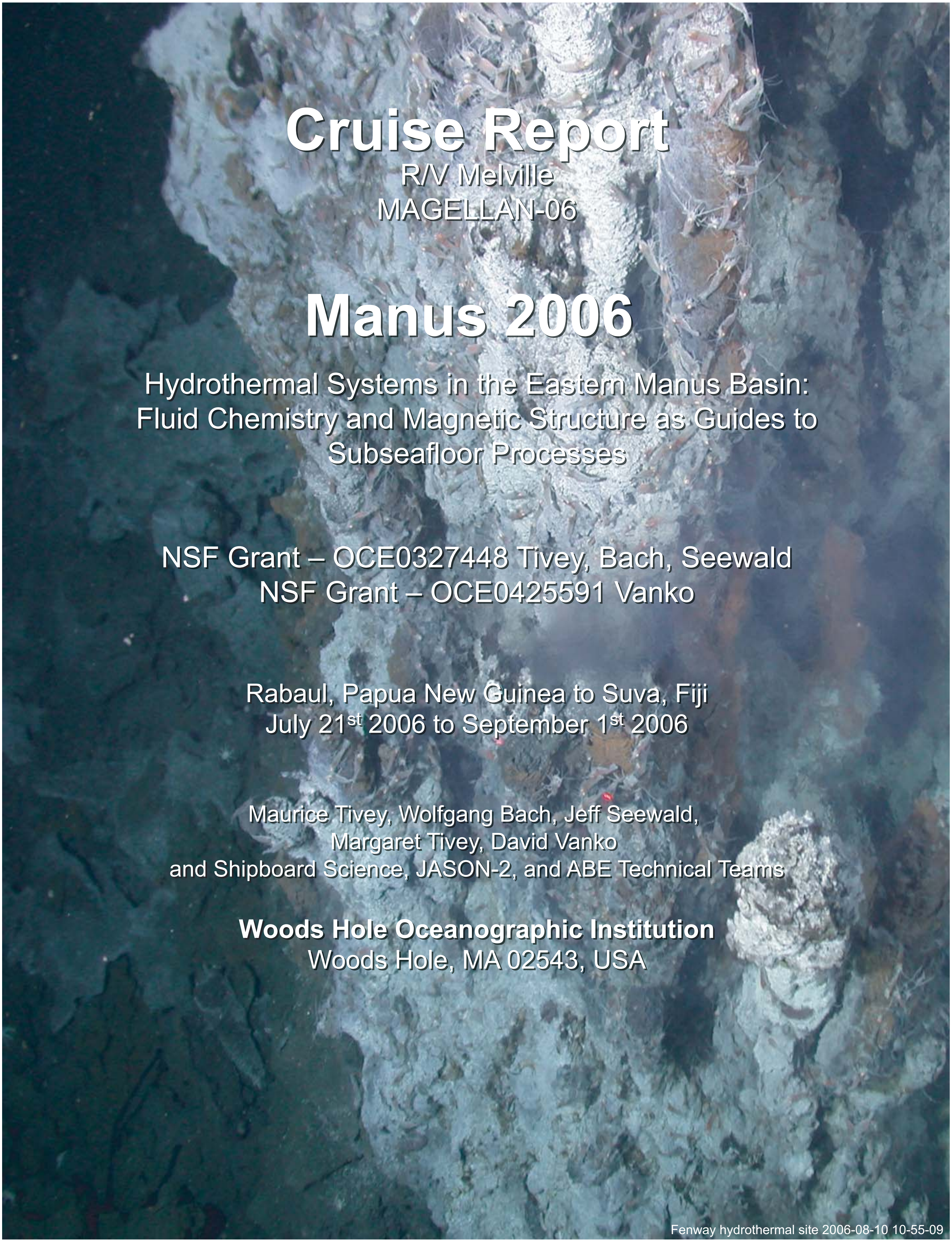


Cruise Report

R/V Melville
MAGELLAN-06

Manus 2006

Hydrothermal Systems in the Eastern Manus Basin: Fluid Chemistry and Magnetic Structure as Guides to Subseafloor Processes

NSF Grant – OCE0327448 Tivey, Bach, Seewald
NSF Grant – OCE0425591 Vanko

Rabaul, Papua New Guinea to Suva, Fiji
July 21st 2006 to September 1st 2006

Maurice Tivey, Wolfgang Bach, Jeff Seewald,
Margaret Tivey, David Vanko
and Shipboard Science, JASON-2, and ABE Technical Teams

Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA

Fenway hydrothermal site 2006-08-10 10-55-09

Cruise Report

R/V Melville
MAGELLAN-06

Manus 2006

Hydrothermal Systems in the Eastern Manus Basin: Fluid Chemistry and Magnetic Structure as Guides to Subseafloor Processes

NSF Grant – OCE0327448 Tivey, Bach, Seewald
NSF Grant – OCE0425591 Vanko

Rabaul, Papua New Guinea to Suva, Fiji
July 21st 2006 to September 1st 2006

Maurice Tivey, Wolfgang Bach, Jeff Seewald, Margaret Tivey, David Vanko
and Shipboard Science, JASON-2, and ABE Technical Teams

Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA

R/V Melville Magellan Leg 6 (MGLN06)
Personnel List

Science Passengers – LEG-1 July 21st July 31st Rabaul to Kavieng, PNG

1) Dr. Maurice Tivey	WHOI	mtivey@whoi.edu	Chf. Scientist
2) Dr. Wolfgang Bach	Bremen	wbach@uni-bremen.de	Co-Chf. Sci.
3) Paul Craddock	WHOI	pcraddock@whoi.edu	GRA
4) Dr. Vicki Ferrini	WHOI	vferrini@whoi.edu	Data Manager
5) Dr. David Vanko	Towson	dvanko@towson.edu	Scientist
6) Steve Wicker	Towson	swicke1@towson.edu	UG Student
7) Paul Poloka	UPNG	20020970@studmail.upng.ac.pg	PNG Observer
8) Justin Baulch	Nautilus	jcb@nautilusminerals.com	Observer
9) Glenn Creed	Nautilus	gc@nautilusminerals.com	Observer
10) Phil Jankowski*	SRK	pjankowski@srk.com.au	Visitor
11) Anthony O'Sullivan*	Nautilus	apo@nautilusminerals.com	Visitor
12) Ray Goldie*	Salman	rgoldie@SalmanPartners.com	Visitor
13) JC St Amour*	Blackmont	JCSt-Amour@blackmont.com	Visitor
14) Dr. Dana Yoerger	WHOI ABE	dyoerger@whoi.edu	ABE
15) Alan Duester	WHOI ABE	aduester@whoi.edu	ABE
16) Andrew Billings	WHOI ABE	abillings@whoi.edu	ABE
17) Will Sellers	WHOI DSL	wsellers@whoi.edu	Pilot ExpLdr
18) Bob Waters	WHOI DSL	b_waters@charter.net	Pilot
19) Phil Forte	WHOI DSL	pforte@whoi.edu	Pilot
20) Robert Fuhrmann	WHOI DSL	rfuhrman@whoi.edu	Eng
21) Scott Hansen	WHOI DSL	hansen@levelcomponents.com	Eng
22) Will Handley	WHOI DSL	handleys@compuserve.com	Eng
23) Steve Gegg	WHOI DSL	sgegg@whoi.edu	Nav
24) Dara Scott	WHOI DSL	dara_scott@hotmail.com	Nav
25) Casey Agee	WHOI DSL	Kcagee1@cs.com	Eng
26) James Pelowski	SUNY	jpelowsk@ic.sunysb.edu	Data
27) Woody Sutherland	SIO	woodys@rv-melville.ucsd.edu	Comp Tech

*Anthony O'Sullivan, Ray Goldie and JC StAmour visited the ship for one night. Phil Jankowski stayed for 4 days.

Science Passengers – LEG-2 July 31st Sept 1st Kavieng to Suva, Fiji

1) Dr. Maurice Tivey	WHOI	mtivey@whoi.edu	Chf. Scientist
2) Dr. Wolfgang Bach	Bremen	wbach@uni-bremen.de	Co-Chf. Sci.
3) Dr. Jeff Seewald	WHOI	jseewald@whoi.edu	Co-Chf Sci.
4) Paul Craddock	WHOI	craddock@whoi.edu	GRA
5) Dr. Vicki Ferrini	WHOI	vferrini@whoi.edu	Data Manager
6) Dr. David Vanko	Towson	dvanko@towson.edu	Scientist
7) Steve Wicker	Towson	swicke1@towson.edu	UG Student
8) Eoghan Reeves	WHOI	ereeves@whoi.edu	GRA
9) Dr. Peter Saccocia	BSU	psaccocia@bridgew.edu	Scientist
10) Dr. Olivier Rouxel	WHOI	rouxel@whoi.edu	Scientist
11) Emily Walsh	BSU	walsh@bs.edu	UG Student
12) Roy Price	USF	reprice@mail.usf.edu	GRA
13) Paul Poloka	UPNG	poloka@upng.pg	Observer
14) Dr. Chris Yeats	CSIRO	chris.yeats@csiro.au	Scientist
15) Melissa Quigley*	CSIRO	melissa.quigley@csiro.au	Scientist
16) Dr. Tim McConachy	CSIRO	tim.mcconachy@csiro.au	Scientist
17) Dr. Dana Yoerger	WHOI ABE	dyoerger@whoi.edu	ABE
18) Alan Duester	WHOI ABE	aduester@whoi.edu	ABE
19) Andrew Billings	WHOI ABE	abillings@whoi.edu	ABE

20) Will Sellers	WHOI DSL	wsellers@whoi.edu	Pilot ExpLdr
21) Bob Waters	WHOI DSL	b_waters@charter.net	Pilot
22) Phil Forte	WHOI DSL	pforte@whoi.edu	Pilot
23) Robert Fuhrmann	WHOI DSL	rfuhrman@whoi.edu	Eng
24) Scott Hansen	WHOI DSL	hansen@levelcomponents.com	Eng
25) Will Handley	WHOI DSL	handleys@compuserve.com	Eng
26) Chris Roman	URI	cnr@gso.uri.edu	Nav
27) Dara Scott	WHOI DSL	dara_scott@hotmail.com	Nav
28) Casey Agee	WHOI DSL	Kcagee1@cs.com	Nav
29) James Pelowski	SUNY	jpelowsk@ic.sunysb.edu	Data

*Melissa Quigley transferred off the ship on August 12th swapping places with Dr. Tim McConachy who transferred on from Rabaul.

Ship's Crew

David Murline	Captain	master@rv-melville.ucsd.edu	
Ian Lawrence	1st Mate		
Dave Kramer	2nd Mate		
Heather Galiher	3rd Mate		
Dave Grimes	Bosun		
Donald Taylor	AB		
Brian Matthiesen	AB		
Jerome Donnelly	AB		
Buddy Carron	OS		
Charlie Hand	Chf. Engineer		
Randy Flannigan	1st Engineer		
Ernest Juhasz	2nd Engineer		
Christopher Clayton	3rd Engineer		
Richard Floyd	Electrician		
C.W. Hall	Oiler		
Andrew Hall	Oiler		
Pamela St. Amand	Oiler		
Ken Evett	Oiler		
Ed Miller	Sr. Cook		
Tyson Smith	Cook		
Kris Weeks	SIO	kweeks@rv-melville.ucsd.edu	Comp. Tech
Brent Riemer	SIO	restech@rv-melville.ucsd.edu	Resident Tech.

Table of Contents

Appendices

Figure List

Acknowledgments

We thank Captain Dave Murline, along with his officers and crew of the RV Melville for their help and operational knowledge in making this an enjoyable and rewarding cruise experience. We likewise thank the operational teams for Jason-2 and ABE for their efforts in making the Magellan-06 cruise a tremendous success. We thank Will Sellers for his leadership of the Jason team and Dana Yoerger for the ABE team. We thank Jim Robins at National Research Institute of PNG for helping smooth the way for the PNG research permit and Pat Pepena of PNG MSRC for advice on the research permit application process. We also want to acknowledge our colleague Dr. Sang-Mook Lee who was supposed to join the cruise but was critically injured in a tragic accident just days before the cruise. We missed his presence on the ship and we wish Sang-Mook all the best for the future. Finally, we wish to thank the National Science Foundation (NSF) for funding this work along with additional funding by Nautilus Minerals Inc. who made the ABE work possible.

Executive Summary

The hydrothermal systems in the Manus Basin of Papua New Guinea (PNG) were comprehensively investigated through a combination of sampling and mapping using the Remotely-Operated Vehicle (ROV) Jason, the autonomous underwater vehicle (AUV) ABE (Autonomous Benthic Explorer) and ship-based CTD work and multi-beam bathymetric mapping using the RV Melville. The objectives of the cruise (July 21st to Sept. 1st, 2006) were to identify the tectonic/geologic settings of the vent systems, examine the interactions of seawater with felsic rocks that constitute the high silica end-member range of seafloor basement compositions, determine the extent of volatile magmatic inputs into these systems and to examine the evolution of hydrothermal activity through time. The first 10-day portion of the cruise was funded by Nautilus Minerals in a collaborative research effort to examine the Manus Spreading Center and the Vienna Woods basalt-hosted hydrothermal vent systems. The second 32-day portion of the cruise, funded by the National Science Foundation (NSF), focused on the felsic-hosted hydrothermal systems of the PACMANUS (Papua New Guinea – Australia – Canada Manus) vents drilled by the Ocean Drilling Program (ODP) in 2000 and the nearby seafloor volcano vent systems of Desmos and SuSu Knolls. Nautilus Minerals generously funded the add-on use of ABE throughout the NSF program allowing for high resolution mapping to be completed on all the major vent sites within the eastern Manus Basin. A total of 30 ROV dives (497 operational hours) were completed collecting 198 vent sulfides, 83 altered substrate and 43 fresh lava samples along with 104 black, gray and clear fluid samples using gastight and major samplers. ABE successfully completed 14 high resolution bathymetric, CTD and magnetic field mapping dives covering a total of 364 line km of seafloor.

We located and mapped in detail the Vienna Woods and nearby Tufar-2 and -3 vent areas on Manus Spreading Center documenting the strong tectonic control on the distribution of the vent systems and the presence of reduced magnetization i.e. "magnetic burnholes", that help define the lateral extent of the vent fields. The Vienna Woods vent systems (273°-285°C) form tree-trunk-like chimneys 5-15 m tall, that emit black to gray fluids with pH and compositions similar to other documented midocean ridge (MOR) systems like the East Pacific Rise. At PACMANUS, high-resolution mapping by ABE reveals a distinctive seafloor morphology associated with dacitic lava flows along with discrete magnetic burnholes associated with the active venting systems of Roman Ruins, Satanic Mills, Snowcap, Tsukushi and a new vigorous vent system discovered southeast of the Satanic Mills area named Fenway. Another vent field in its waning stages was also discovered ~8 km northeast of PACMANUS on the Northeast Pual Ridge. At PACMANUS, the 40 m diameter Fenway mound hosts outcrops of massive anhydrite on the seafloor beneath the sulfide chimneys, a rare occurrence as anhydrite is unstable at ambient seafloor conditions. Fenway is also boiling (356°C, 172 bar) with two-phase fluid producing a "flashing" phenomenon when the Jason lights illuminated the vent orifices. The five PACMANUS vents (271° – 356°C) have ubiquitous low pH (2.3 to 2.8) relative to Vienna Woods and typical MOR fluids, presumably reflecting water-rock reaction with the felsic hosted lava, input of magmatic volatiles and the subsurface deposition of metal sulfides.

We investigated two strongly magmatically influenced vent systems associated with seafloor volcanoes. Desmos is a breached caldera with white smokers (70°-115°C) that are highly acidic (pH 1 – 1.5) and sulfur lava flows. SuSu Knolls and the adjacent Suzette mound (Solwara-1 of Nautilus Minerals) were mapped in detail and sampled intensively. Hydrothermal activity at SuSu Knolls showed a remarkable range from boiling black smokers to white sulfur-rich fluids, native sulfur flows and massive anhydrite outcrops. Vent fluids from North Su (48° – 325°C) are

characterized by a measured pH of 0.87, more than an order of magnitude more acidic than any deep-sea vent fluid sampled to date. Many of the low pH fluids sampled at North Su and Desmos were actively precipitating native sulfur creating thick plumes of dense white smoke. In general, sampled fluids show a considerable range in pH and gas contents, sometimes within individual hydrothermal fields. The pronounced variability of fluid chemistry within 10's to 100's of m at North Su is probably unparalleled in systems studied to date. The most plausible explanation for the observed variability is that different fluid-rock reaction pathways are expressed in regimes of variable magmatic volatile input and extent of subsurface cooling. This hypothesis is supported by the distribution of alteration types at the seafloor, where the occurrence of advanced argillic alteration - that relates to interactions with acid-sulfate waters such as sampled at Desmos and North Su – is patchy and spatially confined to patches of active (Desmos, North Su) and past (Snowcap) venting of such fluids.

In relationship to the ODP drilling results at PACMANUS we identified and sampled examples of advanced argillic rock alteration similar to that seen in the drill core. Good examples came from Snowcap and from the North Su pillar. We sampled highly clay-altered basement from just underneath extinct chimney complexes at two locations in the Satanic Mills hydrothermal field. Both samples have dense networks of sulfide veins and may represent the stockwork or feeder zone through which hydrothermal fluids rise up to the seafloor. These samples, in addition to the other altered rock types recovered, will provide useful stepping stones in bridging the knowledge gap between the extensive surface sampling now accomplished and the basement rocks recovered by ODP, where coring was almost nil shallower than 40 m subseafloor depth.

Overall, the quality and quantity of solid and fluid samples that can be put in a direct geochemical context is remarkably high. This unique dataset encompasses a broad range of geological environments that includes hydrothermal activity in basalt-hosted oceanic style spreading centers to hydrothermal systems associated with arc-style volcanism. For the first time, alteration assemblages that are commonly observed in drillcore and outcrop on land have been observed in the aqueous environment responsible for their formation.

Cruise Objectives

The cruise was divided into two legs based on the primary location of the Jason and ABE dives. The first leg funded through a collaboration with Nautilus Minerals focused on the Manus Spreading Center and the Vienna Woods hydrothermal field. This midocean ridge basalt (MORB) -hosted black smoker hydrothermal system has been rarely visited since its discovery in 1990 by Tufar (1990). The second leg funded by the National Science Foundation (NSF) focused on the hydrothermal vent systems in the East Manus Basin (EMB), which include the PACMANUS, SuSu Knolls, the recently discovered Suzette (Solwara) field adjacent to SuSu Knolls and the caldera Desmos. These vent systems are primarily hosted in felsic rocks and as such demonstrate some distinctly different chemistries than their MORB counterparts.

The objectives of this cruise are to (1) identify the tectonic setting of the PACMANUS and North Pual vent systems, (2) examine interaction of seawater with felsic rocks that constitute the high-silica endmember in the range of basement compositions, (3) determine whether or not there are magmatic inputs into the hydrothermal systems present in the EMB, and (4) examine the evolution of the PACMANUS and Desmos vent systems through time.

Specifically, we plan to conduct a high-resolution bathymetric and magnetic survey and sampling program of the PACMANUS hydrothermal fields. The strong contrast in rock magnetization suggested by ODP drill core data from PACMANUS may allow us to map out the distribution of different alteration styles in the subseafloor and link these data to the high-resolution mapping results to determine how surface expressions of volcanic construction and tectonic dissection of Pual Ridge may relate to fluid flow patterns. Comprehensive sampling of black smoker, gray smoker, white smoker and clear fluids at PACMANUS will allow us to assess the variability in fluid composition. Geochemical data for solids and fluids will be used to determine the styles of mixing and reaction occurring beneath the vent fields, and to estimate subsurface mineral deposition. They will also be used to investigate whether, and to what extent, input of magmatic fluids is occurring at PACMANUS at this time. Geochemical reaction calculations will then be used to examine the causes of this variability (subseafloor mixing with seawater, conductive cooling/heating, influx of magmatic vapors and brines, etc.).

To further investigate the question of magmatic inputs, we will also collect fluid samples (and corresponding solids) from the nearby Desmos hydrothermal system. It has been previously proposed that large inputs of magmatic fluids are responsible for the presence of sulfate-rich acidic fluids at Desmos. These fluids may represent an interesting end-member in the spectrum of submarine crustal fluids and may reveal important information on the possible role of magmatic degassing and direct incorporation of magmatic volatiles into vent fluids on metal transport in hydrothermal systems. We will also examine the potential roles of near-surface H2S oxidation and sediment-seawater interaction in setting the vent fluid chemistries, as these reactions may impose geochemical signatures to the fluids that could be mistaken as magmatic input.

To complete our investigations we will carry out a reconnaissance geophysical surveys and sampling campaigns if warranted at any newly discovered vent areas. Based on CTD work we plan to investigate the “Northeast Pual” vent site located 9 km NE of PACMANUS and also the Umbo area, located 8 km east of Desmos.

Geologic setting of Manus Basin

The Manus Basin in the Bismarck Sea north of Papua New Guinea is a rapidly-opening (~10 cm/yr) back-arc basin associated with subduction of the Solomon plate under New Britain (Fig. 1). Northward subduction of the Solomon plate was preceded by subduction of the Pacific Plate that terminated in the Oligocene due to the effect of Ontong Java Plateau docking against the Manus Trench [*Martinez and Taylor*, 1996]. Spreading is currently taking place along the Manus Ridge spreading center in a rapidly propagating clockwise rotating microplate setting.

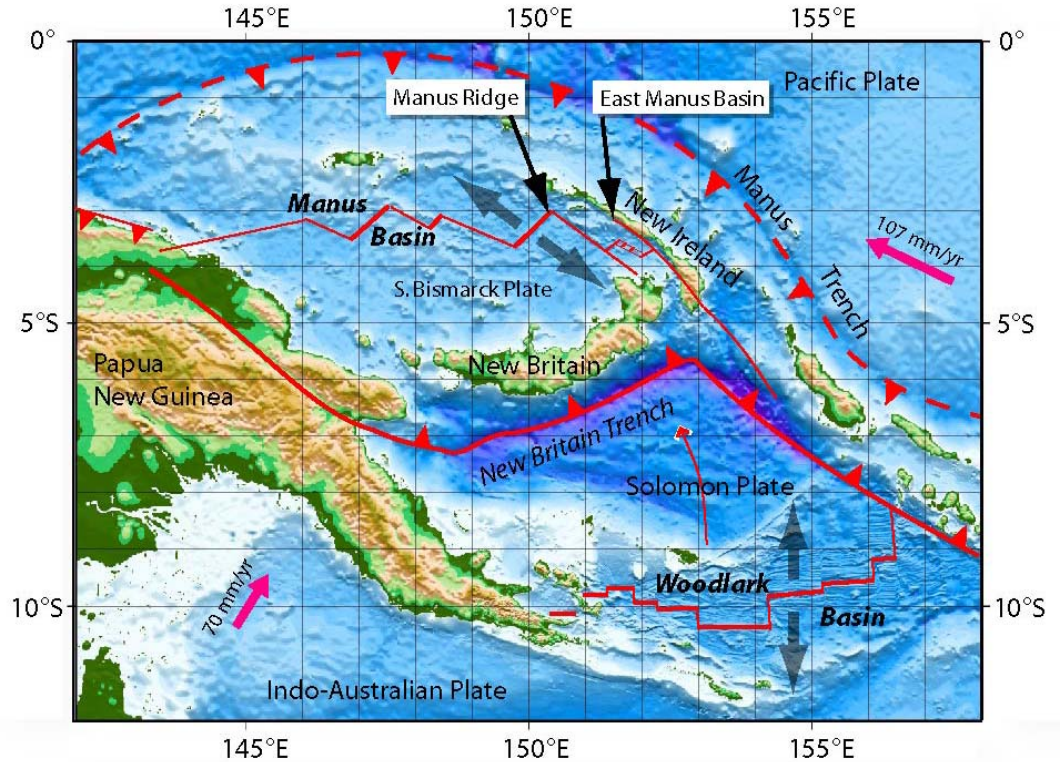


Figure 1. Map showing the location of the Manus 2006 study area identifying the major tectonic elements of the region. The Manus Basin is a back-arc environment relative to present-day subduction at the New Britain Trench. Active spreading is taking place at the Manus Ridge spreading center forming a small clockwise-rotating microplate. The Eastern Manus Basin consists of series of felsic- volcanic ridges and volcanoes in a pull-apart environment between two transform faults. Purple arrows indicate plate motion directions and magnitude.

Hydrothermal activity was discovered along the Manus Ridge in the late 1980s [*Both et al., 1986; Craig and Poreda, 1987*] and subsequently visited and sampled with towed camera and dredging by Tufar [1990] who named the largest of these vent systems "Vienna Woods" (Figure 2). The area was also visited by the Mir submersible in 1990 [*Lisitsyn et al., 1993*]. To the east in the felsic lava dominated crust of eastern Manus Basin is the PACMANUS hydrothermal field, located south of New Ireland (Figure 3) and discovered in 1991 by hydrocasts, dredging and bottom photography [*Binns and Scott, 1993*]. PACMANUS is one of three known hydrothermally active areas in the EMB, including Desmos [*Gamo et al.*, 1997; *Ishibashi et al.*, 1997] and SuSu Knolls [*Binns et al.*, 1997]. It is situated at 3°43.5S, 151°40.5E at water depths of 1650-1740 m depth on the crest of the 35-km long, 500-m high Pual Ridge that appears to be dominantly composed of dacites and rhyodacites [*Binns and Scott*, 1993]. Pual Ridge is externally terraced and appears constructed of stacked, sub-horizontal flows 5-30 m thick, with negligible to minor sediment cover along the crest. Lobate andesitic lava flows occupy the lower reaches of Pual Ridge (Fig. 3).

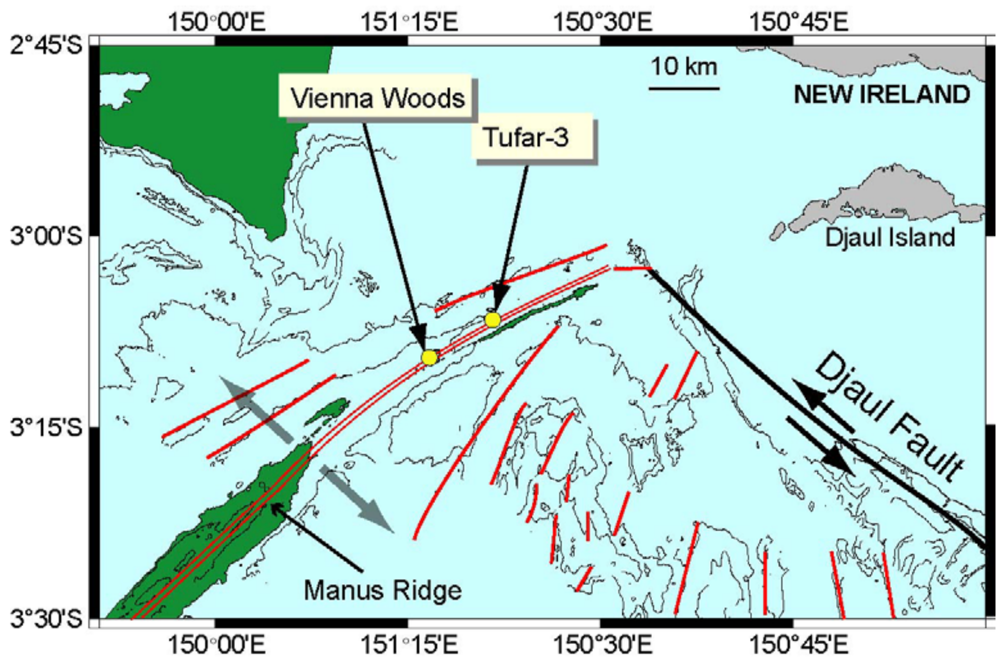


Figure 2. Simplified bathymetric and tectonic map of northern portion of Manus Ridge spreading center showing the location of the Vienna Woods (and nearbyTufar-2 area) and Tufar-3 vent areas.

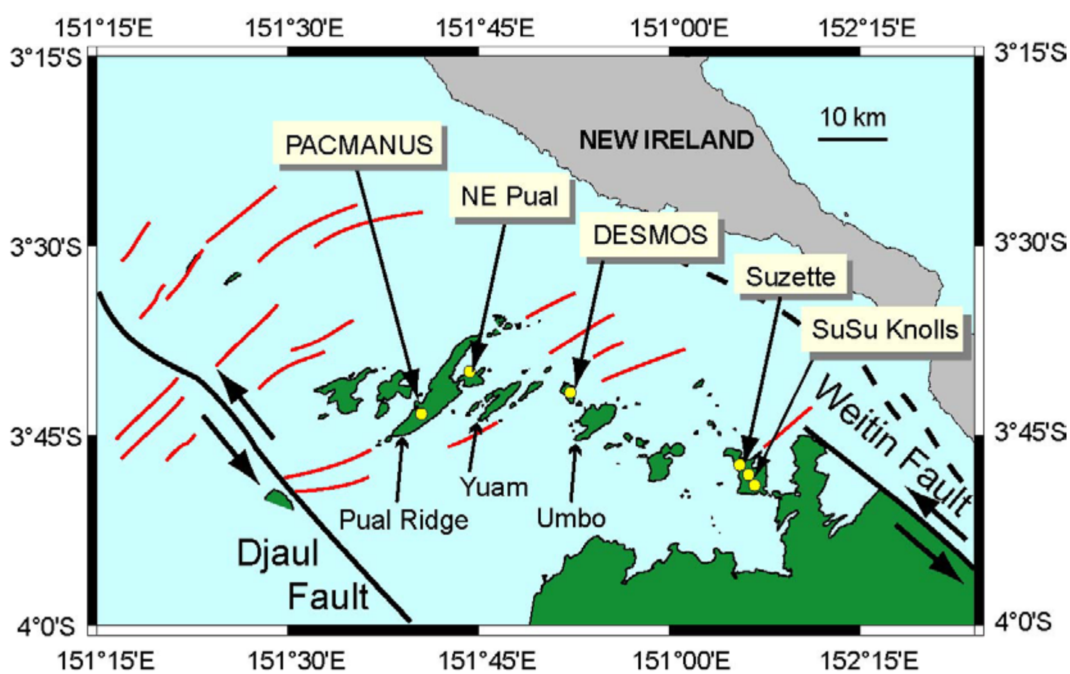


Figure 3. Simplified bathymetric and tectonic map of Eastern Manus Basin showing the location of the main hydrothermal vent areas known to date.

Previous work

The focus of expeditions by Japanese and French researchers (e.g., STARMER and New STARMER cruises in 1995, 1996, 1998, and 2000) and by Australian researchers has been on locating sites of active venting using water column surveys and camera tows, and on recovering representative samples of fluids, vent deposits, and fresh and altered substrate through dredging and submersible dives [*Binns and Scott*, 1993; *Binns et al*., 1996; *Auzende et al.,* 1996a,b; 2000; *Douville*, 1999]. Several hydrothermally active sites have been discovered in the Manus Basin to date, covering a wide variety of deposit types and fluid chemistries (Table 1).

Table 1: Known hydrothermal vent sites in Manus Basin

Lat Long	Water depth (m)	Size (m)	Brief description (**Bold = drilled, ODP leg 193**)
Pacmanus - Roman Ruins			
3º 43.27'S 151º 40.50'E	1693-1700	250 x 150	Close-packed columnar chimneys, up to 20 m high;black, gray, and white smokers and diffuse venting (45-60ºC) of clear fluid
Pacmanus - Rogers Ruins			
3º 43.15'S 151º 40.50'E	1740	100 x 100	Close-packed columnar and multispired active and inactive chimneys, black smokers and diffuse venting of clear fluid. Separated from R.R. by an area of Fe-Mn oxide deposition
Pacmanus - Satanic Mills			
3º 43.63'S 151º 40.40E	1708-1720	200 x 200	Many small, active, multispired chimneys, T=240ºC; a single fluid sample suggests F excess
Pacmanus – Snowcap			
3º 43.67'S 151º 40.25'E	1654-1670	200 x 100	Extensive diffuse venting (6°C); patches of white, flocculent material (microbial mats or gas hydrates); advanced argillic alteration of dacites in area
Pacmanus – Tsukushi			
3º 43.77'S 151º 40.05'E	1670	60 x 60	Young field? Tall (>25 m) chimneys, probably formed between 1996 and 1998, vent clear or white fluid
Desmos Caldera - Onsen			
3º 41.45'S 151º 51.97'E	1930	50 x 150	White smokers (90-120°C) and diffuse venting; advanced argillic alteration; no clams; light H and S isotope compositions of fluid samples suggest magmatic input
Desmos - Genge-Ba			
3º 41.45'S 151º 51.97'E	1860-1890	?	Diffuse venting, abundant clams
Su Su Knolls – Suzette			
3º 47.5'S 152º 05.70'E	1550	400 x 400	Black smokers 233C

Vienna Woods Manus Spreading Center					
3º 9.86'S	150º 16.78'E	2486-2500	1000 x 1000 300 x 300	Black,white,gray smokers, massive sulfide chimneys, hydrothermal biota 275C (Lisitsyn et al., 1993) 285-300C (Auzende et al., 1996)	
Tufar-2 – Manus Spreading Center					
3º 9.47'S	150º 17.04'E	~2500	500 x 500	mostly inactive chimneys	
Tufar-3 – Manus Spreading Center					
3º 6.67'S	150º 21.75'E	2562	6 x 10	small sulfide chimneys and nontronite/precipitate mounds Fe/Mn hydroxides	
Tufar-4 – Manus Spreading Center					
3º 22.18'S	150º 2.24'E	2183-2189	?	nontronite sediments, milky smoke, hydrothermal biota	

Sources: *Auzende et al., 1996a,b; Binns et al.* [1996], *Binns and Yeats* [pers. comm.], *Ishibashi et al.* [1997], *Gamo et al.* [1997], *Douville*, [1999]. Nautilus Minerals (pers. Comm.), *Tufar* 1990, *Lisitsyn et al.* [1993]

ODP Drilling Summary

In 1999, the Ocean Drilling Program (ODP) Leg 193 drilled 13 holes in the PACMANUS area reaching to 386 meters below seafloor (mbsf) at Snowcap (Site 1188) and 206 mbsf at Roman Ruins (Site 1189) where fluids are actively venting. Additional holes were drilled slightly east of the Roman Ruins site 1189 (Site 1190) and at Satanic Mills (Site 1191) but only with limited success in core recovery and penetration depths less than 20 m. Observations of drill core, recovered from the low-temperature Snowcap site and the high-temperature Roman Ruins site [Binns et al., 2002]; Figs. 1 and 2), reveal that basement alteration and subseafloor mineral deposition is extremely variable on a spatial scale of tens of meters. The rocks encountered are dacitic in composition and include massive to vesicular lava flows, autoclastic breccias, and volcaniclastic sediments. Except for fresh lava flows near the seafloor, all rocks are highly to completely altered to silica (cristobalite and/or quartz), clay (chlorite, illite, pyrophyllite, smectite, mixed-layer phases), and anhydrite. Preliminary geochemical and mineralogical analyses of drill core samples, coupled with observations from previous dives *[Yeats et al., 2000]*, provide evidence that PACMANUS has experienced large fluctuations in fluid pH and redox conditions likely related to waxing and waning magmatic input *[Bach et al., 2001; Bach et al., 2003; Roberts et al., 2001; 2003; Yeats et al., 2001]*. Two distinct mineral assemblages are present, one (chlorite-feldspar-quartz) consistent with formation from interaction of fresh rock with a fluid of relatively high pH (~5), and the other (quartz-illite-pyrophyllite-anhydrite±alunite±diaspore) with formation from interaction with low-pH (~3) fluids. The different alteration assemblages within the crust at PACMANUS likely reflect reaction of rock at different fluid-rock ratios and temperatures, and with fluids of differing compositions (e.g., pH, redox). This provides the motivation for this research program to sample the fluids and to collect the associated sulfides and altered rock sequences through which this fluid is passing.

METHODS

SeaBeam Data

The RV Melville has an original SeaBeam 2000 120 degree swath multibeam complete with Calcomp plotter providing a swath of 121 beams of bathymetry and sidescan. SeaBeam bathymetry data were obtained throughout the cruise generally on transits greater than 2 hours. A bathymetry map was made of Manus spreading center (Fig. 4) prior to the Jason dives there. Another map was made of the Eastern Manus basin area (Fig. 5) through successive surveys that included the approaches to Rabaul harbor. During the cruise it was noticed that there was a significant roll-bias in the data being collected (a bias down to starboard). On Aug. 19th we conducted a roll bias test and computed a roll-bias value of 0.637 degrees that was used in the processing of the SeaBeam data. Seabeam data processing started with the basic median filtered beam data which were merged with cleaned navigation data created by the Melville Shipboard Computer Group (SCG). The freely available MBsystem software package, installed on the Melville's SunRay computer network, was used to process the data into data grids. Two basic grids were made at 100 meter grid cell resolution: Manus Ridge and Pacmanus.

Sea Surface Magnetic Data

Unfortunately no sea surface magnetic data were collected during the cruise due to a malfunctioning sensor unit, a Marine Magnetics SeaSpy overhauser model. There was no back system on board.

CTD Data

The CTD program was run by Australian colleagues, Chris Yeats, Tim McConachy and Melissa Quigley from CSIRO. The deck recording part of the CTD system consists of a SeaBird Model 11 deck unit and SeaSave software from SeaBird. A Knudsen 320B bottom profiler provided bathymetry depth on station although this record was frequently noisy and or weak. A summary of CTD stations is provided in Table 5. The first station was named MH-101 to match Australian databases. The last CTD station was MH-126.

ROV Jason

ROV Jason is a ~30 HP scientific mission configured ROV with two full-function manipulators, a retractable sample basket capable of 200 lbs of samples, a full-ocean depth Simrad 2000 multibeam sonar, a CTD, a digital still camera, a three-axis vector magnetometer and multiple color cameras (Fig. 6). We mounted an Eh sensor, graciously provided by Ko-ichi Nakamura of AIST, Japan, to measure real-time Eh signals for tracking active hydrothermal plume signatures. For the second leg Chris Roman (URI) also mounted a 675 Khz multibeam sonar to the front of Jason for mapping purposes in addition to the Sm2000. Jason is connected via a ~40m long neutrally buoyant tether to its fiber-optic cable junction vehicle, Medea. Medea is the junction of the fibre-optic 0.680 cable from the ship. Jason is navigated using a combination of long-baseline navigation (LBL) utilizing acoustic transponder beacons, downlooking acoustic doppler velocity log (DVL) and a high frequency acoustic ranging system between Medea and Jason (SHARPS system). Jason dove in two areas without any bottom deployed transponder net: Desmos (Dive 220) and Umbo (Dive 228). When ABE was operating simultaneously within the same transponder net as Jason, typically Jason relied more heavily on DVL navigation. The DVL navigation provides a high data rate (typically 1Hz) position value but tends to drift or be plain wrong if bottom lock is lost. The LBL navigation suitably cleaned and edited is used as a set of fixed points to which the DVL navigation is fit to. This re-navigated data was completed on board during the cruise. Other data collected by Jason include vector magnetic data which is calibrated on each dive with a spin at mid-water depths (Tivey Twist). The north-seeking laser gyro system (Octans) on board provide an excellent vehicle attitude reference to calibrate the vector magnetometer against. Typical corrected noise levels of Jason magnetic calibrations were about +/-100 nT.

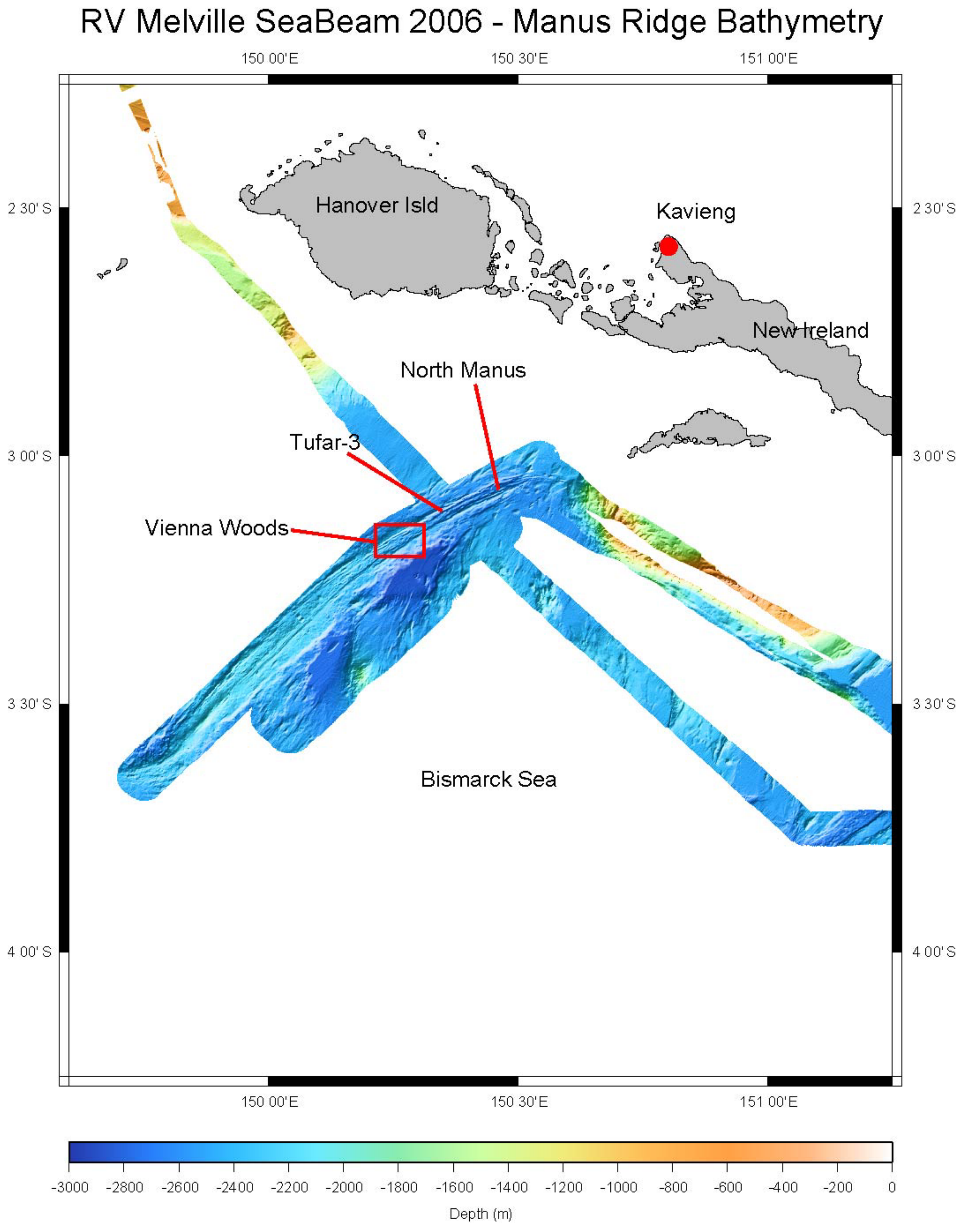


Figure 4. Melville 2006 SeaBeam bathymetry map of Manus Ridge spreading center showing the location of the dive sites at Vienna Woods, the Tufar Field #3 and North Manus Ridge areas.

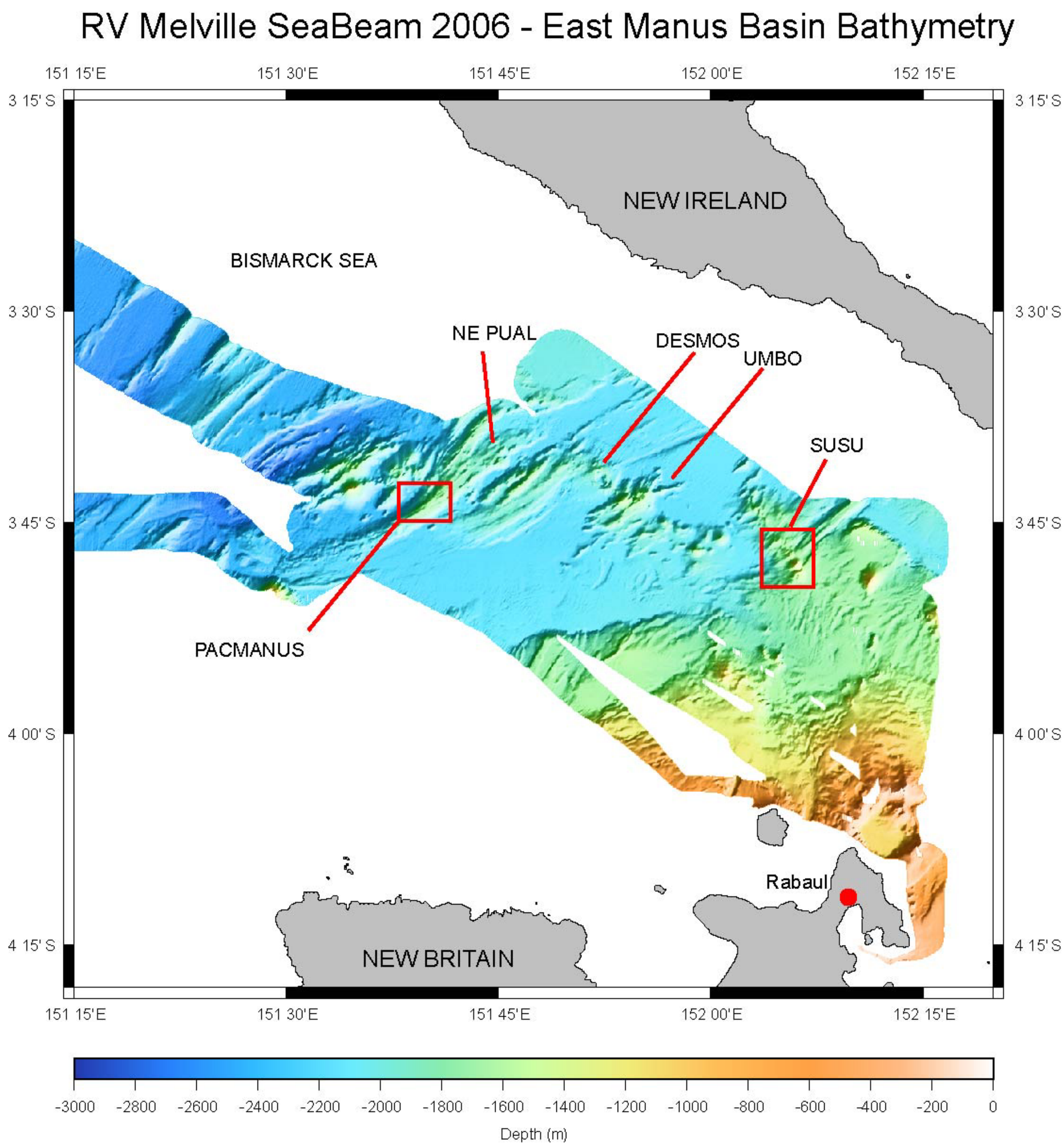


Figure 5. Melville 2006 SeaBeam bathymetry map of Eastern Manus Basin showing the location of the hydrothermal sites visited during the cruise.

ROV Jason and tow vehicle Medea were launched a total of 30 times during this cruise. Seven dives were conducted on the Manus Spreading center (6 funded through the Nautilus Minerals - WHOI agreement) and the remainder of the dives in Eastern Manus basin. For the second leg, typically four Seewald isobaric gastight (IGT) water samplers were mounted on Jason with inductively coupled link (ICL) communications along with 2 major water samplers. This accounted for half of the basket space leaving room for rock and sediment samples. Two Niskin bottles were mounted on the rear of Jason for bottom water collection. Occasionally push cores and sample scoop bags were used to pick up friable samples and sediment.

Figure 6a. ROV Jason basket showing 4 gastight water samplers and holders for two major water samplers, along with two push cores and scoop bags.

Figure 6b. ROV Jason being launched.

ABE

ABE is an autonomous underwater vehicle (AUV) capable of carrying out seafloor mapping over a range of approximately 30 km at deep water depths (Fig. 7). A summary of ABE dives is shown in Table 4. An engineering summary of ABE dives is included as an appendix to this report. Out of a total of 18 dives, ABE aborted 4 times. ABE carries a 200 khz 3000 m rated Simrad multibeam sonar along with a 3-axis fluxgate magnetometer, an Eh sensor graciously provided by Ko-ichi Nakamura of AIST, Japan, an optical backscatter sensor (OBS) and CTD. The Eh sensor was used to detect active hydrothermal plume signatures and along with similar hits in temperature and OBS would provide targets for Jason to dive on. The multibeam bathymetric sonar provided a superior mapping capability that was critical to the success and efficiency of the Jason operations. Maps with pixel sizes of 2 meters were made from surveys with a line-spacing of 50 meters and an altitude of 50 meters. ABE also conducted a few missions with broader line spacing of 150 meters at 150 meters height. The bathymetric mapping remained superb at this altitude although the ability to detect and locate plumes diminished somewhat. Magnetic data collected by ABE was also instrumental in directing the location of some vent areas. Calibration of ABE magnetic data relied solely on the magnetic data with no independent heading reference. Given this only a compass-swing type of approach was used in calibrating the sensor, resulting in a noise level of approx. 200 nT on average. This noise level was sufficient to pick out magnetic anomalies even those some of those were weak (<1000 nT). Processing of ABE magnetic data follows the standard procedure of calibration, removal of the International Geomagnetic Reference Field (IGRF) followed by gridding onto a grid with typical data spacing of 15 meters. This observed magnetic field grid was upward continued to a constant depth level using the *Guspi* [1987] approach and then inverted for crustal magnetization using the *Parker and Huestis* [1974] Fourier transform approach assuming a constant 500 m thick source layer. A notch filter was used to reduce noise due to the low-latitude of the survey area. The maps in this report are crustal magnetization maps made using this approach.

Figure 7. The autonomous underwater vehicle, ABE being recovered after a mission. ABE is a hovering type of vehicle which allows it to survey in rugged terrain.

Rock Sampling and Curation

Rock samples include active and inactive chimneys, fresh and altered volcanics, massive anhydrite+/-sulfide and native sulfur rocks, Fe(Mn)-oxyhydroxides, as well as variably cemented clastic rocks. Each rock sample was weighed and measured for size before it was described in terms of color, texture, mineral composition, grain size. Vesicularity and phenocryst size and content was described for volcanic samples as was alteration style and type. The sample description logs are available as hard copies and scanned images of each page of that log. The samples were dissected using either a small tile saw or hammer and chisel for further description and subsampling. Very delicate or crumbly samples were usually wrapped up and shipped whole-sale to Woods Hole for cutting with a superior, larger tile saw or the Buehler Microsaw. Sulfide samples were usually split between WHOI, CSIRO, and Nautilus. Volcanic rocks were split between U Bremen, Towson U, and CSIRO. Samples of anhydrite rock were split between WHOI and Towson U, with the exception of several that were too precious to try to cut on board – these will be sliced and split at WHOI. An archive piece of every solid sample went to WHOI. A comprehensive sample spreadsheet with lists of subsamples of each researcher is included in the Appendices of this report. Large samples were packed in canvas bags; smaller ones were packed in plastic Ziploc packs. Prior to packing, all samples were dried. Particular care was taken in drying the sulfide samples before packing; they were kept in baskets under lamps for days in order to dry completely.

Fluid Sampling

Sample Inventory:

70 gastight fluid samples
34 “major” fluid samples

Collection Methods

Fluids were collected using titanium isobaric gastight (IGT) fluid samplers (*Seewald et al., 2002*) and titanium syringe style “major” samplers (*Edmond et al., 1992*). In general, two gas-tight samples and one “major” sample were collected at each edifice ORIFICE?. The IGT samplers were equipped with thermocouples that allowed real time temperature measurement during collection of fluids. Communication with the IGT samplers was achieved via an inductively coupled link (ICL) that allowed RS-232 communication. The “major” samplers were deployed as singles without ICL temperature probes. In the rare case where a “major” sample was collected without an IGT sample, temperature was measured prior to sampling using the Jason II temperature probe. Reported temperature for each IGT fluid sampler represents the maximum temperature recorded while the thermocouple/snorkel tip was inserted in the vent orifice prior to, during, or after sampling.

Sample Processing

Fluid samples were processed within ten hours of vehicle recovery. Subsamples were extracted from the “Major” bottles for measurement of pH (25°C), refractive index (RI), arsenic abundance and speciation, trace metal abundances, trace metal isotopes, and major cation and anion analyses. The aliquot for trace metal analyses (~500 ml) was acidified with 1 ml of ultra-pure HCl. For selected samples the acidified trace metal sample was subsequently diluted 100X for SiO_2 analyses. For the IGT bottles, aliquots were withdrawn in addition to those described above for shipboard analysis of H_2, CH_4, and H_2S. Additional aliquots were archived in evacuated glass containers for lab based determinations of the abundance and isotopic composition of CO_2 and He, and the isotopic composition of CH_4. Aqueous subsamples were also collected for lab-based analyses of oxygen and hydrogen isotopes and the abundance of aqueous organic species. Following complete removal of the fluid from the samplers, solid precipitates were removed from the bottle by sequentially rinsing with water and acetone and collected on a 0.45 μm nylon filter.

Shipboard Analytical Methods

Salinity (equivalent wt.% NaCl) was measured using a handheld refractometer. A Ross combination electrode was used for measuring pH (25°C). To minimize loss of acid volatiles, samples were not sparged with an inert gas during measurement. Attainment of stable pH values indicated that significant sulfide oxidation was not occurring during measurement, the absence of an inert gas overlying the sample, notwithstanding. Aqueous H2S was measured using an ion specific electrode calibrated on a daily basis by potentiometric titration of a Na2S standard with PbNO3. Aqueous H2S concentrations are also determined gravimetrically by acidifying a separate fluid aliquot with 25 wt. % phosphoric acid and precipitating the evolved H2S as Ag2S in a 3 wt % AgNO3 solution. The precipitated Ag2S will be weighed in a shore based laboratory to determine H2S concentrations and will subsequently be used for sulfur isotope analysis. Dissolved H2, CH4, and CO were measured by gas chromatography (GC) following a headspace extraction in a purpose-built inlet system. For samples with relatively high concentrations of H2 and CH4, the GC was equipped with a 5Å molecular sieve column, nitrogen carrier gas, and a thermal conductivity detector. For low level H2 and CH4, and CO analyses, a 5Å molecular sieve column, helium carrier gas, and a helium ionization detector were utilized. Following the headspace extraction, the remaining fluid was sparged with N2 to remove any residual aqueous H2S and archived for shore based chemical and isotopic analysis of aqueous SO4.

INITIAL RESULTS

Manus Ridge Hydrothermal Fields

Tufar Field #1 – Vienna Woods or "Weinerwald"

The Vienna Woods hydrothermal field was first discovered and documented by *Tufar,* [1990] and subsequently visited by a Mir submersible dive program (*Lisitsyn et al. 1993*). A joint Japanese-French Shinkai 6500 submersible program conducted five dives in the area in 1995 [*Auzende et al.*, 1996a]. The field is located within the central part of the rift valley of the Manus spreading center just south of the axial neovolcanic ridge (Fig. 8). Vienna Woods was documented by Tufar [1990] to extend for 1000 m along strike with some chimneys reaching up to 20 m high. Subsequent Shinkai-6500 dives reduced the active area to 300 m in diameter [*Auzende et al.*, 1996a]. The hydrothermal fields are hosted in midocean ridge basaltic pillow lavas. The Mir submersibles delineated "five hydrothermal fields": 2 active fields, one inactive field and 2 active low temperature fields. The two active fields were named Vienna Woods and White-Chimney field. An inactive area was called the Dead Forest due to the predominance of tall columns of inactive sulfide chimneys. This is located slightly west of Vienna Woods and White-Chimney fields. A low temperature field apparently forms a 10 x 10 m patch on the eastern periphery of the Vienna Woods field. The White chimney is an 8m tall chimney, colored white on its upper portions and emanating dark gray smoke. Hydrothermal fauna is dominated by gastropods, galatheid crabs and shrimp.

The Tufar location for Vienna Woods is -3° 9.86'S 150° 16.78'E (x3297, y5787) which is slightly different than the *Lisitsyn et al*. (1993) position of the main edifice which is -3° 9.745'S 150° 16.815'E (x3362, y5998) as derived from their published map of the area. Other locations from *Lisitsyn et al.* [1993] include a low temperature field (-3° 9.77'S 150° 16.88'E) (x3483 y5952) and the Dead Forest (-3° 9.76'S 150° 16.78'E) (x3297 y5971). There appears to be an offset in these positions from our coordinates: *Lisitsyn's* positions are shifted approximately 80 m east and 100 m north of our positions if we take the Dead Forest area and main smoker complex as guideposts.

Our observations:

ABE dive 182 produced a bathymetric map of the area with some additional coverage to the southern edge provided by ABE dive 183 (Map-1). The ABE bathymetric data shows discrete bathymetric pinnacles that can be directly identified as individual chimneys. The ABE magnetic

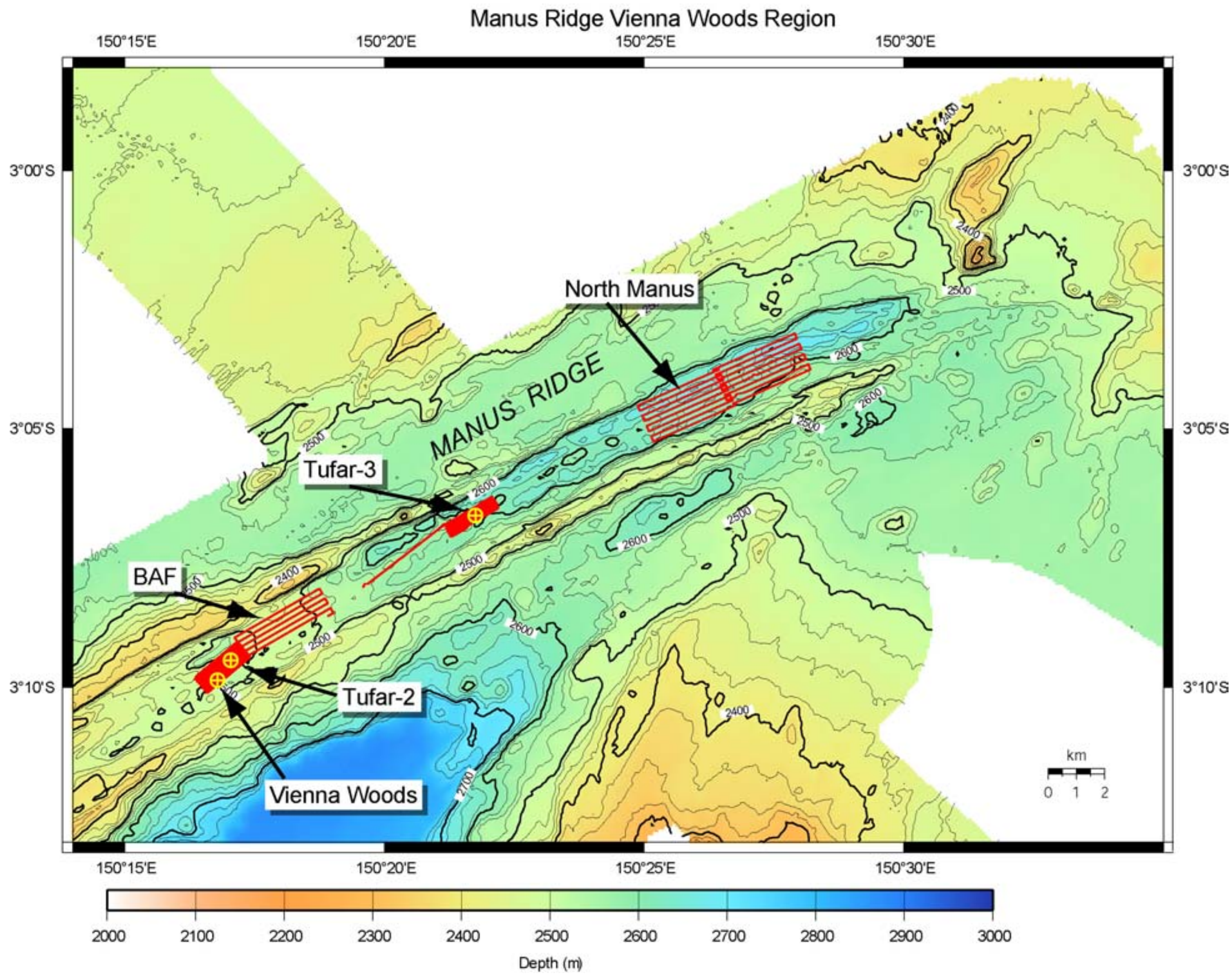


Figure 8. SeaBeam bathymetry map of Manus Ridge showing the location of the Vienna Woods and other Tufar hydrothermal areas. ABE tracklines are shown by red lines. Individual hydrothermal sites are indicated by yellow circles and identified. BAF indicates the Bronze-Age Fort area.

data also shows a well defined magnetic low centered over the Vienna Woods field at -3° 9.85'S 150° 16.7'E (Map-2). Three Jason dives focused on Vienna Woods: 200, 202, 207 (Map-3).

Jason Dive 200 dove on the position of the Vienna Woods hydrothermal area from the reports of *Tufar* [1990] and *Lisitsyn et al.* [1993]. The dive took place prior to the ABE mapping and focused on collecting inactive sulfides for Nautilus Minerals. Sulfide chimney structures form tall columns up to 8 m high. Numerous smaller chimneys are observed. Chimneys are arranged in linear arrays in places indicative of fault control. The majority of chimneys are aligned along fissures and small-offset faults that trend 040 to 050. Active venting was observed in the form of diffuse venting through chimney structures (either near base or near top) and focused venting from orifices near the top of structures that are between 5 and 12 m tall. The appearance of venting fluids ranges from black (x3237, y5745) to gray and clear (x3312, y5782). Gastropods, galatheid crabs, barnacles, and annelids colonized the walls of active chimneys and rare patches of diffuse venting occurs through the pillow basalt substrate. Dive 202 followed up on the first dive and had the benefit of the ABE map for directing the dive sampling. Actively venting chimneys with clear to gray smoke were observed and sampled north of y5850. A sulfate/sulfide spire sampled at x3167 y5815 resulted in vigorous clear venting as did sampling at x3312 y5815 (T=255C). Inactive chimneys were observed in the area x3207 y5668 and x3224 y5698. Presumably this latter region was the "Dead Forest" referred to by earlier observers. The final dive 207 collected fluid samples and temperature measurements of the active vents for comparison with those from the PACMANUS and SuSu vents of Eastern Manus Basin.

Our estimate of the size of the Vienna Woods hydrothermal field is approx. 300 by 100 meters much smaller than the original assertions of 1000 m diameter [*Tufar*, 1990] along strike. The present day hydrothermal activity is confined to a much smaller area perhaps 150 by 100 m within a broader magnetic low region of 250 by 150 m (Map-4). Dive 201 collected 22 samples, while Dive 202 collected 17 samples all sulfides. Dive 207 collected 9 samples (4 active sulfides, 2 relict sulfide, 2 volcanic rocks and one sediment sample) and 4 fluid samples, 2 majors (see Tables 6 and 7 for a summary).

Tufar Field #2

The Tufar-2 region was discovered and described by *Tufar* [1990] as being a hydrothermal field that is smaller in size and more or less inactive but otherwise comparable with the Vienna Woods Field. *Tufar* [1990] located the field at 3° 9.47'S 150° 17.04'E (x3779, y6505) with a diameter of about 500 m. ABE 182 mapped the area prior to our Jason dive which helped considerably in the exploration of the field (Map-1). The ABE bathymetry data shows the presence of chimney spires and the magnetic data indicates an area of reduced magnetization centered at 3° 9.50'S 150° 17.00'E (x3704, y6450) and extending northeast to approximately 150° 17.10'E (Map-2). Jason Dive 201 explored and sampled this field and found the area to be totally dead with no active hydrothermal venting observed (Map-5). No animal life was observed either, other than typical deep sea sessile fauna, sponges, sea lilies, seastars and holothurians. The extinct hydrothermal field was found to be comprised of old inactive sulfide chimneys covering an area of 140 m along strike by 50 m across strike. The main sulfide chimney complex was arrayed along a south facing scarp some 10 meters high and trending along a north-east to south-west azimuth parallel to the axis of spreading. A few smaller areas of isolated sulfide structures were found to the south and east of the main field (x3750 y6440; x6480 y3820). A few solitary sulfide chimneys were found further to the northeast sticking out of the sediment cover. The substrate was primarily pillow lava that was heavily sedimented in flat areas such that no observed lava poked through the cover. Some larger chimney structures produce distinct bathymetric peaks in the ABE bathymetry map. A few chimneys reach up to 9 meters tall. There was also ample evidence for large collapsed chimneys. Several chimneys also had extensive aprons of Fe-hydroxides. A total of 26 samples were collected from 24 stations. All samples collected were sulfides.

Bronze-Age Fort area

Jason Dive 203 traversed an area to the north of Tufar Field #2 between 3° 8.2'S 150° 18.80'E and 3° 9.4'S 150° 17.20'E (Fig. 8; Maps 6 and 7). ABE 183 surveyed this area with a broader scale survey (150 m altitude survey with 150 m line spacing) and documented an extensive platform of flat-lying volcanic lava which was found to be an extensive jumbled sheet flow covering an area of almost 2 sq. km. ABE detected a small Eh anomaly on the flank of a curious semi-circular rampart (and nick-named the "Bronze-age fort" and thus the name for the area) on the northern edge of the survey area. This semi-circular rampart is also visible in the SeaBeam bathymetry data and produces a small magnetic low in the ABE data (Map 8). Jason dive 203 began to the north of this area and traversed a series of pillow domes before arriving at the jumbled/sheet flow front. After traversing across this lightly sedimented sheet and lobate flow surface Jason arrived at the rampart and found it to be a steep fault-bounded feature exposing truncated pillow lavas with pillow talus at the base. The rampart is up to 60 m high. The top and interior of the circular rampart zone is dominated by pillow lavas. A small stand of sulfide chimneys up to 4-5 meters tall were found outside of the rampart at the base of the scarp and talus apron. These chimneys were inactive and were sampled. A total of 9 samples were taken on thus dive comprising of 3 Zn-rich sulfides and 6 volcanic rocks (see Table-7).

Tufar Field #3

The third hydrothermal field discovered and documented by *Tufar* [1990] had suggested that this field, centered at 3° 6.67'S 150° 21.75'E (x12504, y11665), was active with small sulfide chimneys and mounds of hydrothermal precipitate (nontronite, Fe/Mn hydroxides) and colonized by antler soft coral. ABE Dive 185 mapped the area (Fig. 8; Map 9) and flagged a single Eh anomaly at 3° 6.55'S 150° 21.70'E (x12411, y11886). The ABE magnetic data (Map 10) shows a couple areas of reduced magnetization at 3° 6.85'S 150° 21.35'E (x11763, y11333) and 3° 6.7'S 150° 21.7'E (x12411, y11609), the latter over the Tufar #3 area. Jason dives 204 and 205 focused on Tufar Field #3 (Map 11).

Dive 204 explored the northern half of the ABE mapped area around the Eh anomaly just northeast of a low magnetization area (Maps 10 and 11). A small active hydrothermal mound was found in the vicinity of the Eh hit at x12445 y11725. A temperature of 194°C was measured at one small active sulfide chimney. That chimney was sampled along with one inactive chimney. Those were the only samples from the dive. Other nearby pillow domes had evidence of sporadic hydrothermal activity with thick bacterial coatings on black rock which may have been degraded sulfide. Another area of shimmering water was found at the crest of small pillow dome at x12437 y11645 with gastropods, shrimp, crabs and barnacles. Most of the remaining area outside of the "Tufar #3 area to the north was dominated by pillow lava domes that were heavily sedimented. A total of two sulfide samples were obtained on this dive (Table-7)

Dive 205 explored the southern half of the ABE 185 map south of the Tufar #3 site (Map 11). This is the site of reduced magnetization intensity and of weak temperature anomalies from the ABE survey. The majority of the area is floored by pillow lava which forms small domes. The area is cut through by faults and fissures with the larger ones visible in the ABE map. The central area within the reduced magnetic zone has an area of completely degraded Fe-oxyhydroxide material adjacent to a small fault x11768 y11284. Although attempts at sampling the oxyhydrxide were made only one rock sample was taken and that was a pillow lava from talus on the large volcanic dome (x12165, y11407).

North Manus Ridge

ABE mapped the North Manus rift axis between 3° 5.40'S 150° 25.0'E and 3° 3.20'S 150° 28.20'E at a line spacing of 150 m and altitude of 150 m. Two ABE missions, 186 and 187 collected data in adjacent areas (Fig. 8). These areas were selected for strictly exploratory purposes with no apriori knowledge. The ABE 186 bathymetry map revealed little in the way of pinnacle fields and no Eh or temperature anomalies (Map 12). The ABE magnetic data (Map 13) shows no obvious demagnetized zones but does have a well developed central anomaly magnetic high that correlates with a series of circular volcanic domes which presumably mark the neovolcanic axis. Jason Dive 206 explored the area (Map 14) with no success in locating any hydrothermal activity. The region was dominated by pillow lava flow with heavy sediment cover. Most domelike bathymetric features were pillow lavas. The domes within the center of the rift valley formed the locus of the high magnetic zone. Six samples were collected; two pillow basalts, two pumice samples, a sedimentary breccia and an Fe-Mn oxide crust.

The adjacent rift valley area to the north of ABE dive 186 was mapped by ABE 187 and revealed a similar dearth of hydrothermal targets (Map 15). No Eh, temperature, OBS or obvious magnetic targets (Map 16) were observed in the data. The strong magnetic anomalies align closely with the volcanic domes suggesting these are the locus of neovolcanic activity. The area did not have a Jason dive.

PACMANUS – Overview

The PACMANUS (Papua New Guinea-Australia-Canada Manus) hydrothermal area, originally discovered in 1990 [*Binns and Scott*, 1993], consists of several chimney fields distributed over a 1 km long stretch of Pual Ridge at depths between 1650 and 1740 m (Fig. 9). The fields were first visited by submersible in 1995 [*Auzende et al.,* 1996a]. The fields comprise Roger's Ruins, Roman Ruins, Satanic Mills, and Snowcap. In 1996, the Tsukushi field was discovered during a Shinkai-2000 dive [*Hashimoto and Ohta*, 1999]. We visited and sampled all of these sites and registered a new very active vent field – Fenway – that was previously described as a fairly inactive southern extension of Satanic Mills (Fig. 9).

One of the major goals of the cruise was extensive mapping and surveying of the PACMANUS area and sampling of fluids and solids (active and inactive chimneys and other hydrothermal precipitates as well as fresh and altered volcanic basement). Two focus sites in this effort were the Snowcap and the Roman Ruins hydrothermal fields, which had been drilled successfully (down to 386 mbsf) during Ocean Drilling Program (ODP) Leg 193 in 1999/2000. Geochemical and fluid inclusion work on anhydrite veins from drill core samples revealed prominent differences in the fluid sources and hydrology of these two systems (*Roberts et al., 2003; Bach et al., 2003; Vanko et al., 2004*), which point to spatial and temporal variations in the hydrothermal regimes in the area. Comprehensive sampling and geochemical analyses of vent fluids will enable us to test the hypothesis that some of these differences are due to variable input of magmatic volatiles.

A total of ten Jason dives were conducted in the PACMANUS area. These are Jason Dives. 208 through 216 and Dive 222. During these dives, 52 fluids samples were collected from active vents, 28 active sulfide samples were recovered, most of which represent the orifices of chimneys discharging sampled fluids and 34 inactive sulfides were also obtained (Table 6). In addition, 30 volcanic basement rocks were sampled, of which 22 represent hydrothermally altered rocks that had interacted with upwelling hydrothermal fluids. Other samples included massive anhydrite (7 specimens from the Fenway site), native sulfur (2 specimens from the Snowcap site), Fe-oxide deposits (3 samples from the Tsukushi site), sulfur-cemented volcaniclastic rocks from Snowcap (6 samples), and scoop samples of unconsolidated material from various locations (for summary see Table 7).

Sampling at PACMANUS was greatly facilitated by microbathymetry, Eh, optical backscatter, water temperature, and magnetic field data collected during ABE dives 188 and 190 (Map 17).

In addition to the ABE maps, high-resolution sonar and magnetic surveys were conducted by Jason during dives 212-214 in order to provide very high resolution microbathymetry and subsurface imaging via the magnetics for the Fenway and Roman Ruins hydrothermal fields.

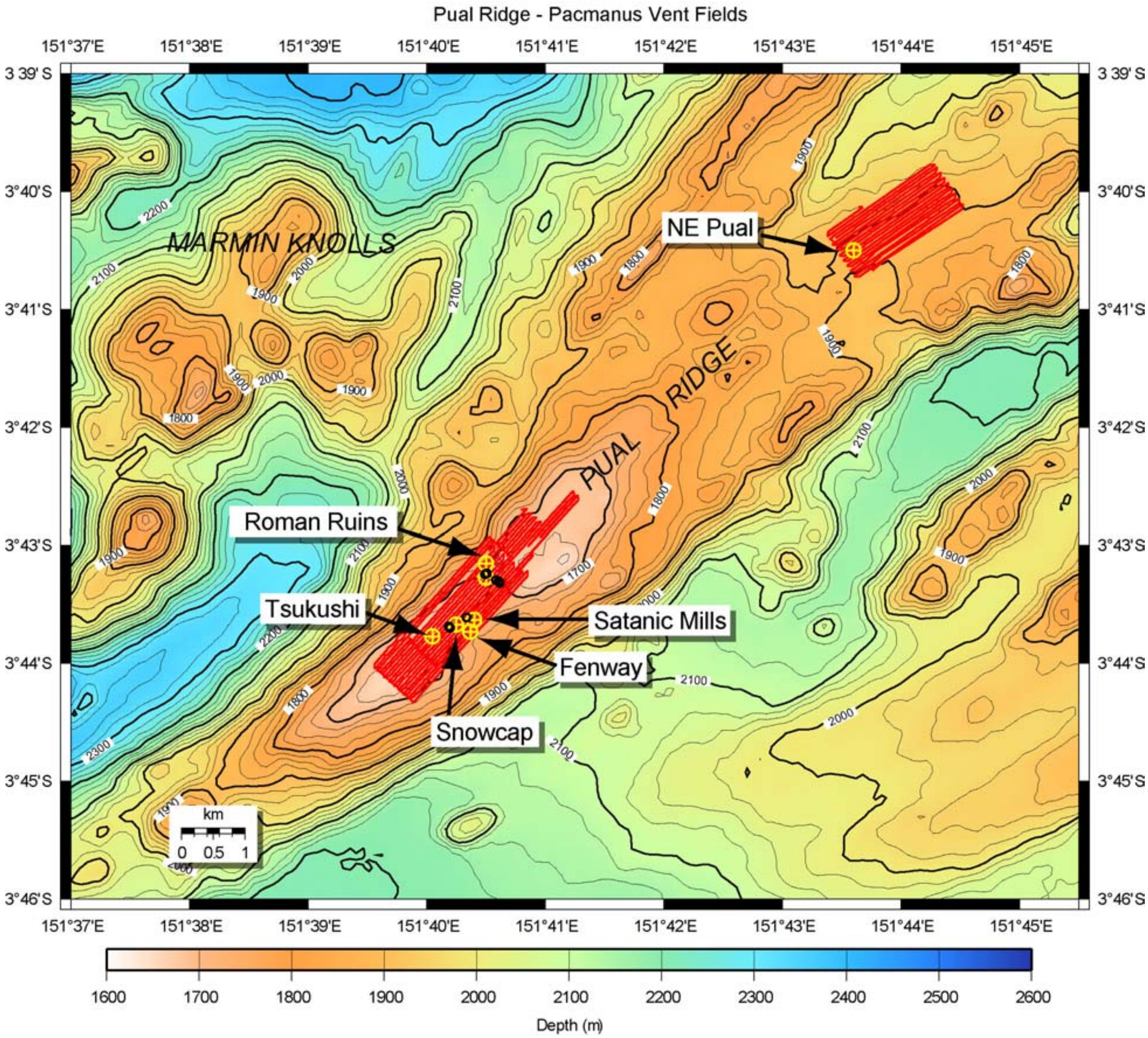


Figure 9. Bathymetry map of Pual Ridge in Eastern Manus basin showing the location of the PACMANUS hydrothermal vents sites and the NorthEast Pual hydrothermal field. Red line sindicates the ABE tracklines in this area. Individual vent locations are marked by yellow crosses and circles and identified. Black circles are the ODP drill hole locations.

The seafloor in the area is characterized by steep slopes of blocky lava; the lack of talus at the base of the lava flow suggests that the blocky appearance is due to autobrecciation, indicating highly viscous flows probably having a felsic composition. Crests of ridges are very rugged owing to the large number of big blocks (up to meter-sized) and platy fragments of lava. Small plateaus exist within this rough terrain that have smoother lava flow surfaces and a few cm of sediment accumulation. The ABE microbathymetry shows a distinctive character with numerous sigmoidal flow units emanating from centralized volcanic rifts (Map 17). The hydrothermal mounds, chimney fields and deposits can be recognized by their morphological character that differs from the volcanic character. The ABE magnetic data (Map 18) shows that all the major vent fields with perhaps the exception of Tsukushi having well developed and sharply defined zones of reduced magnetization intensity. In particular, Roman Ruins shows a discrete “bulls-eye” anomaly with a diameter of ~ 150 meters. The adjacent smaller Rogers Ruins vent field does not seem to have a similar zone of reduced magnetization either because it is too small to be imaged or is relatively young compared to Roman Ruins. Reduced magnetization intensity zones are present over Satanic Mills, Fenway and on the southwest edge of Snowcap where hydrothermal activity was observed and sampled. The strongest intensity reduction is over Fenway. Also of interest is that the overall magnetic signal over Pacmanus is less than that at Vienna Woods by almost an order of magntitude presumably indicating the weaker magnetism of the felsic lavas that dominate at Pacmanus compared to the basaltic lavas at Vienna Woods.

Following are brief summaries of the results of the ten PACMANUS dives grouped by the different vent field areas and with a focus on the vent sampling. More detailed and chronological reports on a dive by dive basis are provided as electronic supplement along with the dive logs. The main objectives of all dives within the Pacmanus field on the Pual Ridge was to sample two solid / fluid sample pairs at sites of active venting of high-T fluids. In addition to the sampling, the extent, geologic setting and characteristics of hydrothermal activity in the area was examined and documented. Part of the dive operation was a description of the ODP drill-hole locations from Leg 193, in particular the deep holes marked by re-entry funnels on the seafloor (Holes 1188A, 1188F, and 1189B). Upon surveying the area, samples of sulfides as well as fresh and altered rocks characteristic of the area were collected.

Roman Ruins and Roger’s Ruins

In previous descriptions, the Roman Ruins/Roger’s Ruins vent area was described as a continuous hydrothermal field, separated by a zone of Fe-Mn oxide deposits. Roman Ruins is about 250 m E-W and 150 m N-S, and Roger’s Ruins’ 50 m in diameter (Map 19). The fields are characterized by simple columnar chimneys and complex multi-spired chimneys. Many chimneys are broken or have collapsed and form partly oxidized chimney talus. There is black smoker and gray smoker activity as well as diffuse venting of clear fluids from the base of chimneys as well as through chimney and rock talus.

Dive 208 sampled a cluster of chimneys in the eastern part of the Roman Ruins field and in the immediate vicinity of the ODP re-entry cone of Hole 1189B (x2802, y3250, Fig. 10); it is lined up along a ridge with an azimuth of 170°. Multi-spired chimney complexes of considerable height (estimated 5-6 m) contrast with small solitary smokers with white beehive-tips that are occasionally developed in the area. The color of the smoke ranges from gray to black at the multispired complexes and from white to light gray for the white-tipped chimneys. Vent fluids with Tmax of 314°C were sampled and a small piece with obvious chalcopyrite inner linings could also be retrieved. We left “Marker 2” at the sampling site (x2795, y3254). The next chimney cluster was located following a bearing of 230° and on top of another rugged lava ridge, separated by the previous one by a deep trough with sedimented blocky lava. Shimmering waters and rich biota (polychaetes, gastropods, crabs, and shrimp) in between fallen chimneys indicated pervasive hydrothermal venting. The active venting (x2799, y3237, z1670) is exclusively through white beehive-tipped chimneys. They form structures between 0.5 and 7 m in height. The tall chimneys have rusty-looking, tree trunk-like stems crowned by porous and friable white tips that commonly vent gray fluids through poorly defined orifices. A beehive smoker was selected for sampling of vent fluid (Tmax=272°C) and corresponding chimney material. This is Marker 1 site (x2802, y3234, z1675). The chimney field extends to the northwest in a line of tall, free-standing chimneys. Sulfide and volcanic rocks were collected from the central and western part of Roman Ruins and include inactive chimneys, chimneys venting 196°C, 236°C and 316°C fluids, and fresh volcanics. The eastern part of Roman Ruins

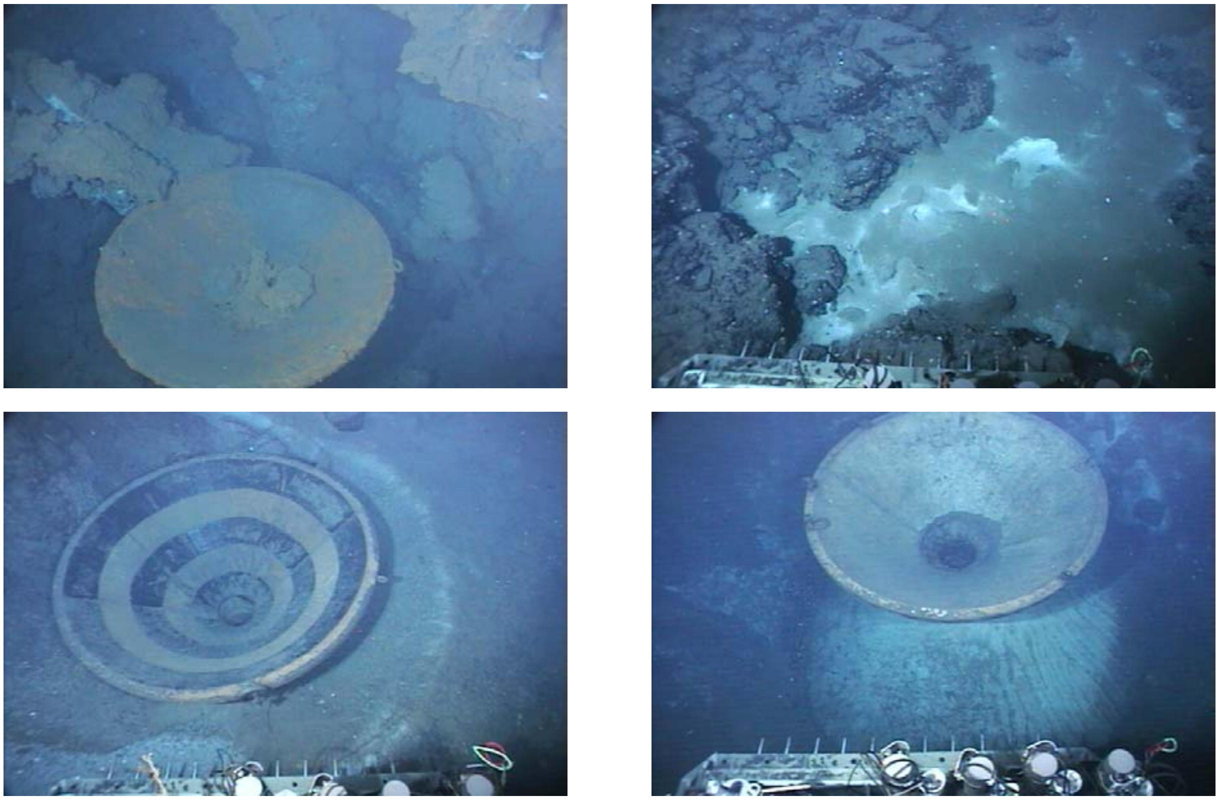


Figure 10. Framegrabs of various ODP holes visited by Jason in the PACMANUS hydrothermal field. Top left : Roman Ruins ODP Hole 1189B, Dive 208 (vvan 19103). Top right : Satanic Mills ODP Hole 1191A Dive 209, (vvan 23629). Bottom left : Snowcap ODP Hole 1188B Dive 210 (vvan 25388). Bottom right : Snowcap ODP Hole 1188F Dive 214 (vvan 36436).

is characterized by steep, rugged terrain of steep sided blocky lava flow, with several linear arrays of chimneys and clusters featuring focused and diffuse venting and rich biota. The majority of the chimneys seen are inactive and many are fallen or disintegrated into debris littering the slopes of the lava ridges. One chimney group in the NW part of the field consisted of a half dozen gray smokers and a small clear fissure vent, with 106°C fluid emerging from the several cm-wide crack in volcanic rock. A few meters away is a gray smoker with a fragile beehive-top venting 277°C fluid. The highest vent fluid temperature measured was 316°C at Marker 4 site in the westernmost part of the field, which is situated on the top of a smooth round volcanic mound, that contrasts with the rugged topography in the eastern part of the field. The southern part of that mound is crowned by a line of tall inactive chimneys. Dive 213 returned to the Marker 4 site and sampled a tall orange-stained chimney venting gray smoke at x2722, y3161; max Temp 278°C.

Fluid sampling at Roman Ruins was completed during Jason dive 222 with the collection of fluids from one of the isolated active chimney complexes, venting black and gray fluids through chimney with varied shapes and heights, up to 10 m tall, located north and northwest of the main Roman Ruins site. In addition to the chimney activity, that area is characterized by large and active oxide mounds venting fluids as hot at 88°C (e.g., Marker 20 site, x2699, y3295, z1702). A large chimney wall consisting of several chimneys that were fused together is exceptionally active with emanation of billowing black smoke, too intense to permit sampling. Just south of that site, more black smoker activity was encounter through large multiple meter tall tree trunk type of smokers along with small stubby chimneys. Black smoker fluids/solids with Tmax=341°C are recovered at this site (Marker #18; x2764 y3264 z1679). Multiple samples or inactive chimney sulfide, rock talus (all sulfide) and volcanic basement rocks were also collected from the Roman Ruins site.

An SM2000 high-resolution sonar survey comprised the second half of Jason dive 213 and the first half of Jason dive 215. The result is a highly detailed map that shows individual chimney complexes and geological features such as mounds and flow front at high resolution (Fig. 11).

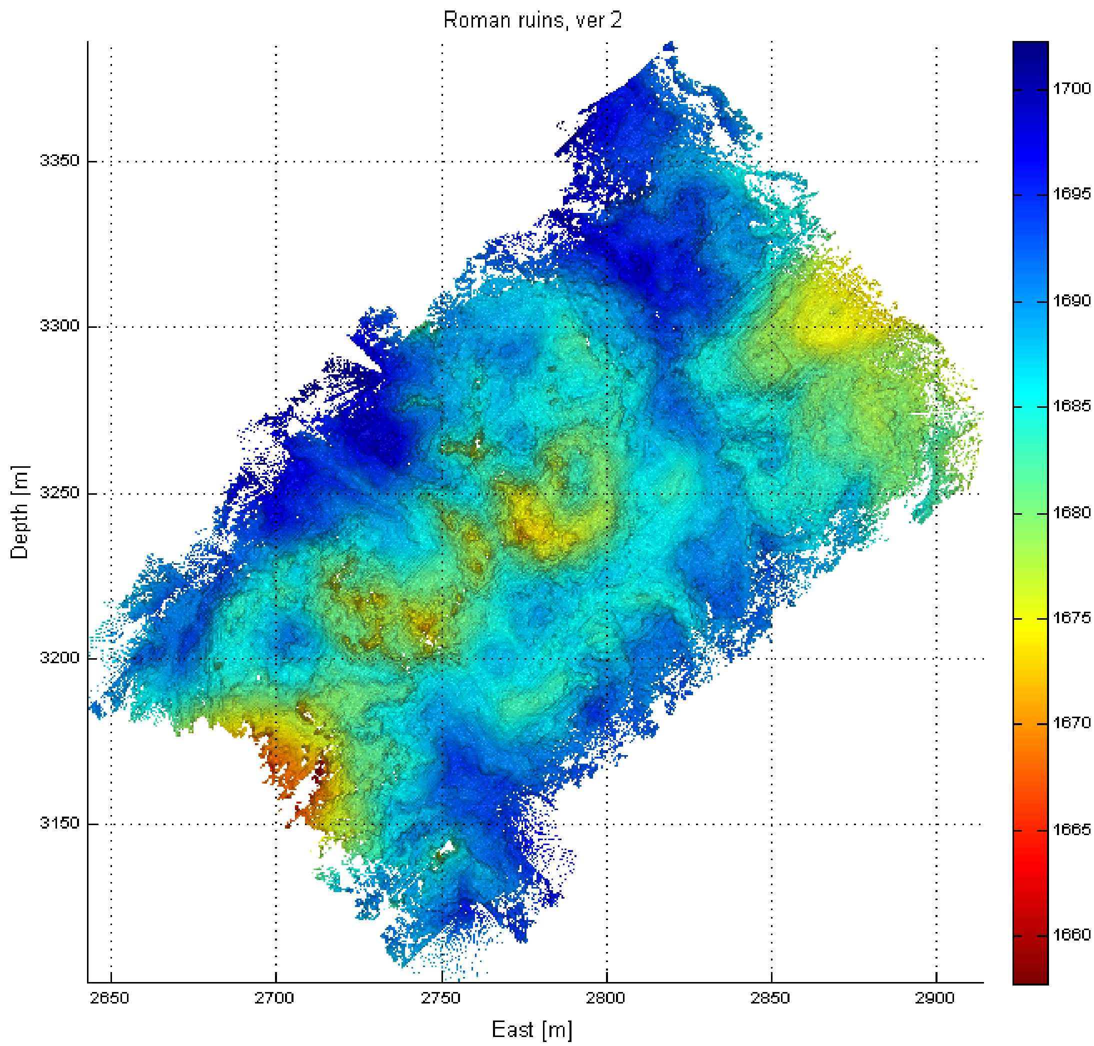


Figure 11. Preliminary image of high resolution sonar bathymetry of the Roman Ruins vent area collected by Jason surveys.

Roger's Ruins can be regarded as the northernmost extension of Roman Ruins. It consists of two chimney clusters – a larger one in the SW and a smaller one in the NW – that are about 30 m apart. Roger's Ruins is located approximately ~20 m deeper than Roman Ruins on the northern slope of Pual Ridge. The main chimney complex - a 15-m diameter cluster of largely inactive chimneys, with diffuse venting through oxide mats around its base - appears to be confined to a circular mound of blocky lava. A small multispired chimney complex in the area is vigorously venting black smoke (x2672, y3426, z1716; Marker 8). First visited during dive 208, fluids and solids were sampled at the main Roger's Ruins smoker complex in the vicinity of Marker 8 during dives 213 and 222. Samples comprise a black smoker fluid venting at 320°C as well as a gray smoker fluid, a diffuser chimney venting 202°C clear fluid, and fluids and active/inactive chimneys pairs venting 274°C gray smoker fluids.

Reconnaissance surveys of the areas NE and SW of Roman and Roger's Ruins observed lightly sedimented rough and blocky lava terrain and several distinct steep-sided flows or coulees. Areas of suspected hydrothermal activity (based on previous reports or magnetometer data) in the NE turned out to be sedimented lava flows with no obvious hydrothermal deposits or venting (see dive tracks of Dives 213 and 222; Map 19). An area 1500m NE of Roman Ruins looks particularly interesting in terms of low Eh and high optical backscatter anomalies, but a brief survey of the site during dive 215 found only low-T activity and oxide mounds. The area of a prominent volcanic rift zone SW of Roger's and Roman Ruins was explored during dive 222. This zone is particularly well imaged in the ABE map. Steep fault scarps with fresh talus on the bases are developed here in otherwise heavily sedimented terrain. Volcanic flows and talus were sampled to provide geochemical and magnetic reference data.

Satanic Mills

The terrain hosting the Satanic Mills vent field is characterized by steep slopes of lightly sedimented felsic lava flows with big, broken up sheets of lava with ropey to irregular and rough surface (Map 20). Steepest parts of slopes are draped with elongate and striated lava sheets/fingers that are also broken up. Overall, the lava is massive and blocky to slabby. The chimney clusters are small and not particularly active. However, diffuse venting is common in the area with vestimentiferans, mussels, snails, shrimp and galatheid crabs, and scaleworms and locally intense red and white staining, due to microbial mat formation.

A large chimney field has large inactive structures with rusty outer surface and colonies of barnacles and anemones. Few small spires are active; one that is venting dark gray smoke was picked for fluid/solid sampling. The spires are part of a multi-spired complex that is 6-7 m high. Fluid sampling with gas-tight samplers records temperatures between 293 and 295°C. A massive chimney with a thick stem and a mushroom-like cap that is colonized by snails and appears to be composed of coalesced diffusers is the central landmark of this chimney field (Marker 3 was deployed here). A triplet of small active chimneys in an area of white staining was sampled for fluids/solids. Maximum vent fluid temperature was 240°C at the site labeled by Marker #5. A third fluid-chimney pair was sampled during Jason dive 214 at x2454, y2601, z1682 with a maximum temperature of 288°C for the gray smoker fluid.

A white sediment pond at x2474 y2567 probably marks the location of Hole 1191A (x2477 y2567; Fig. 10), which was a bare-rock spud-in. The pond appears to be a deposit of drilling mud and borehole cuttings, with white microbial floc. The area is warm (15°C), and probably harbors microorganisms, and may reflect fluid flow out of Hole 1191A.

A white, brecciated and veined rock was sampled near the base of an escarpment during Jason dive 209. It was talus from a group of light-colored rocks mass-wasting away from the scarp. A similar sample was recovered from an escarpment 20 m south of the sampled 295°C fluid venting site. It represents gray to white clay-altered and sulfide-veined stockwork cropping out underneath an extinct sulfide chimney. See Tables 6 and 7 for a complete sample summary.

The southernmost extension of Satanic Mills is at about y2520. A transect from Satanic Mills to Fenway during Dive 214 shows that there is >100 m hiatus in hydrothermal activity in an area of sedimented lava flows, before encountering an extensive diffuse vent field that forms the northern extension of the Fenway field. Because of this spatial separation and the contrasting settings of the two fields (see below), it appears justified to call Satanic Mills and Fenway separate fields (Map 20).

Fenway

The Fenway hydrothermal field was discovered at the end of Jason dive 210, when a sharp Eh anomaly in the ABE survey map was investigated (Map 20). The core of the Fenway site is a 40 m diameter two-tiered mound, with a large black smoker chimney complex (Big Papi) forming the upper tier. The entire mound is composed of chimney debris, massive anhydrite-sulfide rock and anhydrite sand. Diffuse venting of clear to gray to black smoker fluids takes place in numerous locations along the base and up the slope of the Fenway mound. The area around the Fenway mound also features hydrothermally active in the form of extensive fields of diffuse venting, densely populated by crabs and mussel beds, as well as smaller chimney complexes, active and inactive, up the south and southeast facing slopes that bound the Fenway site to the north. The southern slopes of Fenway are covered with talus, mostly massive sulfide. The slopes to the NW, separating Fenway from Snowcap, are sedimented and the tops of knolls in that area are heavily colonized by microbial mats (white and red) that completely cover Fe-oxide and sulfur encrusted clastic rocks (breccia and hyaloclastite).

Two entire Jason dives (212 and 216) were committed to sampling at Fenway, and additional samples were collected from a small chimney complex NE of the Fenway mound during dives 210 and 214 (Map 20). A total of 11 gastight samples and 5 major fluid samples were obtained, 12 active sulfide samples, 10 inactive sulfide samples, 2 massive sulfides, 4 rock samples, 7 samples of massive anhydrite, 1 oxide crust, 1 volcaniclastite and 4 mound sediment samples were collected (See Tables 6 and 7).

The hallmark of Fenway is the black smoker complex that vents fluids of temperatures between 353 and 356°C, which corresponds to the boiling point of seawater at a pressure of 172 bar (i.e., 1710 m water depth). The boiling results in episodic pulsing and flashing of fluids venting from the orifices. Apparent shining or flaming of the fluids is caused by reflection of light, as this phenomenon disappears when Jason’s lights are turned off. Despite the vigor of black smoker activity, the main Fenway mound, including Big Papi, are only sparsely inhabited by shrimp with other vent fauna lacking completely. This observation, in addition to the large number of disorganized venting of black smoke through sediments without or through tiny incipient chimneys, suggests that the system is probably in a waxing stage of hydrothermal activity. Other fluid sampling at Fenway comprised 296 and 330°C gray smoker vents from the chimney cluster SE of Fenway mound, 340°C black smoker fluids from near the base of Big Papi, 284°C gray smoker fluid venting from Marker 7 site, only meters away from Big Papi, and 80°C venting of clear fluids from a fissure in the sedimented southern slopes of the mound (Marker 10).

Fenway is clearly fault controlled, as the seafloor in the larger Fenway area is either sedimented or littered with talus. Away from the Fenway mound, diffuse venting is most intense through rubbly talus fields that are thickly settled with crabs and mussels. The diffuse vent areas have commonly very sharp boundaries to inactive areas devoid of macrofauna. These transitions usually occur at a break in slope, again suggesting fault controlled fluid upwelling.

Snowcap

The Snowcap hydrothermal site is a large area of mostly diffuse venting in a smooth, dome-like terrain in about 1650 m water depth. A small active field at around x2150, y2430 at a depth of 1640 m is developed in the SW part of the Snowcap area (Map 20). The slopes bounding the Snowcap area are heavily sedimented with very rare lava outcrops; they commonly show heavy red and white staining. Locally, there are hyaloclastite fields near the top of the slope and small craters that appear to be the source of the clasts (x2235, y2432, z1638). The top of Snowcap features a virtually continuous sediment cover with common whitish staining and lesser red and rare lava outcrops that are completely covered with white microbial mats. Temperature probe measurements during Jason dive 210 into the white sediment cap reveal a steep thermal gradient of up to 20°C per meter.

The chimney field consists of two multi-spired complexes that show patchy diffuse and semi-focused venting about half way up the 6-7 m tall structures. Smaller solitary spires in the area are all inactive. The field sits near the termination of a NE trending ridge and is about 15 m SW-NE and 7 m NW-SE. Some chimneys grow out of fissures in hard rock basement. Overall, venting activity is minor. The area immediately north of the chimney field shows common diffuse venting and thick mats with occasional corkscrew worm colonies, snails, crabs, and rare mussel beds. There is no further hydrothermal activity in the area around the northern and shallowest part of Snowcap.

During Jason dive 210, Marker 6 was deployed at the site of first fluid sampling at Snowcap, a 151°C max. clear fluid venting from a Alvinella-colonized patch half way up a chimney. A second active chimney fluid/solid pair was collected during dive 211 from a chimney issuing clear fluids with Tmax=179°C. A flow of native sulfur was found and sampled in an area just SW of the chimney field. Another sample of native sulfur was retrieved from on outcrop 25 m NE of Marker 6. Hyaloclastite outcrops in gullies and slopes SW of the smoker field feature bleached altered rocks – probably representing the advanced argillic alteration type – that were sampled in several locations. Also sampled in numerous locations on the top of Snowcap, were slab-like pavements that turned out to be sulfur-cemented volcaniclastic material. The ODP drill cone of Holes 1188A (x2221, y2412) and 1188F (x2204, y2427) were located (Fig. 10) but none of these holes appears to produce fluids.

Tsukushi

The Tsukushi (Japanese for "cat tail") hydrothermal area is the southwestern most site of high-T venting within the Pacmanus field in about 1630 m water depth (Map 20). A Shinkai dive in 1996 found black and gray smoker activity here; however, the ABE Eh anomalies over the area were weak.

The Tsukushi chimney field, the main target of Jason dive 211, was found to be mostly inactive. It extends about 40 m E-W and comprises numerous structures that are simple, tall pillars (cat-tails) with white conical tips and occasional patches of snails. Rare diffuse fluids seep up through oxide stained cracks in the volcanic basement on which the chimneys stand. The sediment cover is generally light. Diffuse venting though oxide patches and a stubby oxide "chimney" is found in an area several 10's of meters across located north of the chimney field. The oxide field is hosted in a terrain of sedimented knobby lava flow. The site of most vigorous venting was sampled for fluids and oxide precipitates (Tmax=62°C).

The area to SW, S and N of the chimney field was surveyed to faithfully establish the spatial extent of Tsukushi. The volcanic center north of Tsukushi is the location of a magnetic high and was sampled during Jason dive 211.

North East Pual Ridge

The North East Pual ridge area 3° 40.5'S 151° 43.6'E was identified as a possible site of hydrothermal activity from a series of CTD casts (MH101-103, 105-107, 109,110) carried out during the cruise (Table 5). Located ~8 km north east of the Pacmanus vent field (Fig. 9), the CTD casts revealed a particulate plume that was distinctly separate from the distal plume from Pacmanus. We deployed ABE twice, dives 192 and 193 (Map 21) in the area of the presumed activity centered on a small axial ridge based on SeaBeam bathymetry (Fig. 9). ABE 192 revealed a number of Eh and temperature anomalies. The ABE 192/193 magnetic data (Map 22) show a well defined zone of reduced magnetization at the southern end of the central volcanic ridge coincident with Eh lows (x4900, y4550). This area was the objective of Jason Dive 218 (Map 23) which was to explore and sample the basement in the area of the pronounced magnetic low (x4870, y4550), to explore a mound at x4900, y4490, explore an area of Eh lows around x4900, y4380 and to investigate areas of temperature anomalies around x5550, y5500 if at all possible.

The area of the magnetic low is hydrothermally active, but appears to be waning because the only active flow is diffuse shimmering associated with snails, crabs, shrimp and mussel beds, white microbial mats, and oxide crusts. One location with a few relict sulfide chimneys provides evidence that more vigorous activity was present in the past. Overall, sampling activities resulted in one complete set of fluid samples (T maximum = 35°C) with a paired scoop sample of oxide crust and sediment; 1 relict sulfide chimney sample; and 4 volcanic rock samples (see Tables 6 and 7).

The hydrothermal activity extends for a length of about 100 m along a seafloor lineation that may be a fault. The Eh readings dropped considerably while Jason was working in the vicinity of this diffuse flow. The relict sulfides were near the middle of the area, while the oxide mounds with 35°C flow that was sampled are located toward the western edge of the survey. Just east of the hydrothermal activity is a volcanic mound with a small crater that was explored during the dive, but hydrothermal activity did not extend up onto this volcanic mound or into its crater.

A location where a CTD cast (MH-105) detected a plume 500 m east (x5500 y4600) of the low-temp. area, was visited during the Jason dive with no observations of hydrothermal activity. The remainder of the dive was used to investigate the location of a temperature anomaly detected by ABE, about 800 m north (x5500, y5500). No hydrothermal activity was found at this location (Map 23).

Desmos

The DESMOS caldera was discovered in 1990 during a Japanese cruise [*Gamo et al.*, 1993] and was known to be the source of strong water column anomalies [*Both et al.*,1986; *Craig and Poreda*, 1987]. DESMOS (named after the Japanese Deep Sea Multi-monitoring System used to map the area) is located ~20 km east north east of the PACMANUS field at 3° 42' S, 151° 52.3'E (Fig. 12) and was visited by a joint Japanese-French Shinkai 6500 program in 1995

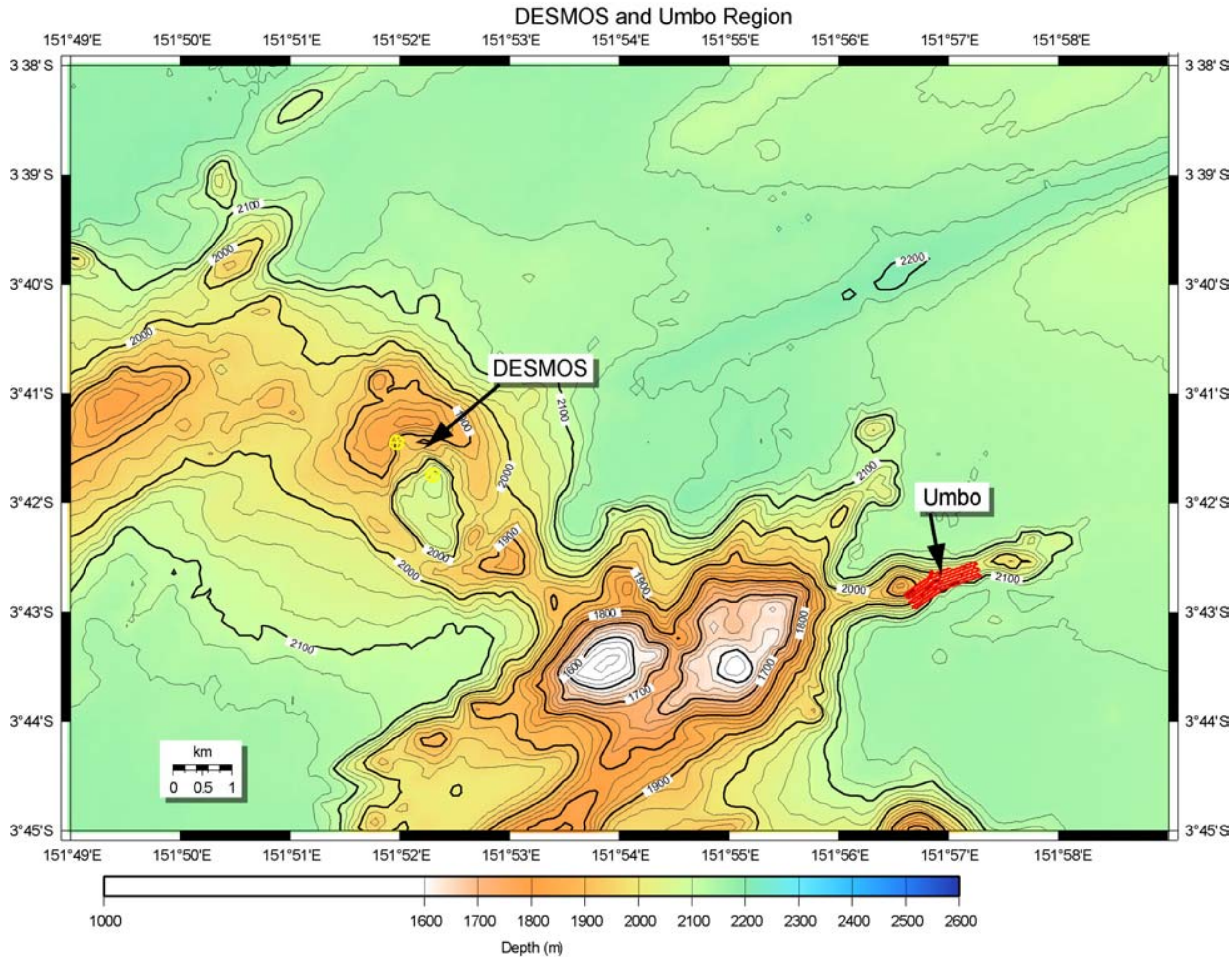


Figure 12. SeaBeam bathymetry map showing the DESMOS caldera and Umbo Ridge areas. One Jason dive (220) visited DESMOS while two dives (228,229) visited Umbo. Red lines show extent of ABE mapping in Umbo area. Yellow circles indicate the Onsen (north) and Genge-Ba (south) hydrothermal sites at DESMOS.

[*Auzende et al.*, 1996a,b; *Gamo et al.*, 1993,1997) who found that this 300 m deep breached caldera hosts highly acidic hydrothermal activity. We did not conduct any ABE mapping surveys at this location and so our basemaps are based on SeaBeam data collected over the area (Map 24). Jason Dive 220 dove on the DESMOS caldera (Map 25) and explored an area on the northern caldera wall, including the Onsen hydrothermal site previously reported on by *Gamo et al.* [1997]. Jason reached bottom at 3° 41.80' S, 151° 52.30'E in 2080 m water depth, and then headed in a northwesterly direction towards the Onsen site located at 3°41.50'S, 151°51.92'E in 1900 m water depth. The lower slopes of the caldera wall are composed of monotonous, sediment-dusted pillow lava, of which one sample was collected. Further up the slope several terraces strike roughly E-W. Shortly before we reached the main terrace, visible in the SeaBeam map (Map 25) we came across scattered clam shells and occasional crabs, but could not locate the source of the clams or any significant hydrothermal activity.

The main terrace features flat seafloor with the hyaloclastite deposits, both altered and unaltered clasts, and variable sediment cover. Continuing to the NW, are heavily sedimented fields with abundant white microbial mats, not unlike the top of the Snowcap dome. That area is followed by another field of mainly fresh hyaloclastite with extensive patches of bleaching and staining. Just SE of the Onsen site is a field of fresh hyaloclastite with patchy diffuse venting and thousands of crabs. The Onsen site is the source of intense white smoke that covers large parts of the near vertical caldera wall that borders the field to the north. We find the Japanese location coordinates to be correct within the accuracy of our doppler-based navigation. The Onsen site itself is small, maybe 30 m across, and is nestled in a half-bowl framed by steep outcrops of hydrothermally altered pillow basalts and hyaloclastite or talus that form a crescent-shaped base. Near the base of the slopes, talus seems to be more common than in the flat area of the terrace to the SE. Four fresh rock samples, 10 altered rock samples and 2 sulfur samples were collected (see. Tables 6 and 7 and Appendix 1). Some of the pillow flows appear rather recent, as they flow over talus.

Fluid samples were collected from a white smoker emitting 119°C fluids. A rock and a precipitate scoop sample were also collected at this same site. Another fluid sample was taken of 72°C diffuse fluids venting from a fault wall only meters north of the white smoker field which is completely coated with microbial mats. Exploration of the upper reaches of the headwall of the caldera enables sampling of outcrops exposing variably altered and mineralized pillow lavas. A strange tufa-like feature is composed of brittle foam of glass completely encased in red Fe-oxide floc. Another sampling highlight was the recovery of native sulfur from a volcaniclastite or talus spine just northeast of the bowl hosting the Onsen hydrothermal vents.

Su Su Knolls - Overview

The third broad area of concentration studied was Su Su Knolls, located about 45 km east of PACMANUS. Su Su Knolls, originally discovered after PACMANUS in the 1990s, was the name given to two closely-spaced prominent seamounts (Fig. 13). Another, smaller bathymetric mound feature to the NNW, Suzette, was mapped in detail by commercial exploration efforts only recently and is referred to by Nautilus Minerals as the Solwara-I prospect.

Several ABE dives were completed over this area. ABE dive 189 mapped the Suzette mound region while ABE dives 194, 195 and 198 completed mapping over both North and South Su volcanic cones (Fig. 13). Jason operations at Su Su Knolls encompassed dives J2-217 (Suzette), J2-219 (Suzette), J2-221 (North Su), J2-223 (North Su), J2-224 (South Su), J2-225/226 (Suzette sediment trap deployment), and J2-227 (Surprise area, South Su and North Su). We summarize the dive results for each of the areas grouped by location in the following section.

Suzette

The goal of the Jason dives was to collect solids and fluids from the Suzette hydrothermal field, specifically at the site locations of known sulfide chimney structures provided by Nautilus Minerals, who have mapped and sampled the field extensively. ABE dive 189 was completed over Suzette mound (Map 25) ostensibly to collect magnetic data (Map 26) at a line spacing of 50 meters and altitude of 50 m. The ABE magnetic data shows reduced magnetization over the northeastern portion of the mound where a NW-SE trending linear array of sulfide chimneys are located. A contrasting magnetization high is located to the southwest portion of the mound indicating potential for subsurface volcanic substrate.

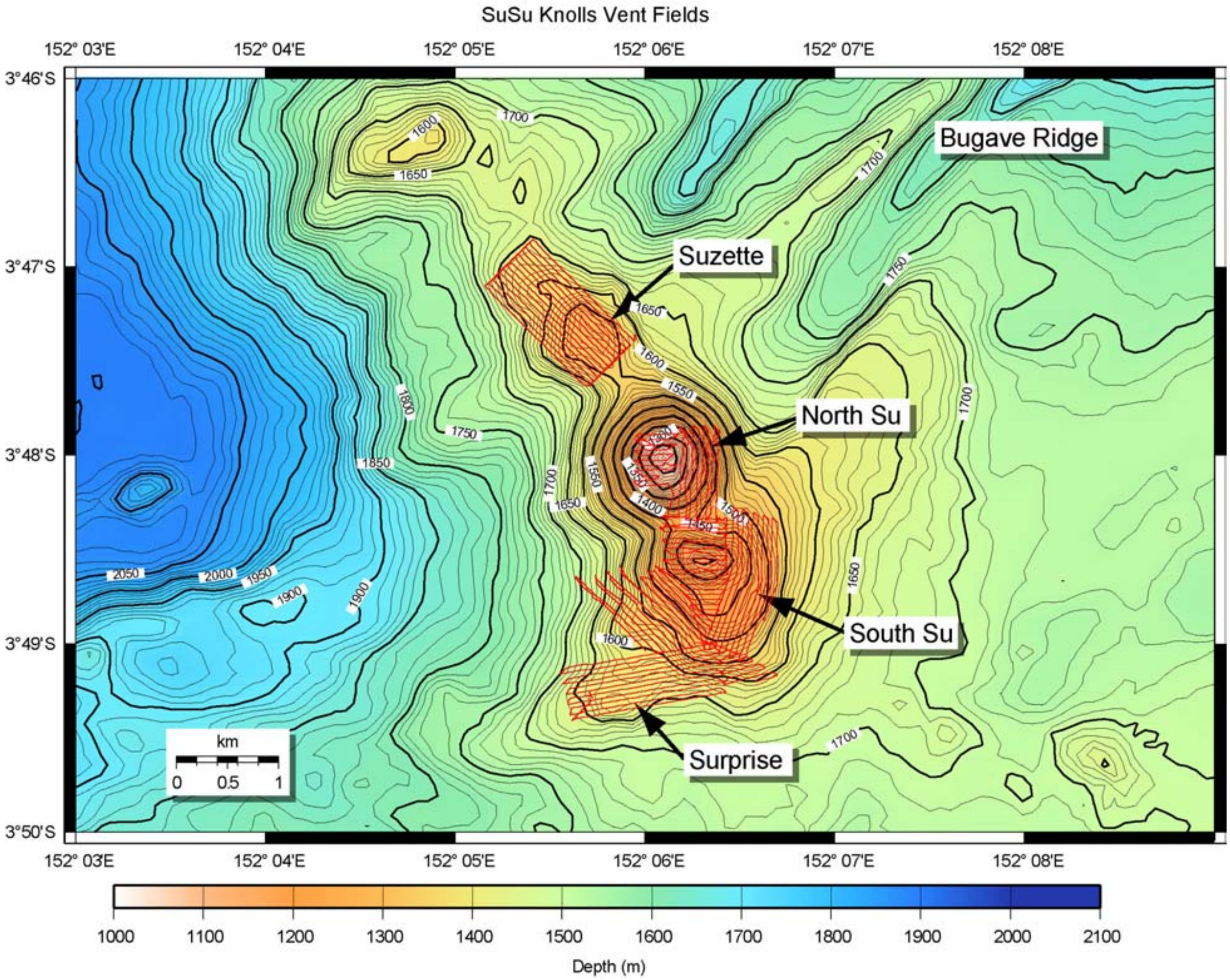


Figure 13. SeaBeam bathymetry map showing the SuSu Knolls area. Red lines show extent of ABE mapping with one dive over Suzette and 3 dives over the North and South Su areas.

The Jason dives collected 6 complete sets of water samples with paired solid chimney samples were collected, with fluid temperatures of 302°C, 288°C, 274°C, 228°C, 226°C, and one that varied widely between 60 and 250°C. In addition to those six active sulfides, another 11 active sulfide samples were collected (with temperature measurements), along with 2 inactive sulfides, 10 sulfide talus pieces, 3 volcanic rock samples, and 1 sediment sample.

Jason dive 217 (Map 27) began in a heavily sedimented area with patches of dead snails and proceeded in a northwesterly direction towards a circular mound entirely composed of sulfide, mostly fallen chimneys, but with a few chimneys still standing and reaching up to 7 m in height. This is the “forest” field that sits atop the mound. The base of the mound has bacterial mats and a fissure emitting clear fluid at >76°C and is colonized by alvinella worms and shrimp. The top of the mound is an active chimney field with focused venting of clear to dark-gray fluids through multi-spired chimney complexes that are densely colonized with snails (*Ifremeria* and *Alviniconcha*). A gray smoker with multiple chalcopyrite-lined orifices and a beehive-type diffuser just next to them provided a full sample set (two IGT bottles, one majors bottle, and a solid sample of the orifice, J2-217-2-R1); fluid temperature was 302°C and the outside of the chimney wall was 13°C. A mostly-sealed chimney, gently diffusing, was also sampled (J2-217-

2-R2), as well as a small fragile chimlet adjacent to the orifice that was sampled for fluids (J2-217-2-R3).

To the west of “forest” is a fault scarp exposing sulfide debris, and beyond that a 14 m-tall inactive chimney. A nearby active chimney with beehive structures at the top yielded a solid sample (J2-217-3-R1) and it produced 280°C fluid. Nearby is another set of chimneys with gray to black smoke and measured temperatures of 290°C and 288°C.

Heading northwest for about 120 m to the summit area of the Suzette mound, inactive spires were noted that had perhaps been sampled previously by Nautilus. Shimmering water emanating from a crack gave a temperature of 83°C. The sediment is rippled. There are patches of oxide crusts and altered sediment, with vigorous shimmering water and snails. At the Suzette summit, a low lying volcanic rock outcrop was sampled (J2-217-6-R1; x3185, y4867). Then the dive continued northwest toward black smoker targets, passing rippled sedimented terrain on the way.

Old dead chimneys poked up through sediment, their underlying debris completely buried in sediment. Heading NW and upslope, many more small chimneys were seen, some emitting shimmering flow, amid patches of sediment densely colonized by snails. There is a picket of sulfide chimneys, most inactive, oriented roughly N-S. Some of the chimneys are colored white in the upper halves, and there are some tall skinny beehive structures that are diffusing hot fluid. Nearby is a very dense forest of dead chimney trunks. A 296°C beehive is sampled accidentally by bumping into it (J2-217-7-R1; x3016, y4929). A temperature of 250°C is measured at a clear-fluid orifice among snails on another chimney (target 10). Two small 1-2 cm pipes emitting clear fluid are sampled (J2-217-9-R1) and measured (T=260°C). Many of the larger pinnacles here have subhorizontal cracks highlighted by white microbial material. Atop one of these pinnacles is a large beehive that gave a temperature of 276°C, and next to it a small sulfide nubbin. The nubbin was sampled (J2-217-10-R1), and a complete set of fluid samples was taken (T=274°C).

Jason now headed in a northeasterly direction, passing a massive 12 m-tall chimney with subhorizontal white cracks. An outcrop with white veins is sampled, and this turned out to be massive sulfide, probably from stockwork underneath a chimney (J2-217-11-R1 and R2; x3042, y4971). Three conical features oriented SSE-NNW are clusters of mostly inactive chimneys up to 11 m tall. Hydrothermal sulfide talus from the base of these contains probable secondary atacamite (J2-217-12-R1). Temperature measurements of clear-fluid chimneys at the most active (NW) part of the edifice are 220 and 226°C. A sulfide sample here is very fragile (J2-217-13-R1, Marker 11; x3047, y4998). The slope beneath this edifice to the east is rippled sediment, contains many snail shells, and is marked by a conical depression possibly related to Nautilus drilling operations.

Jason dive 219 (Map 27) began in a sediment covered area on the western flank of Suzette (x2500, y4800). Moving east there was a solitary old dead sulfide chimney poking up from the sediment, with just a couple of broken ones near the base. Further east, the ground slopes upward and is stained with white bacterial mat and orange Fe-oxide. Then, steepening, the sediment gives way to mass-wasting rock with sporadic outcrops. There are long cracks, a few cm wide, running across the mass-wasted outcrop – two or three run up and down the hill, and at least one runs across the hill – that are highlighted white with microbial material. At a break in slope there is a horizontal white sulfide flange outcrop about 4 square meters, heavily populated by crabs and worms of several types. Shimmering water oozing out from underneath the flange is 52°C, and a small nubbin on the flange (J2-219-1-R1; x2527, y4808) and the flange itself (J2-219-1-R2) were sampled, as well as a scoop of clayey sediment from downhill (J2-219-1-R3).

To the east are heavily sedimented mounds with numerous inactive chimneys. Further east is an area of low-T diffuse venting in a field of oxide mounds, and two pavement-like features with white veins that make them look like turtle shells. At the targeted active chimney field a beehive-type chimney, after clearing of the beehive, issues black smoke from a chalcopyrite-lined stump at a temperature of 283°C. A full set of bottles was fired to collect fluid samples (T measured of 280 and 288°C), and a solid sample collected (J2-219-2-R2, marker 12; x2729, y4725). This chimney field features "hundreds" of 5-10 m-tall chimneys. A gray smoker was measured at 294°C. An active orifice was then sampled (J2-219-3-R1) and a temperature measured (280°C).

Continuing east, many chimneys in a sedimented bottom were seen. A low lying block of possible outcrop was sampled (J2-219-4-R1), and more sulfide chimneys in sediment are seen. A larger sulfide complex features some shimmering water along with bacteria and biota, and a nearby rock gives two sampled of sulfide talus (J2-219-5-R1 and R2; x2920, y4774). More dead chimneys with only some shimmering water continue to the east. Next the dive track descends NW into a sedimented depression, and emerging from that there are sporadic chimneys, talus blocks, and a small sulfide spire complex. Farther north is a small valley where a push core attempt is foiled by a lack of sediment cohesion.

Jason Dive 219 traversed east across the mound to the northeastern corner where Jason dive 217 ended. Jason ascended a small hill where small conical spires poke up through the sediment followed by an increasing amount of sulfide rubble. The summit of this hill is the location of numerous sulfide chimneys. Two small white chimneys are measured with the T-probe and gave 132 and 55°C. A white flange at the summit is producing clear fluid from below it. There are many large clusters of massive extinct chimneys (typically 10 m high, individuals 1-2 m wide, and clumps 3-5 m across). Active vents are few, identified by local clusters of snails and shimmering water. The "normal" biology of sponges, anemones, gorgonians seem to be absent, even though there are good places in the current for attachment. Two small chimneys give temperatures of 233°C (target 15) and 200°C (target 16). The latter chimney is sampled (J2-219-10-R1; x3118, y5046), and two IGT samples are taken (T = 228°C).

The dive continued off this small hill down the eastern slope of Suzette traversing over mostly sedimented terrain eventually heading south back towards the summit of the mound. A large pillow flow was sampled at x3195, y4940 (J2-219-11-R1). A small knoll to the south on this east-facing slope of the mound has hydrothermal seepage at 80 and 125°C through a turtle-back like pavement. A little chimney crowning the pavement was sampled (J2-219-12-R1; x3226, y4916).

Jason dives 225 (short dive) and 226 were dedicated to deploying an ADCP at the summit of Suzette and six sediment traps around Suzette (Map 27). The ADCP was deployed on Jason dive 225, and the sediment traps were deployed during the first part of Jason dive 226. On the N-S crossing of Suzette after deploying trap #3, an attempt was made to sample an old chimney, but it failed. A block of talus that contained significant chalcopyrite was picked up (J2-226-1-R1; x3317, y4862).

After all the trap deployments, the dive continued to sample the turtle-back outcrop at marker 9 (x3247, y4909) on the east flank of the Suzette mound at the lava flow sampled in the earlier dive (J2-219-11-R1). Maximum temperatures of the clear fluids venting from the turtle-back area were between 147 and 153°C. Fluid samples were collected at a site where 125°C fluid was flowing up the edge of the pavement/flange. The IGT thermocouple measurements, though, were highly variable (the first bottle read 157°C, but dropped to 60°C; the second bottle was 189°C, but it increased to 250°C during sampling). A piece of the turtle pavement/flange was sampled (J2-226-2-R1).

Jason dive 226 then headed across Suzette toward an ABE Eh and optical backscatter anomaly. The terrain is heavily sedimented, until a steep scarp with toppled sulfide chimneys is encountered and which were visited during Jason dive 217. Continuing first NW, then south Jason skirted around a chimney complex with a platy sheet-like coating forming sulfide-cemented apron at the base of a chimney. A sample was taken of this platy material (J2-226-3-R1, x3013 y4943). Continuing south, chimneys diminish and sediment prevails. Going SSW, a solitary "topped" chimney complex emerges from the sediment. Then, going down slope to the NW the sediments continue. There is a ridge possibly made of lava, and some sulfide talus. Further west a talus ramp of sulfide pieces ascends to a local high, a sedimented bench with increasingly abundant Fe-staining. A 1-2 m-across sulfide flange complex with a few small central chimneys is located, and a temperature measurement of 210°C is made on one small orifice. A chimney was sampled in three pieces (J2-226-4-R1 through R3) and a set of water samples taken (T=226°C). An associated flange was also sampled (J2-226-4-R4; x2694, y4750).

To the west, the sulfide shelf/flange outcrop from the beginning of Jason dive 219 was revisited. Samples were taken of the shelf (J2-226-5-R1), and a different shelf 10 m away (J2-226-6-R1), as well as a blocky sulfide outcrop (J2-226-7-R1; x2547, y4776). Moving ESE there was sedimented terrain with some talus. A light-colored piece of talus (J2-226-8-R1) and a volcanic rock (J2-226-8-R2; x2775, y4594) were sampled.

North Su

ABE dive 194 mapped the summit region of North Su and South Su (Fig. 13). The southern flanks of South Su were mapped on ABE dive 195 and after two aborted dives ABE dive 198 completed an "in-fill" survey to complete a bathymetric picture of the Su Su edifices (Fig. 13; Map 28). The ABE mapping of North Su reveal a circular cone with no obvious summit caldera or pit crater. The summit of North Su culminates at a depth of 1154 m and both CTD casts over the summit of North Su (MH-104, 119, 125) and ABE's plume mapping reveal active vent systems at the summit and on the flanks of the volcano. Magnetically the entire Su Su Knolls area is only weakly magnetic with the summit of South Su being the most reduced region (Map 29).

Three Jason dives (221, 223 and 227) visited North Su made observations and took samples (Map 30). This volcano is very active hydrothermally, with so many white-smoking vents on the flanks that "white-out" conditions prevailed in some areas. Activity on the flanks was dominated by diffuse venting and more concentrated white venting. Black smokers were present at the summit and along a high ridge approaching the summit from the west. Overall, samples at North Su included 6 sets of fluid samples at temperatures of 324°C, 300°C, 298°C, 240°C, 215°C, and 48°C. Five of those sets have solid sample pairs associated with them. In addition, there are 4 more active sulfide orifice samples, 6 active sulfide flange or sulfide ledge samples, 3 relict sulfide chimneys, 9 volcanic talus samples, 7 volcaniclastic rock samples, 1 anhydrite cement sample, 2 sulfur samples, and 2 scoop samples.

Jason dive 221 began on the west slope of the conical volcano (x3600, y3400). There, the seafloor is sedimented but littered with volcanic clasts up to the size of several 10's of cm in diameter. Red and white staining of the sediment surface indicates microbial activity. A solitary steep bathymetric target on the SW flank of North Su is a huge massive rock sticking up from sediments vertically about 15 m, and is possibly a volcanic spine or dike. There is minor diffuse venting along its base. The macrofauna in the SW flank area consists of pink shrimp and fish, including eels. Up slope to the north there is more talus covering the sediments, then a vertical wall that trends NNE and forms the prominent ridge visible in the ABE map. The wall is massive volcanic rock; and along its base there is a site of white smoker activity. Native sulfur forms flanges where it appears to have oozed out of the massive rock. Just W of the massive rock is white smoker activity in a volcanic debris field where black and yellow sulfur splashes litter the sediment surface. Fluid temperatures of only about 20°C were recorded, but when the T-probe was stuck into the sediment, the temperatures rose up to between 272°C and 284°C. The T-probe was covered with sulfur when retracted from the sediments. It appears that the sediments are saturated with liquid sulfur and the white smoke is seawater that gets flash-heated in contact with the liquid sulfur. A piece of altered rock on top of these liquid sulfur-saturated sediments was sampled at the end of this dive (J2-221-15-R1), as was a piece of fresh volcanic talus nearby (J2-221-15-R2).

Further up slope, following the base of the wall, 20°C fluids vent from a collapsed roof of a pillow flow. White smoke issuing from a crack in a steep volcaniclastic slope provided a set of fluid samples with temperatures of 45 and 48°C. Some distance away, samples of friable volcaniclastic rock were obtained (J2-221-4-R1 and R2), and in another area a maximum 215°C white smoker was sampled for a complete set of fluid samples and an adjacent piece of rock talus (J2-221-5-R1).

Because of white-out conditions, the next view of the seafloor was abundant Fe-stained flocculent material ("floc") on almost vertical walls and promontories of outcrop (rock sample J2-221-6-R1). After more white-out time, the smoke cleared and more sampling of the scarp, which is friable volcaniclastic material, took place (J2-221-7-R1). Higher up there is a sedimentary flow-like deposit (clasts in a finer matrix) and then a brecciated flow front (sample J2-221-8-R1). Reaching the summit, there are black smokers. The hydrothermal field is dominated by an 11 m-high structure with multiple orifices with beehives, both at the top and up along the sides. Smaller active chimneys and many inactive ones form along a N-S trending ridge. One small delicate black smoker was measured at 302°C, and the broken orifice had chalcopyrite lining. A relict spire was sampled (J2-221-9-R1), and then an active chimney (J2-221-9-R2) that had a T of 286°C. Following the ridge to the NE, beyond the 10 m-tall active chimney, there are numerous relict chimneys, then a small group of active black smokers. At the summit, the chimneys are located on top of a broad convex shield of sulfide-cemented flange-like material which is undercut and has hot fluid (T=68°C) leaking out from under it. Samples of the slabby sulfide ledge (J2-221-10-R1 and J2-221-12-R1) and a scoop sample of soft, disintegrating material below the ledge (J2-221-11-R1) were obtained.

The terrain off summit to the SE is a mixture of volcaniclastic scree slopes and extremely jagged massive pillar-like outcrops. Both this and the summit area are eerily dusted with white flocculent material, similar to that at Snowcap. There are abundant fish, shrimp and galatheids. In a cirque-like feature there is a barren scree slope with several white-smoking vents. One 71°C vent has a short white sulfur-rich chimney construction which provided sample J2-221-13-R1. The nearby scree slope contained a gray volcaniclastic rock (J2-221-13-R2), and another piece of breccia is sampled from the slopes to the east (J2-221-14-R1).

Jason dive 223 commenced by relocating the summit black smoker complex. The 11 m-tall chimney complex, colonized with shrimp and crabs, was sampled about half way up where a 300°C black smoker orifice and a complete set of fluid samples was obtained (J2-223-1-R1). Then in the area west of the summit a 90°C clear fluid vent emerged from a hole in the ground, just below the pavement that was sampled during dive 221. The sediments immediately adjacent to the hole are 54°C. The N side of the summit had white-out conditions, and the NE flank of the volcano has outcrops of massive volcanic rock (J2-223-3-R1) forming a ridge like a dike. Further down slope there is diffuse 32°C and 23°C venting through talus, with snails, barnacles, crabs, limpets, eel-like fish, miniature tubeworms and scale worms.

Following the 1200m depth contour to the SE, the appearance and faunal composition changes dramatically as fields of acidic white smoker activity are approached. A diffuse flow patch has many fewer mollusks and no fish, barnacles, or tubeworms, but features extensive white mats and pink shrimp in addition to the white shrimp seen before. Further to the SE diffuse sites have even thicker white mats, very few snails and shrimp, but numerous crabs.

Continuing south around the volcano there is a large promontory outcrop jutting out from the slope, where sample J2-223-5-R1 was obtained. Moving west there was a steep scarp and several very steep almost vertical cliffs and overhanging cliffs. The rock outcrop is universally a reddish coarse volcaniclastic breccia. Some whiter areas look like sulfur-cemented debris forming a coating on the slope. In an area of large volcanic breccia boulders, a small linear crack in the outcrop featured white bacterial growth on either side. The temperature here was 59°C, and a rock sample was taken (J2-223-6-R1). Another knob of volcaniclastic rock was also sampled (J2-223-7-R1) prior to ascending to the summit.

Moving off-summit to the north there are lava flow units and then a smooth surface of consolidated breccia and hyaloclastite. An Fe-stained platy piece was sampled (J2-223-8-R1). Further down slope there is a promontory with a sulfur flow ledge (J2-223-9-R1) and a vesicular volcanic rock (J2-223-9-R2). To the NE there are white bacterial mats with shimmering water on talus and two m-high chimneys. Talus from the base of these chimneys was sampled (J2-223-10-R1, marker 17).

Moving west, there was shimmering water emerging from a slit-like orifice in a rock with bacterial mat at a temperature of 102°C. Beyond this to the west is a barren scree slope covered in white and yellow crust. A set of water samples was obtained from under this surface crust, with temperatures of 240°C and 202°C (J2-223-11-R1 is a rock sample adjacent to the second water sample, and J2-223-11-R2 is a scoop bag sample from the site of the first water sample). The barren scree slope leads down to a 1-m scarp-like drop-off that is producing 89°C fluid. The rock exposed in the scarp is extremely hard pyrite-cemented vocaniclastic breccia (J2-223-12-R1 and R2). 20 m to the west along this scarp/ledge is an active sulfide flange with 212°C fluid (flange sample J2-223-13-R1). Up the slope there is volcanic talus, and one crack with white mat around it emits fluid at 82°C (J2-223-14-R1 is a sample of the white-coated rock).

The western flank of North Su has patchy diffuse venting concentrated around large boulders and outcrops of poorly sorted breccia. Overlooking this area is a ridge with a mound and a black smoker issuing from a pavement-like feature that caps the breccia rock. A few meters SW is a tall chimney complex that is vigorously venting black smoker fluids through multiple orifices. About half way up the temperature is 319°C and multiple fragile orifices are emitting flashing fluids. Multiple pieces of friable chimney fell into the basket during recording the temperature and sampling the orifice with a major bottle (J2-223-15-R1) and a piece of the chimney wall below the orifice was recovered after fluid sampling was completed (J2-223-15-R2). The chimney field extends for about 10 m to the SE and from there 20 m to the north and features mostly inactive, small chimneys and a fauna that is dominated by shrimp and crabs. About 50m SE of the chimneys there is a similar gully with only diffuse venting and little biota (a piece of talus from there is J2-223-16-R1).

The large hydrothermal pillar was sampled again at the end of dive 227. Approached from below and from the west, the pillar is part of a steep ridge that overlooks a bowl-shaped depression covered in scree. The pillar has a well-defined black smoker area active about half-way up from the base, the temperature of which is 299°C. The chalcopyrite-bearing orifice is sample J2-227-7-R1. The pillar itself appears to have volcanic cobbles and boulders, and sample J2-227-7-R2 (x3751, y3697) is the material cementing these clasts together, made of anhydrite and sulfide. Although the volcanic cobbles/boulders could not be sampled, a piece of volcanic talus was sampled later from near the base of the structure (J2-227-12-R1). Moving to the top of the pillar, the flashing orifices provide a complete set of fluids (T=324°C) and a scoop sample of possible solids (J2-227-8-R1; x3752, y3698).

A relict spire was sampled on the way to the North Su summit (J2-227-9-R1). At the summit, a set of fluid and paired rock samples was taken from a small chimney (T=298°C, J2-227-10-R1), and a nearby relict chimney for comparison was obtained (J2-227-10-R2).

Two small mounds in the western part of the summit area are entirely covered in white bacterial mats, but one is dissected by faulting on its northern and NE side, providing an opportunity to sample the basement underlying sulfides at the summit (J2-227-11-R1). Moving to the SE flank of North Su, there are thick white bacterial mats covering a ridge. A steep face of the ridge reveals sediment with cm-sized clasts of volcanic rock, one of which is sampled (J2-227-13-R1).

South Su

South Su is a crescent-shaped volcanic feature (Map 28). ABE mapping revealed little in the way of Eh hits or temperature anomalies over this region, although hydrothermal activity was discovered in some locations on the summit of South Su. Jason dive 224 and a part of Jason dive 227 visited South Su (Map 31). Two complete sets of water samples were taken at black smokers with temperatures of 288°C and 271°C, accompanied by paired solid samples. In addition, there was 1 other active chimney sample, 2 active sulfide flange samples, 2 inactive chimney samples, 1 fresh volcanic rock and 5 altered volcanic rocks sampled, and 2 samples of sulfur-cemented gravel.

The ridge to the north of the crescent-shaped South Su is hydrothermally inactive. There is sediment and old-looking weathered rock outcrop. The north slope of South Su here is a barren scree slope with abundant red oxide and white rocks and crusts.

The north slope of the NW ridge of South Su has abundant bleached, brecciated rock (J2-224-1-R1) and minor diffuse venting with associated clam beds and scattered crabs, related to fissures running up the steep wall or piles of rubbly talus of mostly fresh lava. The NW ridge has smooth, steep slopes to the W, with thick sediment cover over what appears rock talus. The E side of the NW ridge is very steeply faulted and exposes the interior parts of the former volcano (J2-224-2-R1 is altered rock from here). The crest of the ridge is a site of thick sediment with occasional outcrops of massive rock, colonized with microbial filaments. Except for numerous white patches and rare shimmering water, there is no other hydrothermal activity in the area.

In the SW part of South Su there are abundant patches of mussel beds with tubeworm colonies and occasional clams attached to volcaniclastic and volcanic rocks. The surrounding soft sediments are only marginally warm (<= 5°C). A brecciated outcrop with a thin iron oxide coating yielded sample J2-224-3-R1.

The ridge along the crescent of South Su is sediment and scattered volcanic outcrops, with shimmering water (17°C) in places. Locally there are areas of white staining and mussel beds on the warm (up to 25°C measured) sediments. Sulfide chimneys occur along the summit of South Su slightly east of center. There are several groups of mainly inactive chimneys, and more restricted areas of active smokers. J2-224-5-R1 and R2 are two inactive spires, and J2-224-6-R1 (x4257, y2681) is a 271°C active spire from which a complete set of water samples was also obtained. Nearby is a 241°C flow from beneath a flange, and samples were obtained of the flange and a sulfide nubbin that had grown on top of the flange (J2-224-7-R1 and R2). Flow from the site of the sampled nubbin was 293°C (marker 16). Another chimney mound 12 m to the SW is mostly inactive, but an active beehive was cleaned and the underlying chimney was sampled (284°C, sample J2-224-8-R1).

The crescent of South Su extending to the NE is hydrothermally inactive, composed of pillars and outcrops of volcanic and volcaniclastic rock. An altered rock sample was obtained (J2-224-9-R1). From the NE end of the ridge, the SE flank of South Su was ascended, and a fresh volcanic talus piece was collected (J2-224-10-R1). Nearing the summit where the sulfide chimneys were observed, the flank of South Su begins to show some signs of diffuse venting (oxide-stained sediment, shimmering water with mussels, barnacles and snails). A large area of the SE flank is hydrothermally active. A 288°C beehive structure in the SE part of the field was sampled with fluid samplers, and the stem of the beehive was recovered (J2-224-12-R1).

During Jason dive 227, South Su was again visited, this time from the south. The south flank of South Su is sedimented with occasional gravel debris (scree) and meter-sized talus. Some talus pieces are white-stained. Approaching the summit there is some 45°C shimmering water with white bacterial mats, and fauna include shrimps and mussels. A small fault provided a sample of lava (J2-227-4-R1) and nearby, pieces of lava (J2-227-5-R1) and white flange-like breccia (J2-227-5-R2) were obtained. To the north was a crust with small knobs that is a gravelly breccia containing native sulfur droplets (J2-227-6-R1 and R2). Further north is an area of extensive white bacterial mats, leading up to the sulfide chimneys previously discovered at the summit of South Su.

Surprise

The Surprise area refers to an area of sidescan backscatter anomalies that Nautilus Minerals had identified as “of interest” (Fig. 13). It was also the location of an Eh anomaly detected during an ABE survey. Jason dive 227 began at this Surprise area (Map 31), but did not locate any significant hydrothermal activity. Samples of lava and bleached rock, and a scoop of sediment were obtained (J2-227-1-R1 and R2; J2-227-2-R1 and R2), prior to directing attention back to South Su and North Su for the remainder of the dive.

East Umbo Ridge

East Umbo Ridge was thought to be the source of transient plume anomalies found in CTD casts around the area (Fig. 12). CTD cast MH126 at 3° 42.67’ S, 151° 57.00’E in about 2000 m water depth revealed strong optical backscatter anomalies centered at a depth of about 1675 m. Subsequent analysis of the plume water indicated high H2S and CH4 (up to 30 nM). Without prior ABE mapping a decision was made to dive Jason at the site. Jason dive 228 surveyed the summit of the ridge with no success in finding any hydrothermal activity. ABE dive 199 completed mapping over the summit of the ridge (Map 32) but found no obvious magnetic or water column anomalies. The final Jason dive 229 dove (Map 33) on the ridge while ABE was carrying out the mapping program. Curiously during both launches and recoveries of Jason, no Eh anomalies could be detected in the water column during the ascent and descent suggesting the plume source was a transient feature and that its source was still ambiguous.

East Umbo Ridge forms a narrow knife-edge ridge running along an azimuth of ~075° with a mean depth of 2020 m. (Fig. 12) The flanks of the ridge are steep slopes made up of fault walls exposing pillow flows and steep-sided pillow flows. The bases of the faults that have throws of up to 20 m are littered with large, angular pieces of talus. Further up the slopes, steep-sided pillow flows with variable accumulation of sediment prevail. The ridge crest features pillow lavas, lobate and tubular flows and talus, all moderately to highly sedimented. The summit of the ridge at depths between 1970 and 1830 m (at the conical edifice in the western part of the ridge) is marked by hackly, rough surface pillow and lava blocks. The fauna in the area is sparse – fish, brittle stars, soft coral, benthic and free-swimming holothurians, and just a few galatheid crabs

A mound 1 km south of East Umbo Ridge at 3° 43.08'S, 151° 57.43'E, 2100 m and in an area of optical backscatter anomalies in previous CTD casts turned also out to be hydrothermally inactive. The seafloor at the mound resembles that of the NE Umbo Ridge, with generally sparsely sedimented pillow basalt flows and steep fault walls exposing pillows. The mound features E-W trending fault walls with 20 m offset that bound a central graben. The fault walls expose uniform pillow flows. A piece of pillow talus was sampled here to go with a sample of lobate lava from East Umbo Ridge.

Results - Fluid Summary

Owing to the absence of shipboard Mg analyses it was not possible to determine end-member fluid compositions (i.e. extrapolated to Mg = 0). Accordingly, the concentrations of aqueous species discussed below represent measured values and are not corrected for entrained seawater. However, for most fluid samples, replicate samples of the same vent yielded similar concentrations of dissolved species, suggesting near end-member fluids may have been collected. For vents where there was a discrepancy between replicate samples, it is assumed that the lower concentration (higher pH values) reflects entrainment of ambient seawater during sampling. Thus, only the highest concentration value (lowest pH) for each set of replicate samples from a given edifice has been used to constrain the concentration ranges reported below.

The majority of fluids discussed below are characterized by salinities that are lower or higher than seawater, consistent with the occurrence of phase separation at or below the seafloor. Except for a few noted exceptions, measured vent temperatures were below the two-phase boundary for seawater salinity fluids at seafloor pressures, indicating that phase separation must have occurred deeper in the system at significantly higher temperatures (Fig. 14). The implication of this is that most of the fluids sampled have cooled significantly prior to venting at the seafloor.

Vienna Woods

Black/gray smoker fluids venting at 273-285°C from three focused sulfide orifices were sampled at Vienna Woods. Despite being separated by approximately 100 m, the chemistry of all three fluids showed little variability. All fluids were characterized by salinities greater than seawater (3.6 wt. % NaCl based on RI measurement), varying from 4.2 to 4.4 wt. % NaCl. Measured pH (25 °C) varied from 4.2 to 4.7, while H_2 and CH_4 concentrations varied from 42-55 and 62-70 μmol/l, respectively. Shipboard CO and H_2S concentrations are not available for this vent.

Pacmanus

Roman Ruins and Roger's Ruins – A total of six black/grey smoker fluids venting at 271 to 341°C were sampled from focused sulfide orifices at Roman and Roger's Ruins. The hottest of these fluids approaches the two-phase boundary for seawater (Fig. 14). Five of the six fluids had salinities greater than seawater (3.7 to 4.3 wt. % NaCl) while a single fluid from Roman Ruins had a salinity lower than bottom seawater (3.3 wt. % NaCl) indicating the simultaneous venting of vapors and brines produced during phase separation. The close proximity (~20 m) of chloride-enriched and depleted fluids at Roman Ruins suggests they may represent conjugate vapor-brine pairs. Relative to the Vienna Woods samples, Roman and Roger's Ruins fluids were significantly more acidic with pH values varying from 2.3 to 2.7. Measured H_2 and CH_4 concentrations showed significant variability ranging from 17 to 72 and 8 to 36 μmol/l, respectively. Aqueous H_2S concentrations varied from 2.5 to 10 mmol/l. Aqueous CO concentrations varied from 23 to 47 nmol/l at Roman Ruins, but were below detection at Roger's Ruins.

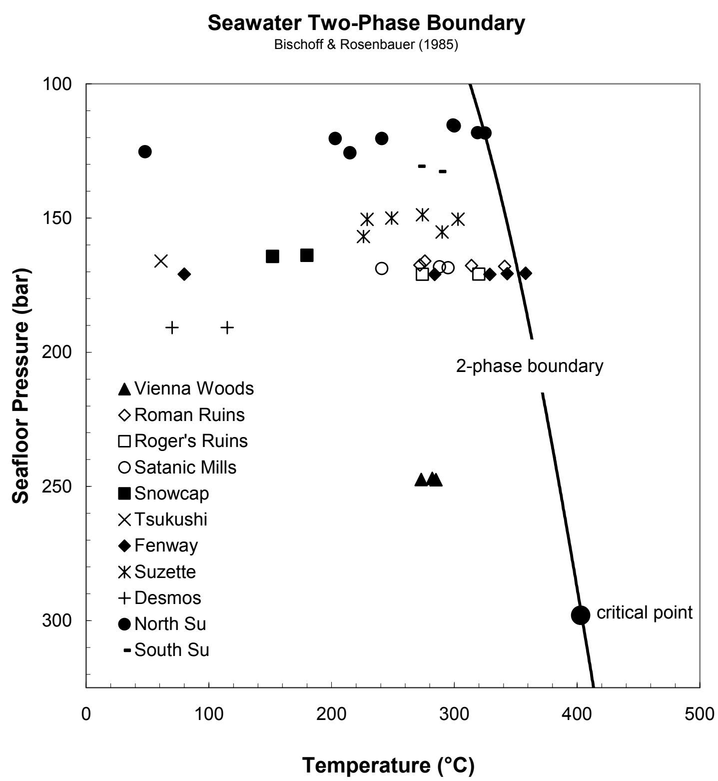


Figure 14. Two-phase boundary for seawater as a function of temperature and pressure (Bischoff & Rosenbauer, 1985). The symbols represent the measured temperatures of vent fluids at pressures corresponding to their seafloor depths.

Satanic Mills – Three black/gray smoker fluids venting at 241 to 295°C were sampled from focused sulfide orifices. All fluids were depleted in chloride relative to seawater with salinities that varied from 2.8 to 3.1 wt. % NaCl. A distinguishing feature of the Satanic Mills fluids was their high levels of dissolved gas. Based on crude visual inspection, approximately five volumes of gas were exsolved for each volume of fluid upon removal from the gas-tight samplers into glass gas-tight syringes at atmospheric pressure. This is substantially higher than fluids from the other areas that typically exsolved one volume of gas or less for each volume of fluid. The exsolved gas was most likely CO_2, since the abundances of H_2, CH_4, H_2S, and CO are insufficient to account for such large volumes. Despite the apparent preponderance of low salinity fluids and elevated CO_2 concentrations at Satanic Mills, the abundances of other aqueous species are similar to fluids from other areas of venting at PACMANUS. Measured pH varied from 2.4 to 2.6. Aqueous H_2 and CH_4 varied from 7 to 26 and 14 to 28 μmol/l, while H_2S varied from 3.9 to 10.5 mmol/l. Aqueous CO varied from 4 to 98 nmol/l.

Fenway – Four black/gray smoker fluids venting at 284 to 358°C were sampled at Fenway from focused sulfide orifices. On the southern slope of the mound an 80°C fluid venting directly from sediment located 2 meters from the sampled 284°C focused orifice was also sampled. Three of the high temperature fluids were characterized by temperatures >329°C, significantly hotter than the other areas sampled at PACMANUS, suggesting that Fenway may be characterized by more intense hydrothermal activity. The hottest fluid (358°C) plots slightly above the two-phase boundary for seawater at a seafloor pressure of 171 bar and was observed to "flash" upon exiting the vent orifice, consistent with phase separation. Four of the five high temperature fluids and the 80°C fluid were depleted in chloride relative to seawater with salinities that varied from 2.8 to 3.5 wt. % NaCl. A 343°C fluid sampled from the base of the structure venting low salinity 358°C fluid at its top was characterized by a salinity of 4.2 wt. % NaCl. The close proximity of these fluids suggests they may represent a conjugate vapor-brine pair. Total dissolved gas concentrations were substantially lower than Satanic Mills located a few hundred meters to the north. For the high temperature fluids, pH varied from 2.5 to 2.8, while the measured pH for the 80°C fluid was 4.9. Aqueous H_2 varied from 24 to 325 μmol/l, the latter value being the highest value observed in all vents sampled during the cruise, while CH_4 varied from 12 to 39 μmol/l. Aqueous H_2S varied from 5.2 to 26 mmol/l. Aqueous CO varied from 33 to 163 nmol/l. The abundance of H_2, CH_4, and H_2S in the 80°C fluid was 2.8, 11 μmol/l, and 2.8 mmol/l, respectively.

Snowcap – In general, vent temperatures at Snowcap were substantially lower than the other high temperature field at PACMANUS. Two clear fluids were collected from sulfide structures with temperatures of 152 and 180°C. The lower temperature fluid is from an area of diffuse venting half-way up the chimney, while the 180°C fluid is from a focused chimney orifice. Despite the lower temperatures, total gas concentrations approached the high values observed at Satanic Mills. Measured pH, however, was higher than at Satanic Mills with a value of 4.6 in the 152°C fluid and 3.4 in the 180°C fluid. Salinities varied from 3.0 to 3.2, significantly lower than seawater. Aqueous H_2 varied from 8 μmol/l in the 152°C fluid to 18 μmol/l in the 180°C fluid, while CH_4 concentration was identical in both fluids at 36 μmol/l. Aqueous H_2S and CO concentrations varied from 2.6 to 1.3 mmol/l and 33 to 45 nmol/l in the 153 and 180°C fluids, respectively.

Tsukushi – High temperature venting was not observed at the Tsukushi field. A single fluid venting at 61°C from a fissure in sediment was sampled. This fluid was characterized by seawater salinity and a pH of 5.7. Dissolved H_2S was barely detectable at 0.0006 mol/l while CO was below detection. Dissolved H_2 and CH_4 concentrations were 0.6 and 6.5 μmol/l respectively.

SuSu Knolls

Suzette – Six black/gray smoker fluids were sampled from the Suzette field with temperatures varying from 226°C to 303°C. Five of the fluids were from focused sulfide orifices and one fluid

(249°C) was sampled from a crack in the "turtle back" pavement observed at this location. All fluids were characterized by salinities greater than seawater, varying from 3.7 to 4.2 wt. % NaCl. Measured pH in the "turtle back" fluid was 2.3, a value that is substantially lower than the 3.5 to 3.7 measured in fluids venting from focused sulfide orifices. Similarly, the abundance of dissolved H_2S in the "turtle back" fluid was 9.3 mmol/l, substantially higher than the concentrations of 1.3 to 2.3 mmol/l measured in the focused flow fluids. Dissolved H_2 varied from 6.2 to 31 µmol/l with no obvious difference observed in the "turtle back" fluid. A striking feature of the Suzette fluids was the relatively high CH_4 concentrations that varied from 91 to 503 µmol/l. These values are considerably higher than CH_4 abundances observed at Vienna Woods and PACMANUS and may reflect entrainment of CH_4 generated by thermal alteration of organic-bearing sediments or biomass. CO concentrations were below detection.

North Su – A high degree of variability in the style of venting and composition of fluids was observed at North Su. Three of six fluids sampled at this location from the summit and the ridge near the summit were characterized by grey/black smoke, focused flow, and temperatures that varied from 300 to 325°C. Salinities of the focused flow fluids varied from 3.2 to 4.5 wt. % NaCl, showing both depletions and enrichments relative to seawater. The hottest fluid (325°C) was the most saline (4.5 wt. % NaCl) and "flashed" as it exited the vent orifice, consistent with it plotting on the two-phase boundary for seawater at a seafloor pressure of 118 bar (Fig. X). Measured pH for these fluids varied from 2.8 to 3.5 and aqueous H_2 and H_2S varied from 20 to 76 µmol/l and 5.3 to 7.7 mmol/l, respectively. As was the case for the Suzette fluids, focused flow fluids from North Su contained high abundances of CH_4, which varied from 91 to 566 µmol/l, suggesting the possible entrainment of CH_4 generated by thermal alteration of organic-bearing sediments or biomass.

Further down the slope to the south, two fluids were sampled from cracks in volcaniclastic debris. These fluids had a measured temperature of 48 and 215°C and formed a plume of thick yellowish white smoke. In contrast to black smoke that forms a few cm above an orifice for focused flow fluids in response to mixing with cool seawater in the water column, the thick white smoke flowing from these relatively low temperature vents appeared to form below the seafloor. Following removal of fluid from the sample bottles, a fine grained yellowish white precipitate was recovered by filtration. The close association of elemental sulfur in the sediments surrounding these vents and the visual appearance of the precipitate, suggests the dense white smoke may be elemental sulfur. Indeed, a few meters away from this vent liquid sulfur was observed oozing out of the seafloor. The pH of the fluids was extraordinarily low, reaching a value of 0.87 in the 215°C fluid and 1.8 in the 48°C fluid. To our knowledge the pH of the 215°C fluids represents the lowest value of any seafloor hydrothermal fluid reported to date. The salinity of these fluids is identical to the bottom seawater value of 3.6 wt. % NaCl, suggesting they have not undergone phase separation. Unlike the focused flow fluids from the summit, these fluids contain very little aqueous CH_4 (0.4 and 0.6 µmol/l) and H_2S (below detection to 1 mmol/l). Aqueous H_2 concentrations varied from 12 to 22 µmol/l. The low pH, possible presence of elemental sulfur, near absence of CH_4 and H_2S, absence of phase separation, and relatively low temperature suggests that the physical and chemical processes responsible for the formation of these fluids are very different than those responsible for the focused flow fluids venting at the summit. A likely explanation for these fluids is that they represent a mix of magmatic volatiles and heated seawater as has been previously reported for low pH fluids from the Desmos area (Gamo et al., 1997).

The sixth gray smoker fluid collected from the northwest slope of the North Su volcano was venting at 241°C from a fissure in a steep scree slope covered with a white and yellow crust.

This fluid appears to be a hybrid fluid characterized by some of the features of the high temperature focused flow fluids at the summit and the fissure flow fluids forming thick white smoke on the southern slope. For example, a salinity of 3.9 wt. % NaCl indicates the occurrence of phase separation while a CH_4 concentration of 476 µmol/l suggests a contribution of thermogenic CH_4, similar to the summit fluids. Measured pH, however, was 1.5, similar to the southern slope fluids. Aqueous H_2 and H_2S concentrations were 42 µmol/l and 13 mmol/l respectively. A likely scenario for these fluids is that they may represent a seawater derived convective hydrothermal fluid into which magmatic volatiles are injected resulting in the relatively low pH.

South Su – Two fluids venting from focused sulfide orifices at 271 and 288°C were sampled from the South Su area. The chemistry of both fluids was very similar with a seawater salinity of 3.6 wt. % NaCl and pH of 2.6 to 2.7. Aqueous H2 and CH4 varied from 11 to 14 and 21 to 23 µmol/l. Aqueous H2S showed more variation increasing from 7.7 mmol/l in the 271°C fluid to 15 mmol/l in the 288°C fluid.

Desmos

High temperature hydrothermal activity was not observed at the Desmos area. Two fluids venting at 70 and 115°C from fissures in the talus piles were sampled at the Onsen site reported by *Gamo et al.* [1997]. The style of venting and chemistry of these fluids is very similar to that observed on the southern slope of North Su. The vents formed thick plumes of billowy white smoke that appear to have formed below the seafloor. Measured pH varied from 1.0 in the 115°C fluid to 1.4 in the 70°C fluid. As was the case at North Su, CH4 and H2S were present at low concentrations of 0.005 to 0.6 and 0.13 to 0.02 µmol/l respectively. Aqueous H2 varied from 3 to 5 µmol/l. Unlike the fluids from the southern slope of North Su, the Desmos fluids are characterized by salinities of 3.7 to 4.0 wt.% NaCl, values that are elevated relative to seawater, suggesting they have experienced phase separation. Comparison of the 2006 fluid compositions with those reported by *Gamo et al.* (1997) for fluids collected in 1995 reveals substantial differences. In particular, the salinities of the 1995 fluids were less than seawater suggesting they represented a low salinity vapor created during phase separation. Moreover, the 1995 fluids contained 5 to 10 mmol/l H2S relative to the <1 mmol/l reported here. The acidity of the 2006 fluids was an order of magnitude greater than in 1995 (pH =1 in 2006 vs. 2 in 1995). *Gamo et al.* [1997] suggested that the Desmos fluids formed by the mixing of magmatic volatiles with heated seawater. Although similar processes are likely responsible for the formation of the 2006 fluids, there is compelling evidence to suggest that the system has evolved compositionally during the past 11 years.

North Pual Ridge

High temperature venting was not observed at North Pual Ridge. A single low temperature (35°C) diffuse area of venting was sampled. The shipboard chemistry of this fluid is very similar to seawater with a pH of 6.9, a salinity of 3.6 wt. % NaCl, and H_2 and CH_4 concentrations of 0.21 and 1.7 µmol/l, respectively. Dissolved H_2S and CO abundances were below detection.

Umbo

Active venting was not observed at the Umbo site.

UNDERWAY LOG

(local time = GMT+10) ***UTM Zone 56S***

JD202 - Fri 21 July 2006

13:50 Melville leaves dock in Rabaul, Papua New Guinea after clearing customs.

14:50 Begin transit. Target coordinate is Vienna Woods on Manus Ridge in the Bismarck Sea at:
3° 9.86' S 150° 16.78' E

As we steam out of the bay the volcano Tavurvur erupts yet another ash cloud since it started the day before.

01:00 Begin SeaBeam survey of Manus Ridge (magnetometer not working properly).
-3° 01' 46'' S 150° 33' 19'' E
-3° 11' 23'' S 150° 15' 12'' E
-3° 39' 50'' S 149° 45' 13'' E
-3° 38' 54'' S 149° 43' 29'' E
-3° 10' 05'' S 150° 13' 46'' E
-3° 00' 10'' S 150° 32' 14'' E

JD203 - Sat 22 July 2006

17:00 Arrive on site and begin to deploy four transponders and survey the net.
The final coordinates for the Vienna Woods transponder net are:

XPNDR	LATITUDE	LONGITUDE	UTMX	UTMY
A	-3 -10.7837	150 16.88897	197846.25	9648143.03
B	-3 -9.41359	150 18.43444	200704.70	9650677.38
C	-3 -8.31898	150 20.26235	204088.16	9652704.80
D	-3 -7.56005	150 22.27316	207812.27	9654113.83

Vienna Woods Net Origin 3° 13.00' S 150° 15.00' E

22:03 Launch Jason Dive 200 Vienna Woods Tufar-1 – Manus Ridge
Lat/Long: 3° 9.86' S 150° 16.78' E

JD204 - Sun 23 July 2006

00:49 Jason on bottom

08:30 ABE 182 launched
Launch site: -3º 9.902'S 150º 16.727'E
ABE is starting to home on start of survey point while Jason is down sampling.

18:00 Jason on the way up. Should be on deck by 20:00

20:01 Recovered Jason on deck. End of Dive 200

JD205 - Mon 24 July 2006

03:30 ABE 182 on deck
Jason found many problems including a bad tether, ground fault on thruster and forward sonar, Schilling manip. The J2-crew will replace the tether and be ready by 08:00.

08:30 Launch Jason Dive 201 Vienna Woods - Tufar-2 Site
Lat/Long: -3° -9.47 ' S 150° 17.04' E

Ground fault in hydraulic unit during maggie twist so that we must abort the dive.
Jason recovered
Jason launched again but ground fault again this time just as entering the water in hydraulic unit.
Jason recovered

15:47 Jason Dive 201 launch successful
Lat/Long: -3° -9.47 ' S 150° 17.04' E (Tufar-2 Site)
21:10 ABE 183 launched in Vienna Woods area.
Launch site: -3º 9.485'S 150º 16.987'E
ABE will add a couple of lines to previous survey then head north and do an adjacent survey at 150 m line spacing, 150 m altitude.

JD206 - Tue 25 July 2006

08:50 Recover Jason. End of Jason Dive 201

11:00 Small boat transfer of Nautilus visitors from Kavieng
Tony O'Sullivan (Nautilus), Ray Goldie (Salomon), JC St-Amour (Blackstone) and Philip Jankowski (SRK) joined the ship for an overnight stay and to watch operations.
14:01 ABE 183 recovered on deck.
16:38 Launch Jason Dive 202 Vienna Woods (Tufar-1 Site)
Lat/Long: -3° -9.83 ' S 150° 16.85' E

JD207 – Wed 26 July 2006

10:03 Recover Jason Dive 202

13:00 Small-boat transfer of Nautilus visitors back to Kavieng.
Philip Jankowski stayed on board and Woody Sutherland (Scripps Tech) got off.

14:00 ABE Dive 184
Launch site: -3º 6.855'S 150º 21.148'E
On monitoring ABE prior to the Jason launch we determined that ABE 184 had aborted its mission and was coming back to the surface. Recover ABE.

19:19 Jason Dive 203 launched North Vienna Woods (Bronze-age Fort)
Lat/Long: -3° 8.10' S 150° 18.80' E

23:00 ABE Dive 185 launched while Jason was down.
Launch site: -3º 13.000'S 150º 15.000'E
ABE will drive a long transit over to its survey track program on bottom mapping at the Tufar-3 hydrothermal area.

JD208 - Thu 27 July 2006

12:28 Recover Jason on deck. End of Jason Dive 203.
Seabeam… while we wait for ABE.
18:30 Recover ABE on deck. End of ABE Dive 185.
Set-up to launch Jason at 20:00

20:00 Jason Dive 204 launched (Tufar #3)
Lat/Long: -3° -6.95' S 150° 21.25' E

Data crunching the ABE data reveal both an Eh and temperature anomaly near the Tufar-3 site. We will investigate this area first.

JD209 - Fri 28 July 2006

10:30 Recover Jason Dive 204. End Jason 204

11:00->16:00 Carry out transponder operations
Deploy 2 new transponders (same origin)
Provisional coordinates:
-3° -03.35' S 150° 25.35' E
-3° -02.95' S 150° 26.85' E

16:30 Launch ABE 186
Launch site: -3° -4.550' S 150° 26.750' E
Waiting for ABE to reach bottom and start survey. ABE is all happy and doing the survey

19:15 leave for Jason 205 Dive Site
10:02 Launch Jason Dive 205
Lat/Long: -3°6.95' S, 150°21.55' E
UTM: 9 655 200N, 206 500E (WGS84 Zone 56S)

JD210 - Sat 29 July 2006

10:32 Jason on deck. End of Jason Dive 205.

11:00 Release transponders 'C' and 'D' and pick them up.
Some confusion about whether the transponder 'C' released, so spent some time looking for it. Turns out it was on the bottom all the time. Resend the release code. All safely recovered finally.

17:10 ABE 186 on surface and recovered.
recovery: -3° -3.856' S 150° 26.443' E
Quick data dump reveals no obvious Eh or temperature anomaly hits.

18:20 Launch Jason Dive 206 – North Manus Ridge
Lat/Long: -3°4.20' S, 150° 26.20' E
UTM: 9 660 328N, 215 077E (WGS84 Zone 56S)

JD211 - Sun 30 July 2006

08:20 ABE 187 launched in North Manus Ridge area.
Launch site: 03º 4.301'S 150º 26.455'E
Jason is still in the area. ABE will drive to start point. ABE has a long anchor time planned (37 hrs) to allow us to dive at Vienna Woods before coming back to get it.

10:00 Jason on the way up
10:30 small boats from Kavieng have arrived.
They must wait while we recover Jason on deck. It is hot and humid today.

11:16 Jason on deck End Jason Dive 206

11:30 Small boat transfer of personnel and supplies from Kavieng.
The Nautilus people are getting off along with one Jason person:
Justin Baulch
Glenn Creed
Philip Jankowski
Steve Gegg (Jason group)

The following people have joined the ship:
Jeff Seewald
Eoghan Reeves
Peter Saccocia
Emily Walsh
Olivier Rouxel
Roy Price
Chris Yeats (CSIRO)
Melissa Quigley (CSIRO)
Chris Roman (Jason group)

13:10 Do a short SeaBeam survey of Manus ridge flank while we wait for Jeff Seewald's people to get the water bottles up and running.

SeaBeam Survey waypoints:
-3° -14.50' S 150° 17.70' E
-3° -31.50' S 149° 59.80' E
-3° -34.20' S 150° 02.60' E
-3° -17.50' S 150° 20.25' E
-3° -9.92' S 150° 16.75' E

13:30 Ship's Fire and Boat drill and orientation for new science crew.

19:30 finished SeaBeam survey
21:00 Jason Dive 207 at Vienna Woods for fluid samples.
Lat/Long -3° -9.92' S 150° 16.80' E
Winch is broken. Ships engineers are fixing the problem.
22:18 Jason is launched

JD212 - Mon 31 July 2006

11:28 Jason on deck. End Jason Dive 207
Release and successfully retrieve transponders 'A' and 'B'. Now transit north and recover ABE 187.
17:33 ABE 187 recovered

Release transponders 'F' and 'E'. We have trouble releasing 'E'. We have spent three hours trying to get 'E' back but no luck. Will have to leave it behind.

23:00 Called it quits on transponder 'E'.
Begin transit/SeaBeam over to Pacmanus site (-3° -43.27' S 150° 40.50' E)

SeaBeam survey waypoints:
-3° -06.00' S 150° 34.00' E
-3° -28.25' S 151° 10.00' E
-3° -49.25' S 151° 47.70' E
-3° -37.50' S 151° 45.70' E
-3° -43.00' S 151° 35.80' E

JD213 - Tue 01 Aug 2006

09:45 Arrive at Pacmanus site and end SeaBeam survey. Deployed transponders at Pacmanus

'A'	-3° -43.071' S	151° 40.988' E
'B'	-3° -42.477' S	151° 40.181' E
'C'	-3° -44.293' S	151° 39.511' E

12:25 Transponders deployed, now do transponder survey

15:45 Finished surveying the transponder net

17:50 ABE 188 launched at Pacmanus
Launch Site: 03º 43.949'S 151º 39.993'E
ABE reached bottom and successfully began moving along the survey track.
19:00 tested CTD setup while ABE descending to do Pacmanus survey.

21:00 leave for Su Su Knolls. Do a SeaBeam survey on the transit over to Su Su Knolls.

SeaBeam Coordinates:
-3° -48.00’ S 151° 40.00’ E
-3° -48.00’ S 152° 15.00’ E
-3° -45.00’ S 152° 15.00’ E
-3° -45.00’ S 152° 00.00’ E

JD214 – Wed 02 Aug 2006

02:30 SeaBeam survey finished and so head to first transponder deployment at Su Su Knolls.
Provisional coordinates are:
‘J’ -3° -46.227’ S 152° 5.802’ E
‘K’ -3° -47.406’ S 152° 7.422’ E
Origin is -3° -50.0’ S 152° 04.00’ E

03:30 Both transponders in and now doing the survey.
05:50 Finished transponder survey at Suzette/SuSu Knolls, transit back to North Pual to do first CTD cast #1 (MH-101)
MH-101 -3° -41.75’ S 151° 43.50’ E

08:30 MH101 done at site ‘E’ as written in the McConachy plan but actually a mistype, so the location turns out to be at the edge of the presumed plume. Only get a weak plume signal, probably from Pacmanus and not the North Pual plume. ABE is at the surface so we must go over and pick it up first before continuing with CTD casts.

11:00 ABE 188 at the surface, recovering vehicle
11:30 ABE 188 on deck

Do 2 CTD casts at North East Pual looking for plume signal
MH102 -3° -41.00’ S 151° 44.00’ E
MH103 -3° -40.75’ S 151° 43.50’ E

18:00 Launch Jason - Dive 208 Roman Ruins - Pacmanus
Lat/Long: -3°43.27’ S, 151°40.60’E
UTM: 353041, 9588583 (WGS84 Zone 56S)

Problem at 100 meters with hydraulics. Also Digital Still Camera has a ground. Come back up on deck and fix.

18:40 Jason on deck

19:26 It’s a fast fix and Jason 208 is back in the water and going down. Jason on bottom at Roman Ruins.

JD215 - Thu 03 Aug 2006

11:03 Jason on deck, End of Jason 208

11:30 Ship transiting to SuSu to deploy ABE for a dive at the Suzette field (-3° -47.45' S 152° 05.65'E)

14:30 ABE Dive 189 launched at Suzette.
Launch Site: -3º 47.326'S 152º 5.637'E

15:00 Do CTD on top of North Su. We will check on the existence of the plume. It was absent the last it was visited in 2000.

MH-104 -3° -48.0' S 152° 06.20'E depth 1200 m North Su

CTD found a strong plume over North Su. CTD deck and software crashed and bottles malfunctioned, but some samples obtained.

16:55 Return to Pacmanus for next Jason dive (209). SeaBeam back over to Pacmanus.

19:07 Secure SeaBeam, within 1 mile of the site.

19:35 Launch Jason - Dive 209 Satanic Mills - Pacmanus
Lat/Long: -3° -43.63' S 151° 40.40' E

JD216 - Fri 04 Aug 2006

11:08 Jason on deck End of Dive 209

Transit over to Suzette at Su Su Knolls to pick up ABE. Winds have picked up considerably over the past hour and are now at 30 kts. Wake up ABE and recall to the surface.

16:15 ABE 189 on deck. Transit back to Pacmanus. Arrive on station by 18:50.

19:01 Launch Jason Dive 210 Snowcap - Pacmanus
Lat/Long: -3° -43.667' S 151° 40.25' E

JD217 - Sat 05 Aug 2006

11:11 Jason on deck End Jason Dive 210
Head off to dump trash – an hour out and an hour back due to the 30 mile offshore limits. We will come back and do a CTD next at North Pual for a last gasp effort to find that plume.

14:15 On station to do CTD at North East Pual ridge
MH105 -3° -40.50' S 151° 44.00' (NE Pual)
Plume found

16:30 Transit back to Pacmanus to launch ABE 190.
17:30 ABE 190 launched.
Launch Site: - 3º 43.949'S 151º 39.993'E
ABE will add to the Pacmanus map by doing wrap around survey and additional tracks to the north and south

18:00 Launch Jason Dive 211 Tsukushi - Pacmanus
Lat/long: -3°43.792' S, 151°40.040'E, 1650 m
UTM: 352006, 9587620 (WGS84 Zone 56S)

JD218 - Sun 06 Aug 2006

11:06 Jason on deck End of Dive 211

14:30 Recovered ABE 190 at Pacmanus. Wind up to 20 kts steady and sea has picked up to 4 ft heights.
Makes recovery of ABE tricky. Now go north to North East Pual and do a CTD cast.
MH106 -3° -40.50' S 151° 43.50' depth 1920 m
Found plume from MH105 again but more distal in this cast.

Drive back to Pacmanus and recover transponder 'I' (10 khz).
'I' Lat/long: -3° -44.26913 151° 39.47996

Successfully recovered transponder in time for Jason launch.

18:07 Launch Jason Dive 212 Fenway site - Pacmanus
Lat/long: -3°43.72' S, 151°40.38'E, 1720 m
UTM: 352635, 9587753 (WGS84 Zone 56S)

JD219 - Mon 07 Aug 2006

Wind has dropped considerably overnight (< 5kts) as have the seas. The wind picks up through the day again however.
11:06 Jason on deck, End of Jason Dive 212

11:30 Launch ABE 191 for mapping Pacmanus north.
Launch Site: 3º 43.227'S 151º 40.591'E
We stay around to listen to ABE descend and then start heading slowly north to CTD site.

12:30 Drive north to do the next CTD MH107.at North East Pual Ridge
MH107 -3° -40.00' S 151° 44.50' depth 1900 m
Trying to box-in the plume anomaly up here. The plume again seems more distal in this cast.

14:30 Drive back down to Pacmanus and set up to do a CTD cast of the Pacmanus plume over Roman Ruins MH108
MH108 -3° -43.25' S 151° 40.50' depth 1675 m

18:00 Jason will launch just east of Roman Ruins area.
ABE 191 goes walk about so we will stop Jason launch and have ABE191 anchor.
18:30 ABE 191 anchoring complete so we can proceed with the Jason launch

19:02 Jason launch Dive 213 (Roman Ruins – 2)
Lat/long: -3°43.40' S, 151°40.65'E, 1690 m
UTM: 353134, 9588344 (WGS84 Zone 56S)

JD220 - Tue 08 Aug 2006

11:08 Jason on deck. End of Jason Dive 213
Go get ABE
13:00 ABE 191 on deck
Go off to do CTD station at North east Pual

14:30 CTD MH108 North East Pual
MH-108 -3° -40.5' S 151° 44.50' depth 1850 m
A much weaker plume was found so source seems to be to the west of here on a small ridge as a northward extension of Pacmanus.

Transit back to Pacmanus and set up for the next Jason dive at Satanic Mills and Snowcap.

18:04 Launch Jason Dive 214 (Satanic Mills- Snowcap 2)
Lat/long: -3°43.62'S, 151°40.36'E, 1690 m
UTM: 352598, 9587938 (WGS84 Zone 56S)

JD221 - Wed 09 Aug 2006

11:03 Jason on deck End Jason Dive 214

Transit up to Northeast Pual site and deploy one transponder and survey in preparation for ABE dive.

'L' -3°-38.873'S, 151°43.200'E, 1550 m (8.5 Khz)
Origin : -3°-43.00'S, 151°41.00'E

Head back south to Pacmanus and do a CTD over Fenway field.

14:00 CTD over the Fenway plume.
MH-110 -3° -43.33' S 151° .' depth m
A plume at same level as the other plume over Roman Ruins.

16:30 Finished survey and set up or Jason launch. Not enough time to do anything else.

18:03 Launch Jason Dive 215 (Romans Ruins / North Pacmanus)
Lat/long: -3°43.26'S, 151°40.45'E, 1680 m
UTM: 352764, 9588595 (WGS84 Zone 56S)

Will complete SM2000 (and delta-T) sonar survey of Roman Ruins and then check out sampling lower temp fluids from cracks in the basement. The dive then was to drive north to look at a T, Eh and optical backscatter anomaly some 1.5 km north of Roman Ruins. This was not found other than small oxide patches leaking diffuse fluid, 10C.

JD222 - Thu 10 Aug 2006

11:05 Jason on deck. End of Jason Dive 215

Recover transponders at Pacmanus.

13:00 Transit north to North Pual.

14:00 Deploy one transponder at North Pual survey that in and then deploy ABE 192.
Transponder coords:
'M' -3°-40.287'S, 151°42.080'E, 1800 m (9.5khz)
Origin : -3°-43.00'S, 151°41.00'E

16:30 Deploy ABE 192
Launch Site: - 3º 40.422'S 151º 43.414'E

18:15 ABE on bottom and moving. Drive back to Pacmanus for Jason Dive 216

19:03 launch Jason - Dive 216 (Pacmanus - Fenway)
Lat/long: -3°43.72'S, 151°40.38'E, 1720 m
UTM: 352635, 9587753 (WGS84 Zone 56S)

JD223 – Fri 11 Aug 2006

11:07 Jason back on deck. End Jason Dive 216

We have been having problems with the Seabird CTD deck crashing the software and hanging up, making the counts for water bottle collection tricky. The Restech switches out the deck with a backup deck. MH-111 will be done with the replacement deck.

11:30 Do a CTD at Pacmanus-Snowcap MH 111.
MH-111 Lat/long: -3°43.75'S, 151°40.00'E, 1705 m

13:23 Now we head out to pick up ABE at North Pual.

14:15 At North Pual, send release signal to ABE.

16:31 With ABE on deck we will head east to do two more CTD casts at Umbo (MH-112) and North Su (MH-113).

19:00 On station for CTD cast MH-112 (Umbo)
MH-112 Lat/long: -3°43.00'S, 151°57.50'E, 2110 m
Find an active plume over Umbo. Sharp base to the plume.

Move over to North Su and do another CTD there
MH-113: -3°47.90'S, 152°46.00'E, 1200 m

We will then commence a short Seabeam survey between Su Su and Pacmanus and end up at small boat transfer location by 6:00 am. After the small boat transfer we will head back to North Pual for another ABE launch.

Seabeam survey waypoints prior to small boat transfer on the 12th starting from the top of North Su:
-3° 48.00'S, 152° 06.00'E
-3° 35.00'S, 151° 47.50'E
-3° 32.70'S, 151° 49.40'E
-3° 44.25'S, 152° 05.00'E
-4° 00.00'S, 152° 05.00'E
Then onto to small boat transfer location at Watom Isld.

JD224 - Sat 12 Aug 2006

08:30 After the boat transfer we head back to North Pual to launch ABE.
We will go through these waypoints on the way back to the dive site:
-3° 58.00'S, 152° 10.00'E
-3°40.50'S, 151° 45.00'E
13:16 Launch ABE 193 at NE Pual
Launch Site: - 3º 40.400'S 151º 43.399'E
We go and dump trash and then check on ABE.
ABE is having problems. It is sent a command to anchor.
We then steam back to Suzette and carry out a Jason dive there.

20:38 Launch Jason - Dive 217 Suzette
Lat/long: -3°47.395' S, 152°05.837'E, 1540 m
UTM: 399763, 9581041 (WGS84 Zone 56S)

JD225 – Sun 13 Aug 2006

11:04 Jason on deck, End Jason Dive 217
Now head off to North East Pual to pick up ABE

13:30 ABE 193 released from its anchor and coming up.

15:36 ABE 193 on deck
Release ABE transponder (8.5 Khz)
Deploy in a Jason transponder 'N'
Survey in the new Jason transponder

18:38 Launch Jason - Dive 218 North-East Pual Ridge
Lat/long: 3°40.504' S, 151°43.674'E, 1870 m
UTM: 358724, 9593689 (WGS84 Zone 56S)

JD226 - Mon 14 Aug 2006

11:06 Jason on deck, End Jason Dive 218
Transit over to SuSu Knolls

13:30 Arrive at SuSu and deploy transponder for the next ABE survey.
Transponder 'O'. Survey in the new transponder.
Proposed transponder 'O' location:
Lat/long:-3°-49.454'S 152°7.560'E
XY: 6590, 1000, 300 m tether, 1680
(SuSu origin: -3°-50.0 152°4.0'E)

16:04 Launch ABE 194 in Su Su transponder net
Launch Site: -3º 47.894'S 152º 5.953'E
17:56 Launch Jason Dive 219 - Suzette-2
Lat/long: 3°47.40' S, 152°05.35'E, 1640 m
UTM: 358864, 9581040 (WGS84 Zone 56S)
Start on the western side of the Suzette mound and drive eastwards across the mound.

JD227 - Tue 15 Aug 2006

11:02 Jason on deck, End Jason Dive 219
14:07 Recover ABE 194 (North Su/South Su survey).

15:20 Do a CTD at East Umbo
MH-114: 3° 43.00'S, 151° 56.00'E Depth 2000 m
Cast was a few km west of MH-112 in order to track the Umbo plume. The cast was near but outside the flank of the main Umbo ridge segment. The plume here appears to be thick and homogeneous and the interpretation is that it is a more distal than the MH-112 plume which had a sharp bottom.

17:20 transit over to the adjacent Desmos caldera for the Jason dive.

18:19 Launch Jason Dive 220 – DESMOS
Lat/long: 3°41.80' S, 151°52.30'E, 2080 m
UTM: 358864, 9581040 (WGS84 Zone 56S)

No transponder net here so will fix a position at the beginning of the dive and then proceed on doppler from there.

JD228 - Wed 16 Aug 2006

11:04 Jason on deck, End Jason Dive 220

Transit over to East Umbo nearby and do a CTD there trying to find the location of the plume.

12:18 MH-115 CTD coords:
MH-115: 3°42.5' S, 151°57.50' depth 1961m
This station is to the north of the previous CTD stations and we find a plume that is slightly weaker than the others, implying a source either to the east or south.

13:52 Now transit over to SuSu Knolls.
Release northern most transponder in SuSu net (9.5) and redeploy this same transponder at the southern end of the SuSu net. Survey in the net.
Proposed transponder 'P' location:
Lat/long:-3°-49.960'S 152°5.648'E

XY: 3051, 0073, 300 m tether, 1720

18:24 Deploy ABE 195 at the south end of SuSu.
Launch Site: - 3º 49.295'S 152º 5.729'E
ABE will complete a map of the southern flank of South Su.

19:08 Launch Jason Dive 221 - North Su
Lat/long: 3°48.16' S, 151°52.05.94'E, 1360 m
UTM: 399965, 9579642 (WGS84 Zone 56S)

JD229 - Thu 17 Aug 2006

11:05 Jason on deck, End Jason Dive 221

12:42 Recover ABE 195 on deck
Steam over to NE Pual to recover transponders 'L' and 'N' and then we drive down to Pacmanus for a dive with Jason.

18:03 Jason Dive 222 Pacmanus (Roman Ruins)
Lat/long: -3°43.05'S, 151°40.59'E, 1690 m
UTM: 353022, 9588988

JD230 – Fri 18 Aug 2006

11:04 Jason on deck, End Jason Dive 222

11:30 steam over to CTD site nearby (1.5 mls) at MH-116 midway between Pacmanus and the NE Pual location.

MH-116 Lat/long: 3°.42' S, 151° 42.0'E, 1780 m

Completed CTD and now transit over to East Umbo for the next CTD cast. We will attempt to define the source of Umbo plume.

MH-117 Lat/long: 3° 44.0' S, 151° 57.0'E, 2140 m

16:25 ABE 196 launched at South Su
Launch Site: -3º 50.000'S 152º 4.000'E
18:58 Launch Jason Dive 223 (North Su)
Lat/long: 3°48.014' S, 152°06.080'E, 1160 m
UTM: 400215, 9579900 (WGS84 Zone 56S)

JD231 - Sat 19 Aug 2006

10:57 Jason on deck End of Jason 223

Sent release code to ABE and it is on its way up now.
12:36 Recovered ABE on deck End ABE 196.
We will now steam over to East Umbo to do another CTD station MH-118. On the way we will steam through two waypoints to do a roll bias test for the SeaBeam. We will transit back through those points on the way back and so get data coming and going.
The news on ABE is that it had a hard ground (or lost comms) with one of its main thrusters and so shut down. They will repair and be ready to go.
SeaBeam Roll bias test waypoints:
3° 45.25' S, 151° 01.35'E
3° 43.70' S, 151° 58.25'E

13:45 At CTD Station on East Umbo Ridge in an attempt to box in the source of the plume found at about 1600 m depth.

MH-118 Lat/long: 3° 42.77’ S, 151° 56.53’E, 1860 m

18:16 Jason Dive 224 - South Su

Lat/long: 3°48.43’ S, 152°06.30’E, 1420 m
UTM: 400615, 9579143 (WGS84 Zone 56S)

JD232 - Sun 20 Aug 2006

11:02 Jason on deck. End of Jason 224

Do a CTD at North Su.
MH-119 Lat/long: 3° 48.20’ S, 152° 06.20’E, 1200 m

After some discussion of Umbo and the possibility of having ABE survey there we decide that it is still quite risky. The plume rise height looks to be at least 500 m, much larger than typical. There are no obvious nearby bathymetric targets other than a small ridge. The plume is also not very distinct in any of the CTDs done around the area. We decide to look at the seamount Nimab just to the southeast of Su Su Knolls. We will do a CTD over Nimab

MH120: 3° 49.10’ S, 152° 11.25’E, 1150 m
No plume is found.
Now transit back to North Su and do a CTD there.
MH121: 3° 47.50’ S, 152° 06.00’E, 1600 m

18:35 Elevator and Jason Dive 225 - Suzette

Lat/long: 3°47.52’ S, 152°05.77’E, 1525 m
UTM: 399641, 9580812 (WGS84 Zone 56S)

Elevator is launched at Suzette with the Nautilus sediment traps on board. The elevator only drifts at most 100 meters west northwest from target. It is safely on the bottom.

19:15 Jason Dive 225 is launched at Suzette.

Jason deployed the ADCP but then has a telemetry problem and is forced to come up and abort the dive. The elevator will stay down.

22:19 Jason recovered. End of Jason Dive 225

Do a CTD over southeast South Su flank
MH122: 3° 48.60’ S, 152° 06.40’E
We think of launching ABE but on its initialization there is a problem and the idea is scrapped as both Jason and ABE get worked on in the lab.
After the CTD we will do a SeaBeam survey until the following morning.
SeaBeam Survey:
3° 50.00’ S, 152° 09.00’E
3° 52.60’ S, 152° 12.75’E
4° 06.50’ S, 152° 12.25’E
4° 06.50’ S, 152° 11.25’E
4° 03.40’ S, 152° 06.50’E
4° 02.00’ S, 152° 07.50’E
4° 04.45’ S, 152° 11.25’E
3° 55.50’ S, 152° 11.40’E
3° 47.50’ S, 152° 00.00’E

JD233 - Mon 21 Aug 2006

It is raining this morning with thick overcast skies. It rains through to the afternoon with showers on and off. By breakfast ABE is still being fixed and so it is not ready to go anytime before lunch. Jason is ready to go. We have decided to launch Jason just after lunch at 12:30. We do two CTDs this morning: MH123 and MH124

MH123: 3° 49.00' S, 152° 08.00'E Southeast of SuSu Knolls (planned 'W')

MH124: 3° 47.30' S, 152° 5.70'E Suzette Mound (planned 'O')

12:25 Jason Dive 226 launched - Suzette

Lat/long: 3°47.52' S, 152°05.77'E, 1525 m
UTM: 399641, 9580812 (WGS84 Zone 56S)

Jason reached bottom and found the elevator and began deploying the Nautilus sediment traps around the mound. Meanwhile it looks like ABE is fixed and we will evaluate a possible launch of ABE while Jason is down.

19:30 ABE 197 is launched and will transit from Suzette past North Su to South Su.

Launch Site: - 3º 47.531'S 152º 5.707'E
Although tracking is bad it looks like ABE has a problem and anchors. We will pick it up tomorrow morning.

JD234 - Tue 22 Aug 2006

Overcast and cloudy again today.
Elevator was sent an acoustic signal to release but it failed to leave the seafloor so Jason has to go back to the bottom and physically "pull the pin". Jason pulls the pin but the release is stiff and the elevator is also stuck in the mud. Finally, the elevator releases at 10:30. It should take about 40 mins to reach the surface. Jason will be hard pressed to beat it up.

11:24 Jason on deck
11:55 Elevator on deck

We now go and release ABE which has anchored at North Su nearby. There were some problems getting ABE to hear the release codes. Finally ABE is released and on the way to the surface.

15:45 ABE 197 on deck

Now go nearby and set up for a CTD over the top of North Su repeating an earlier cast (MH104) which had problems with the CTD hardware and bottle sampling.

MH125: 3° 48.00' S, 152° 6.20'E 1290 m North Su (repeat of MH-104)

17:55 Jason Dive 227 launched – Surprise and North Su-III

Lat/long: 3°48.70' S, 152°05.62'E, 1750 m
UTM: 399366, 9578641 (WGS84 Zone 56S)

19:30 Launch ABE 198 at south end of South Su.

Launch Site: - 3º 48.915'S 152º 5.966'E

JD235 - Wed 23 Aug 2006

Only partly cloudy today with some sunshine. The wind is down.
11:00 Jason on deck. End of Dive 227

ABE is still down and doing its last few tracks. It will finish at noon and then anchor with a fixed release time of 15:00. We decide to head over to Umbo for one last CTD cast there to see if the ridge on the west is responsible for the plume or not. We will come back for ABE by 15:00.

MH126: 3° 42.70' S, 151° 57.00'E 2050 m Umbo

Found a very strong plume over the narrow ridge extending out the northeast edge of Umbo ridge segment. The plume at 1650 has a secondary shallower plume as well. This plume has a 5% transmission anomaly. Definitely a hydrothermal source nearby. This now defines our last two nights here on station. We will dive with Jason tonight here at Umbo and then put ABE in tomorrow afternoon for one last mapping program

14:15 Head back to pick up ABE 198.
We are driving against a very strong current and winds and so our average speed is only about 9 kts. We get to the Abe recovery area at South Su by 15:45 and finally pick up ABE after releasing it.

16:52 ABE 198 on deck

We now recover all the transponders from the SuSu net

20:45 finished with the transponder recovery and proceed over to Umbo for the Jason dive site.

21:45 On site and begin Jason launch operations

22:59 Launch Jason Dive 228 Umbo
Lat/long: 3°42.70' S, 151°57.00'E, 2050 m
UTM: 383398, 9589674 (WGS84 Zone 56S)
X/Y: 7406, 6082 (local origin -3 -46 S 151 53E)

JD236 - Thu 24 Aug 2006

Calm seas today. Light rain showers in the late afternoon.
11:03 Jason on deck. End of Dive 228

Deploy a 2-transponder net at Umbo and survey that in.
Transponder 'Q' and 'R'
Umbo Net origin: -3° 46.0'S 151° 53.0' E

16:10 Launch ABE at Umbo. ABE dive 199
Lat/long: 3°42.651' S, 151° 56.865'E

16:36 Launch Jason Dive 229 Umbo
Lat/long: 3°42.70' S, 151°57.00'E, 2050 m
UTM: 383398, 9589674 (WGS84 Zone 56S)
X/Y: 7406, 6082 (local origin -3 -46 S 151 53E)

23:43 Jason on deck. End of Jason Dive 229. End of Jason ops for the cruise.

ABE has left the bottom and is on the way up. ABE has apparently found some Eh hits on four adjacent lines and in an area consistent with the CTD cast. Unfortunately, it was too late to vector Jason over there to check out the area. Once ABE is on deck and the data is downloaded we find out that ABE did NOT detect any Eh hits and so the source of the MH-126 plume remains a mystery.

JD237 - Fri 25 Aug 2006

01:45 ABE on deck. End of ABE 199. End of ABE ops for the cruise

Release Umbo transponders ‘Q’ and ‘R’.

16:15 Turn on SeaBeam and survey in on the transit into Rabaul.
SeaBeam coordinates:
3° 56.00’ S, 151° 56.50’E
4° 08.00’ S, 152° 15.00’E
4° 08.75’ S, 152° 16.00’E
4° 15.00’ S, 152° 16.00’E

09:00 Arrive in Rabaul in a pouring rainstorm along with lightning and thunder.
Customs paperwork is done and we move further out into Blanche Bay to transfer personnel and load provisions.

10:50 Personnel disembarked and provisions loaded and ship prepares to leave for Fiji.
The following people disembarked here at Rabaul:
Tim McConachy
Chris Yeats
Paul Poloka
Roy Price
Once the ship exits St Georges channel of PNG in between New Ireland and New Britain we have ocean swell making the ship move about more than we have been used to.

JD238 - Sat 26 Aug 2006

Sunny day. In transit to Fiji

JD239 - Sun 27 Aug 2006

In transit to Fiji

JD240 - Mon 28 Aug 2006

In transit to Fiji

JD241 - Tue 29 Aug 2006

In transit to Fiji

JD242 - Wed 30 Aug 2006

In transit to Fiji

JD243 - Thu 31 Aug 2006

In transit to Fiji

JD244 - Fri 1 Sep 2006

Arrive in Suva, Fiji

REFERENCES

Auzende, J.M., Urabe, T., Ruellan, E., Chabroux, D., Charlou, J.-L., Gena, K., Gamo, T., Henry, K., Matsubayashi, O., Matsumoto, T., Naka, J., Nagaya, Y., and Okamura, K., 1996a, Shinkai 6500 dives in Manus Basin: New STARMER Japanese-French Program: JAMSTEC J. Deep Sea Res., v. 12, p. 323-334.

Auzende, J.M., Urabe, T., and Party, S., 1996b, Submersible observation of tectonic, magmatic and hydrothermal activity in the Manus basin (Papua New Guinea): EOS Trans. AGU, WPGM Suppl. v. 77, p. 115.

Auzende, J.-M., Ishibashi, J., Beaudoin, Y., Charlou, J.-L., Delteil, J., Donval, J.-P., Fouquet, Y., Gouillou, J.-P., Ildefonse, B., Kimura, H., Nishio, Y., Radford-Knoery, J., and Ruellan, E., 2000, Extensive magmatic and hydrothermal activity documented in Manus Basin: EOS Trans. AGU, v. 81, p. 449-453.

Auzende, J.-M., Ishibashi, J., Beaudoin, Y., Charlou, J.-L., Delteil, J., Donval, J.-P., Fouquet, Y., Gouillou, J.-P., Ildefonse, B., Kimura, H., Nishio, Y., Radford-Knoery, J., and Ruellan, E., 2000, Rift propagation and extensive off-axis volcanic and hydrothermal activity in the Manus Basin (Papua New Guinea): MANAUTE Cruise: InterRidge News, v. 9, p. 21-25.

Bach, W., Roberts, S., Binns, R.A., Vanko, D.A., Yeats, C.J., and Craddock, P.R., Humphris, S.E. and ODP Leg 193 Scientific Party, 2003, REE and Sr isotope geochemistry of anyhydrite from the PACMANUS subseafloor hydrothermal system: EOS Trans. AGU, v. 82, p. OS11A-0345.

Bach, W., Roberts, S., Vanko, D.A., Binns, R.A., Yeats, C.J., Craddock, P.R., and Humphris, S.E., 2003, Controls of fluid chemistry and complexation on rare-earth element contents of anyhydrite from the Pacmanus subseafloor hydrothermal system, Manus Basin, Papua New Guinea: Mineralium Deposita, v. 38, p. 916-935.

Both, R., Crook, K., Taylor, B., Brogan, S., Chappell, B., Frankel, E., Liu, L., Sinton, J., and Tiffin, D., 1986, Hydrothermal chimneys and associated fauna in the Manus back-arc basin, Papua New Guinea: EOS Trans. AGU, v. 67, p. 489-491.

Binns, R.A., and Scott, S.D., 1993, Actively forming polymetallic sulfide deposits associated with felsic volcanic rocks in the eastern Manus Back-arc basin, Papua New Guinea: Econ. Geol., v. 88, p. 2226-2236.

Binns, R.A., Scott, S.D., Gemmell, J.B., Crook, K.A.W.C., and Shipboard Party, 1997, The SuSu Knolls hydrothermal field, eastern Manus Basin, Papua New Guinea: Eos (Transactions, American Geophysical Union), v. 78, p. 772.

Binns, R.A., F.J.A.S. Barriga, D.J. Miller et al., 2002, Proc. ODP Init. Results 193 [CD-ROM], Ocean Drilling Program, Texas A&M University, College Station, TX 77845-9547, 2002.

Bischoff, J.L., and Rosenbauer, R.J., 1984, The critical point and two-phase boundary of seawater, 200°-500°C: Earth Planet. Sci. Lett., v. 68, p. 172-180.

Craig, H., and Poreda, R., 1987, Studies of methane and helium in hydrothermal vent plumes, spreading axis basalts, and volcanic island lavas and gases in Southwest Pacific marginal basins: Scripps Inst. Oceanog. Reference 87-14, p. 80.

Douville, E., Bienvenu, P., Charlou, J.L., Donval, J.P., Fouquet, Y., Appriou, P., and Gamo, T., 1999, Yttrium and rare earth elements in fluids from various deep-sea hydrothermal systems - evidence for heat extraction from magma chambers or cracking fronts?: Geochim. Cosmo. Acta, v. 63, p. 627-643(17).

Edmond J.M., Massoth G., and Lilley M.D. (1992) Submersible-deployed samplers for axial vent waters. *RIDGE Events* **3**(1), 23-24.

Gamo T., Okamura K., Charlou J.L., Urabe T., Auzende J.M., Ishibashi J., Shitashima K., and Chiba H. (1997) Acidic and sulfate-rich hydrothermal fluids from the Manus back-arc basin, Papua New Guinea. *Geology* **25**, 139-142.

Guspi, F., 1987, Frequency-Domain reduction of potential field measurements to a horizontal plane: Geoexploration, v. 24, p. 87-98.

Hashimoto, J., and Ohta, S., 1999, Hydrothermal vent fields and vent-associated biological communities in the Manus Basin: SOPAC Cruise Report, v. 148, p. 18 pp.

Ishibashi, J., Yamanaka, T., Okamura, K., Gamo, T., Charlou, J.-L., Chiba, H., Shitashima, K., and Takahashi, H., 1997, Geochemical studies of magmatic hydrothermal activity in the DESMOS cauldron, Manus back arc basin: JAMSTEC Journal of Deep Sea Research, v. 13, p. 243-248.

Lisitsyn, A.P., Crook, K., Bogdanov, Y.A., Zonenshayn, L.P., Murav'yev, K.G., Tufar, W., Gurvich, Y., G., Gordeyev, V.V., and Ivanov, G.V., 1993, A hydrothermal field in the rift zone of the Manus Basin, Bismarck Sea: Int. Geol. Rev., v. 35, p. 105-126.

Martinez, F., and Taylor, B., 1996, Backarc spreading, rifting, and microplate rotation between transform faults in the Manus Basin: Mar. Geophys. Res., v. 18, p. 203-224.
Parker, R.L., and Huestis, S.P., 1974, The inversion of magnetic anomalies in the presence of topography: J. Geophys. Res., v. 79, p. 1587-1594.
Roberts, S., Teagle, D.A.H., Bach, W., Binns, R.A., Boyce, A.J., Holland, N., Vanko, D.A. and ODP Leg 193 Shipboard Scientific Party, 2001, Sr and stable isotope (S,O) chemistry of anhydrite and sulfide phases from the PACMANUS hydrothermal system, Manus Basin: Site 1188, ODP Leg 193: EOS Trans. AGU, v. 82, p. OS11A-0348.
Roberts, S., Bach, W., Binns, R.A., Vanko, D.A., Yeats, C.J., Teagle, D.A.H., Blacklock, K., Blusztajn, J., Boyce, A.J., Cooper, M.J., Holland, N., and McDonald, B., 2003, Contrasting evolution of hydrothermal fluids in the PACMANUS system, Manus Basin: The Sr and S isotope evidence: Geology, v. 31, p. 805–808.
Seewald, J.S., Doherty K.W., Hammar T.R. and Liberatore S.P. (2002). A new gas-tight isobaric sampler for hydrothermal fluids, Deep-Sea Research 49, 189-196.
Tufar, W., 1990, Modern hydrothermal activity, formation of complex massive sulfide deposits and associated vent communities in the Manus Back-Arc Basin (Bismarck Sea, Papua New Guinea): Mitteilung der Osterreichen Geologischen Gesellshaft, v. 82, p. 183-210.
Vanko, D.A., Bach, W., Roberts, S., Yeats, C.J., and Scott, S.D., 2004, Fluid inclusion evidence for subsurface phase separation and variable fluid mixing regimes beneath the deep-sea PACMANUS hydrothermal field, Manus Basin backarc rift, Papua New Guinea: Jour. Geophys. Res., v. 109, p. doi:10.1029/2003JB002579.
Yeats, C.J., Binns, R.A., and Parr, J.M., 2000. Advanced argillic alteration associated with actively forming, submarine polymetallic sulfide mineralisation in the Eastern Manus Basin, Papua New Guinea. Geol. Soc. Aust., 59:555. (Abstract)
Yeats, C.J., Bach, W., Vanko, D.A., Roberts, S., and Lackschewitz, K.S., Paulick, H. and ODP Leg 193 Shipboard Scientific Party, 2001, Fluid-dacite interaction inthe PACMANUS subseafloor hydrothermal system - preliminary results from secondary mineral chemistry and geochemical modeling: EOS Trans. AGU, v. 82, p. OS11A-0346.

Table 2. MGLN06MV Transponder Nets

Net	Lat (S)	Long (E)	X(UTM)	Y(UTM)	X	Y	Depth	
Origin Vienna Woods	**-3 -13.00000**	**150 15.00000**	**194355.33**	**9644046.12**	**0**	**0**		
A	-3 -10.78370	150 16.88897	197846.25	9648143.03	3499.2	4084.3	2245.7	R
B	-3 -9.41359	150 18.43444	200704.70	9650677.38	6362.1	6609.2	2192.5	R
C	-3 -8.31898	150 20.26235	204088.16	9652704.80	9748.2	8626.4	2295.1	R
D	-3 -7.56005	150 22.27316	207812.27	9654113.83	13473.1	10025.0	2311.7	R
E	-3 -3.34575	150 25.30472	213413.19	9661899.31	19088.9	17791.3	2336.7	NR
F	-3 -2.95087	150 26.80318	216189.33	9662634.12	21864.7	18519.0	2304.7	R
Origin PacManus	**-3 -45.00000**	**151 39.00000**	**350084.44**	**9585390.86**	**0**	**0**		
G	-3 -43.05982	151 40.91596	353625.79	9588971.50	3547.2	3575.5	1469.7	R
H	-3 -42.45695	151 40.10884	352129.98	9590080.19	2052.9	4686.5	1522.6	R
I	-3 -44.26913	151 39.47996	350970.86	9586739.04	888.6	1346.9	1452.6	R
Origin SuSu	**-3 -50.000**	**152 04.000**	**396369.60**	**9576238.71**	**0**	**0**		
J	-3 -46.16115	152 5.78460	399664.97	9583315.24	3303.7	7074.5	1429.3	R
K	-3 -47.32998	152 7.41223	402679.59	9581164.80	6316.8	4920.5	1365.5	R
O	-3 -49.43995	152 7.57067	402976.75	9577277.55	6610.1	1032.1	1375.7	R
P	-3 -49.94785	152 5.60667	399342.96	9576337.99	2974.3	96.1	1456.6	R
Origin NE Pual	**-3 -43.00**	**151 41.0000**	**353781.20**	**9589081.96**	**0**	**0**		
L	-3 -38.83871	151 43.15029	357750.78	9596755.83	3981.2	7668.7	1539	R
M	-3 -40.24158	151 42.04711	355712.19	9594167.82	1938.7	5083.4	1548.2	R
N	-3 -40.19725	151 42.07077	355755.86	9594249.58	1982.5	5165.1	1574	R
Origin Desmos	**-3 -43.0020**	**151 51.9800**	**374106.63**	**9589106.45**	**0**	**0**		
Origin Umbo	**-3 -46.0000**	**151 53.0000**	**376001.75**	**9583584.75**	**0**	**0**		
Q	-3 -43.53043	151 56.79526	383021.05	9588143.83	7026.4	7026.4	1866.5	R
R	-3 -43.41550	151 57.84643	384966.51	9588357.90	8972.5	4762.9	1864.6	R

Table 3. JASON Dive Statistics – MANUS 2006

(Time in GMT, for reference Local time is GMT+10)

Leg-1 Vienna Woods – Manus Ridge

DIVE	Start/launch	Start data	End data	End/On deck	Net/Area	Data Duration	Dive Duration
J2-200	7/22/2006 12:03	7/22/2006 14:49	7/23/2004 7:37	7/23/2006 10:01	Vienna Woods	16:47:43	21:58:39
J2-201	7/24/2006 15:47	7/24/2006 8:18	7/24/2004 20:04	7/24/2006 22:50	VW-Tufar#2	11:46:05	17:02:59
J2-202	7/25/2006 6:38	7/25/2006 9:00	7/25/2004 21:59	7/26/2006 0:03	Vienna Woods	12:59:31	17:24:29
J2-203	7/26/2006 9:19	7/26/2006 10:55	7/27/2004 0:57	7/27/2006 2:28	North-Vienna Woods	14:01:40	17:08:48
J2-204	7/27/2006 9:54	7/27/2006 12:33	7/27/2004 23:09	7/27/2006 0:27	Tufar#3	10:36:00	14:33:00
J2-205	7/28/2006 10:02	7/28/2006 11:39	7/28/2004 22:08	7/28/2006 23:32	Tufar#3	10:28:19	13:29:48
J2-206	7/29/2006 8:20	7/29/2006 10:07	7/29/2004 23:54	7/29/2006 1:16	North Manus Ridge	13:47:09	16:55:43
J2-207	7/30/2006 12:18	7/30/2006 13:38	7/30/2004 23:38	7/30/2006 1:28	Vienna Woods - Fluids	9:39:16	13:09:52
TOTAL					Totals:		

Leg-2 East Manus Basin

DIVE	Start/launch	Start data	End data	End/On deck	Area/NET	Data Duration	Dive Duration
J2-208	8/2/2006 9:26	8/2/2006 10:47	8/2/2006 23:55	8/3/2006 1:03	Roman Ruins Pacmanus	13:07:37	15:37:22
J2-209	8/3/2006 9:35	8/3/2006 10:51	8/3/2006 23:49	8/4/2006 1:08	Satanic Mills Pacmanus	12:58:00	15:33:00
J2-210	8/4/2006 9:01	8/4/2006 10:23	8/4/2006 23:54	8/5/2006 1:11	Snowcap Pacmanus	13:31:00	16:10:00
J2-211	8/5/2006 8:06	8/5/2006 9:23	8/5/2006 23:55	8/6/2006 1:06	Tsukushi Pacmanus	14:32:00	17:00:00
J2-212	8/6/2006 8:07	8/6/2006 9:16	8/6/2006 23:45	8/7/2006 1:06	Fenway Pacmanus	14:29:00	16:59:00
J2-213	8/7/2006 9:02	8/7/2006 10:30	8/7/2006 0:05	8/8/2006 1:08	Roman Ruins Pacmanus	13:35:00	16:06:00

J2-214	8/8/2006 8:04	8/8/2006 9:09	8/8/2006 23:55	8/9/2006 1:03	Satanic Mills Pacmanus	14:46:00	16:59:00
J2-215	8/9/2006 8:03	8/9/2006 9:21	8/9/2006 23:58	8/10/2006 1:05	Roman Ruins Pacmanus	14:37:00	17:02:00
J2-216	8/10/2006 9:03	8/10/2006 10:10	8/10/2006 23:54	8/11/2006 1:07	Fenway Pacmanus	13:44:00	16:04:00
J2-217	8/12/2006 10:38	8/12/2006 11:48	8/12/2006 23:48	8/13/2006 1:04	Suzette SuSu	12:00:52	14:26:24
J2-218	8/13/2006 8:39	8/13/2006 9:54	8/13/2006 23:47	8/14/2006 1:06	NE Pual NE Pual	13:53:48	16:26:13
J2-219	8/14/2006 7:56	8/14/2006 9:10	8/15/2006 0:02	8/15/2006 1:02	Suzette SuSu	14:51:46	17:05:35
J2-220	8/15/2006 8:19	8/15/2006 9:40	8/16/2006 0:02	8/16/2006 1:04	Desmos No net	14:21:52	16:45:23
J2-221	8/16/2006 9:08	8/16/2006 10:27	8/16/2006 23:50	8/17/2006 1:05	North Su SuSu	13:22:51	15:56:43
J2-222	8/17/2006 8:03	8/17/2006 9:14	8/17/2006 23:49	8/18/2006 1:04	Roman Ruins Pacmanus No net	14:34:43	17:00:53
J2-223	8/18/2006 8:58	8/18/2006 9:55	8/19/2006 0:03	8/19/2006 0:57	North Su SuSu	14:08:15	15:59:22
J2-224	8/19/2006 8:16	8/19/2006 9:28	8/19/2006 23:54	8/19/2006 1:02	South Su SuSu	14:25:44	**:45:22
J2-225	8/20/2006 9:15	8/20/2006 10:28	8/20/2006 11:22	8/20/2006 12:16	Suzette (Abandoned)	0:53:55	3:01:09
J2-226	8/21/2006 2:25	8/21/2006 3:32	8/22/2006 0:33	8/22/2006 1:24	Suzette SuSu	21:01:19	22:59:00
J2-227	8/22/2006 7:55	8/22/2006 9:13	8/23/2006 23:56	8/23/2006 01:00	Surprise/S. Su/N. Su	14:42:45	17:05:01
J2-228	8/23/2006 11:59	8/23/2006 13:24	8/23/2006 23:43	8/24/2006 1:03	Umbo No net	10:18:27	13:03:43
J2-229	8/24/2006 6:36	8/24/2006 7:41	8/24/2006 12:28	8/24/2006 13:43	Umbo	4:46:21	7:07:28
TOTAL	30 Dives				Totals:		

Table 4. ABE Dive Statistics

(Local Time GMT+10)

Dive	Launch	Recovery	Area	Survey duration (hrs)	Survey Distance (km)
182	07/23/2006 08:17:48	07/24/2006 03:33:47	Vienna Woods	13.53	28.3
183	07/24/2006 21:10:24	07/25/2006 14:01:08	Vienna Woods-North	11:41	24.0
184	07/26/2006 12:50:12	07/26/2006 18:20:16	Tufar#3 ABORTED	0.48	0.2
185	07/26/2006 22:26:46	07/27/2006 18:25:25	Tufar#3	13.71	26.1
186	07/28/2006 16:12:29	07/28/2006 17:35:35	Manus North-1	19.77	27.8
187	07/30/2006 08:15:48	07/31/2006 17:33:11	Manus North-2	27.86	27.8
188	08/01/2006 17:38:25	08/02/2006 10:55:09	Pacmanus	13.11	27.0
189	08/03/2006 14:23:10	08/04/2006 16:21:49	Suzette	13.94	25.2
190	08/05/2006 17:25:57	08/06/2006 12:51:02	Pacmanus	14.64	30.25
191	08/07/2006 11:29:59	08/08/2006 13:21:37	Pacmanus-North	5.21	10.6
192	08/10/2006 16:22:31	08/11/2006 16:29:01	North Pual	14.98	32.4
193	08/12/2006 13:16:17	08/13/2006 15:36:31	North Pual (ABORTED)	2.37	4.8
194	08/14/2006 16:04:31	08/15/2006 14:07:44	SuSu Knolls	14.16	23.2
195	08/16/2006 18:24:41	08/17/2006 12:42:31	South Su	14.51	26.1
196	08/18/2006 16:25:01	08/19/2006 12:36:34	South Su (ABORTED)	0.56	0.8
197	08/21/2006 19:21:57	08/22/2006 15:14:02	South Su (ABORTED)	*17.17	14.1
198	08/22/2006 20:53:59	08/23/2006 16:48:02	South Su	13.43	25.7
199	08/24/2006 16:02:18	08/25/2006 01:47:18	Umbo	5.58	9.8
TOTAL	18 Dives			216.42	364.15

Table 5. CTD Operations

CTD #	Site	Date	Latitude	Longitude	Comment
MH-101	NE Pual Ridge	1st August 2006	3 41.75 S	151 43.50 E	Broad, weak (0.1%) plume. Distal PACMANUS plume (?).
MH-102	NE Pual Ridge (planned D)	2nd August 2006	3 41.00 S	151 44.00 E	Weak (<0.2%) diffuse two layer plume from 1380-1730db. Same plume as per MH-101, slightly better defined. Distal PACMANUS plume?
MH-103	NE Pual Ridge (planned E)	3rd August 2006	3 40.75 S	151 43.50 E	Weak (<0.2%) diffuse two layer plume from 1460-1730db. Same plume as seen in MH-101 & MH-102
MH-104	North Su (planned S)	4th August 2006	3 48.00 S	152 06.20 E	Excellent downcast through an intense (1160-1200db, lowest Tx ~83%) and less intense (1200-1250db, lowest Tx ~ 93%) two layer plume.
MH-105	NE Pual Ridge (planned C)	5th August 2006	3 40.50 S	151 44.00 E	Nice sharp proximal looking plume from ~1700 - 1765 db with peak Tx ~1.6%.
MH-106	NE Pual Ridge	6th August 2006	3 40.50 S	151 45.50 E	Complex plume - distal PACMANUS (from ~1500 m depth) and a weaker expression of the NE Pual plume seen in MH-105.
MH-107	NE Pual Ridge	7th August 2006	3 40.50 S	151 45.50 E	Similar result to MH-106, interference between weak, distal PACMANUS plume and stronger NE Pual plume.
MH-108	Roman Ruins (planned G)	7th August 2006	3 43.25 S	151 40.50 E	Sharp ~3% Tx plume from 1450db to bottom of cast.
MH-109	NE Pual Ridge	8th August 2006	3 40.50 S	151 44.50 E	Negative result: weak distal PACMANUS plume (~0.1% Tx reduction at ~1550db); weak NE Pual plume (~0.1% at ~1750db).
MH-110	NE Pual Ridge	9th August 2006	3 43.72 S	151 40.33 E	Sharp proximal plume (~2% drop in Tx) from ~1500-1600db, peak from ~1530-1570db. Also ~0.1ºC T anomaly, at bottom of cast.
MH-111	Snowcap (planned H)	11th August 2006	3 43.75 S	151 40.00 E	Sharp plume top at ~1475db (~0.7% Tx anomaly). CTD remained in plume until bottom of cast (1660db, 8 metres above bottom).
MH-112	East Umbo Basin (planned I)	11th August 2006	3 43.00 S	151 57.50 E	Broad plume with sharp lower cutoff from ~1480 to 1710db. Peak just above base, at ~0.7% reduction in transmission
MH-113	North Su (planned R)	11th August 2006	3 47.90 S	152 06.00 E	Sharp, narrow plume between 1205-1250db, with a peak drop in transmission of ~2.5% at its top. Does not correspond to the main North Su Plume seen in MH-104, but correlates well with the subplume that underlies it.
MH-114	East Umbo Basin (planned I)	15th August 2006	3 43.00 S	151 56.00 E	Weal plume from ~1500db to bottom of cast at 2000db, max -0.4% light transmission at 1600db gradually dropping.
MH-115	East Umbo Basin	16th August 2006	3 42.50 S	151 57.00 E	Weak plume from ~1500-1800db (-0.4% Tx peak at 1600db); better defined than plume in MH-114, but not as distinct nor strong as MH-112.
MH-116	Central Pual Ridge (planned F)	18th August 2006	3 42.00 S	151 42.00 E	Two tier plume: upper plume from ~1440-1490db, peak -0.5% Tx at 1460db; lower plume from ~1500-1600db, with tail to bottom of cast with peaks of -0.8% Tx at 1510, and -0.6% at 1550db.

MH-117	East Umbo Basin	18th August 2006	3 44.00 S	151 57.00 E	Broad plume from ~1470db to peak Tx of -0.4% at 1570db, tailing off gradually to ~1800db.
MH-118	East Umbo Basin	19th August 2006	3 42.77 S	151 56.53 E	Broad plume (~1450-1800db) of low intensity (~-0.4% peak in Tx at 1680db).
MH-119	North Su (planned T)	20th August 2006	3 48.20 S	152 06.20 E	Sharp (~1100 -1120db), high intensity (~3.5% peak drop in Tx) plume, with additional zone of 0.1-0.3% Tx "fog" from 1180db to bottom of cast (1350db, 18 mab), including a weak coherent response from ~1180-1240db.
MH-120	Nimab	20th August 2006	3 49.10 S	152 11.25 E	No evidence of hydrothermal activity.
MH-121	Suzette (planned P)	20th August 2006	3 47.50 S	152 06.00 E	Three plumes: sharp (~1135 -1145db), high intensity (~2.5% peak drop in Tx) plume, probably from N Su; sharp (~1435-1455db), moderate intensity (0.6% peak drop in Tx) plume, probably from Suzette; weak (~0.2% Tx); broad bottom hugging plume . from 1490db to bottom of cast (1586m, 8 mab), also probably from Suzette.
MH-122	South Su (planned U)	20th August 2006	3 48.60 S	152 06.40 E	Four plumes: very weak (~0.1% peak drop in Tx) broad plume from ~950-1000db; high intensity (~2% peak drop in Tx) sharp plume from ~1133-1138db, probably from N Su; two layer weak (0.4% peak drop in Tx) plume from ~1230-1260db; weak (~0.3% peak drop in Tx); broad bottom hugging plume from 1350db to bottom of cast (1381db, 11 mab).
MH-123	SE of SuSu Knolls (planned W)	21st August 2006	3 49.00 S	152 08.00 E	Low intensity plume (~0.1% peak drop in Tx) ~1080-1140db, probably distal expression of N Su plume. Also a very weak (<0.1% Tx) response from 900-1000db.
MH-124	Suzette (planned O)	21st August 2006	3 47.30 S	152 05.70 E	Very sharp, ~5m wide 0.6% Tx anomaly @ 1145-1150db – probably from N Su. Dual layer bottom hugging plume (most likely from Suzette), with a 0.4% peak Tx, from 1440db to bottom of cast (1525db, 10mab). Two shallower broad weak responses (<0.1% Tx) from ~940-1030db and ~1070-1125 db.
MH-125	North Su (repeat of MH-104)	22nd August 2006	3 48.00 S	152 06.20 E	High intensity (-10% Tx) sharply defined two-layer plume 50m in width. Position shifted by 10m between the downcast and upcast of the operation (downcast ~1120-1170db, upcast ~1110-1160db), attributed to billowing.
MH-126	East Umbo	23rd August 2006	3 42.70 S	151 57.00 E	Excellent result. Intense well defined hydrothermal plume from 1640-1680 db. Peak transmission drop of ~3.5% during the downcast and ~5% during the upcast. The plume has a low intensity (0.1-0.5% Tx) halo both above (from 1410db) and below (to 1750 db). Close examination of the plume post-cast revealed a distinct two-tier structure, with an upper ~2% Tx peak from 1640-1660db (not sampled in the cast) and a lower main ~5% Tx peak from ~1660-1680db.

Table 6. Fluid samples (IGT, Major, Niskin)

Number of fluid samples (IGT, Major, Niskin), Temperature measurements and Markers at each vent site. Number of successful fluid-active sulfide pairs also indicated.

Site	Niskin	Marker	Temperature	IGT	MAJOR	PAIRS	TOTAL
Desmos	1	0	5	4	2	0	12
Fenway	3	2	19	11	5	2(1)*	43
NE Paul	1	0	3	2	1	0	7
North Su	1	0	20	12	6	2(1)	42
Off Site	1	0	0	0	0	0	1
Rogers Ruins	0	1	2	4	2	2	11
Roman Ruins	1	4	17	8	4	4	38
Satanic Mills	2	0	4	5	3	3	17
Snowcap	1	1	4	4	2	0	12
South Su	1	0	8	4	2	2	17
Suzette	0	3	25	12	5	3(2)	50
Tsukushi	0	0	2	3	1	0	6
Umbo	0	0	0	0	1	0	1
Vienna Woods	0	0	0	5	1	2(1)	9
West of South Su	0	1	1	0	0	0	2

Table 7. Geological samples recovered from each vent site

Site	Active Sulfide (1)	Inactive Sulfide (2)	Sulfur (3)	Massive Anhydrite (4)	Massive Sulfide (5)	Stock-work (6)	Volcani-clastite (7)	Altered Lava (8)	Fresh Lava (9)	Crust (10)	Sed-iment (11)	TOTAL
Desmos			2					10	4			16
Fenway	12	10		7	2	1	1	3		1	4	36
NE Paul		1							4		1	5
North Su	9	4	2	1		1	10	3	10	2	2	40
Off Site												0
Rogers Ruins	2	2										4
Roman Ruins	9	9				3	2	6	4	2		33
Satanic Mills	5	6				3		1	1	1		16
Snowcap		4	2				6	3	1	1	1	16
South Su	5	2					2	3	3	2		15
Suzette	15	10			5			1	2	1	2	33
Tsukushi		1							2	3		3
Umbo									2			2
Vienna Woods	5	35				1			5	4	2	46
West of South Su								3	2		1	5
Tufar 2+3	1	26			1			1				29
Bronze Age Fort		3						2	3			8
TOTAL	63	113	6	8	8	9	21	36	43	17	13	307

(1) Samples from active hydrothermal chimneys (black and gray smokers), diffusers and flanges. Each sample should correspond to one Temperature measurement and/or one IGT sample

(2) Sulfide samples from inactive hydrothermal chimneys and diffusers. Inactive chimneys could be in place on sulfide mound, volcanic rocks or sediments or as broken pieces from talus. Inactive sulfides include also relict, altered chimneys (but not completely altered)

(3) Elemental Sulfur samples, either as amorphous deposits or crystallized minerals. Color ranging from yellow, white and black

(4) Samples from Massive anhydrite are composed of >80% of euhedral to massive anhydrite crystals with various amounts of sulfides, possible barite

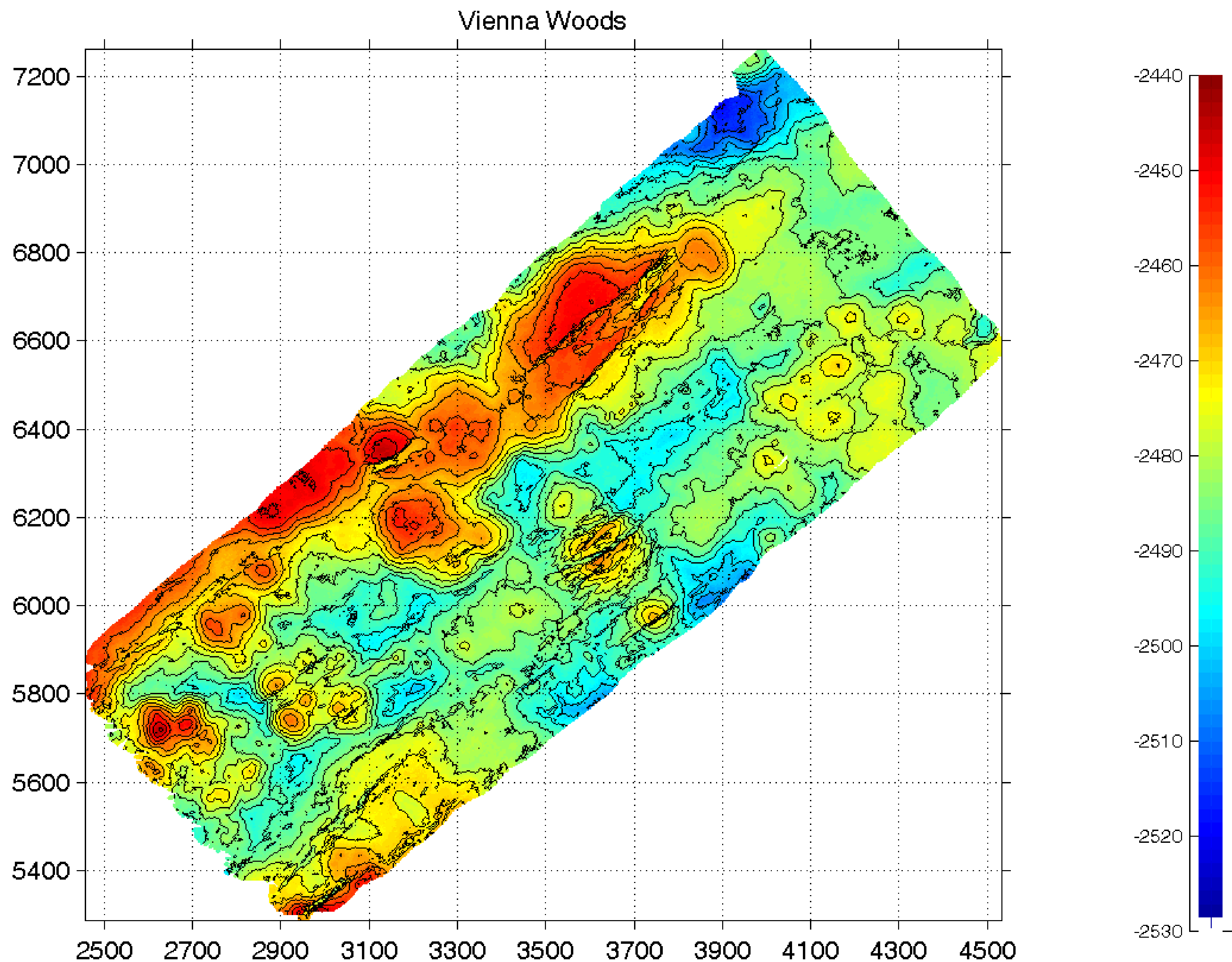
(5) Samples from Massive Sulfides are inactive sulfide deposits showing no obvious chimney structures.

(6) Stockwork samples are sulfide-rich rocks with various proportions of altered to fresh lava clasts (or relicts). Stockworks are composed mostly of massive sulfide as matrix (in some case, fragments of active chimneys have been identified e.g. 208-10-R1)
(7) Volcanoclastite is a general term used to refer to breccia and hyaloclastite rocks with volcanic clasts. Alteration of clasts is highly variable and matrix may be composed of clays, sulfides or elemental S. When sulfide veining and replacement is obvious, samples are classified as Stockwork

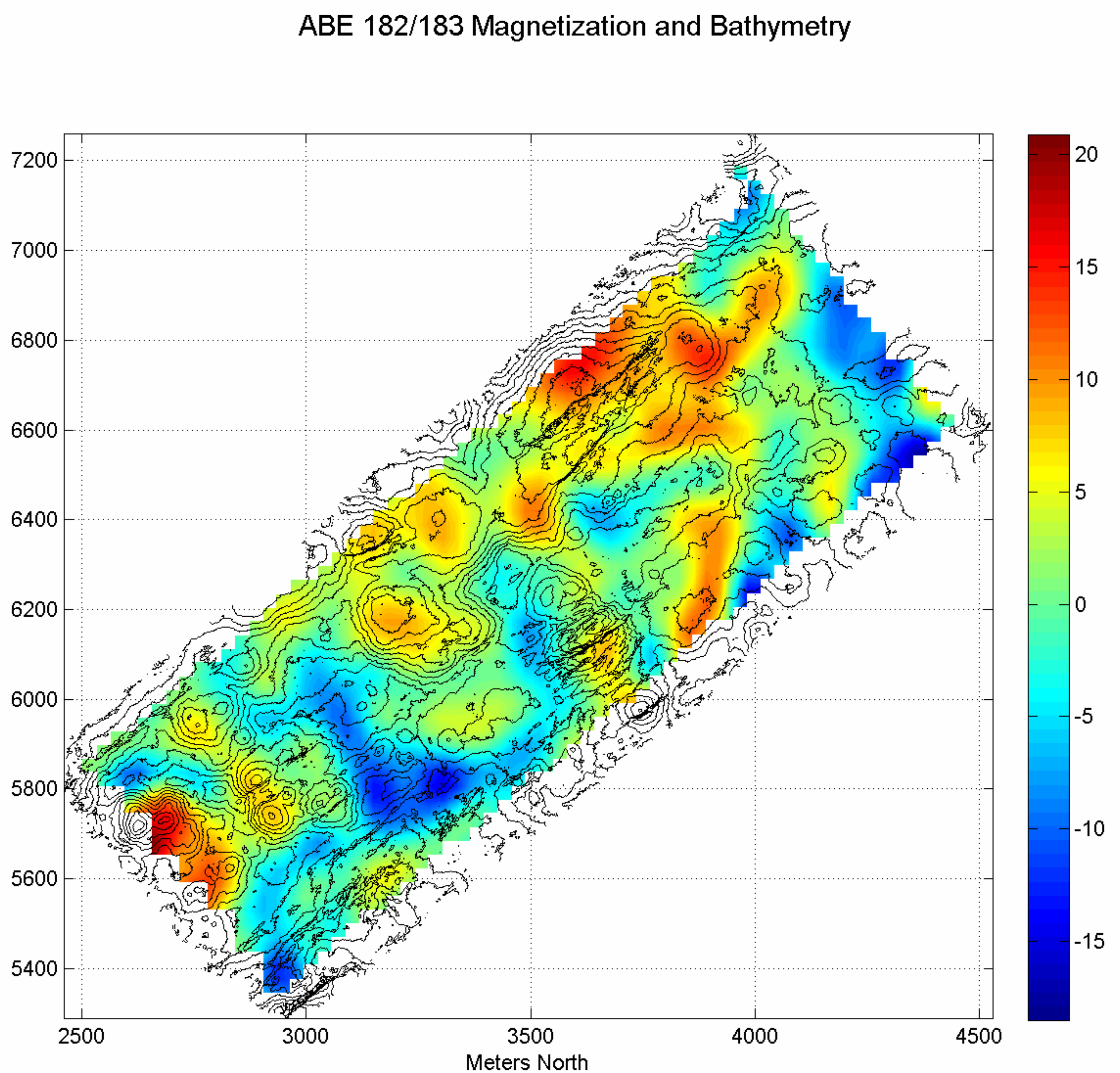
(8) Altered lava rocks range from partially altered lavas with alterations halos or pervasive alteration to advanced argilic alteration

(9) Fresh lava samples include glassy to aphanitic volcanic rocks. Various abundances of phenocrysts and vesicules (including pumice)

(10) Crusts include large range of rock types such as a) completely altered/oxidized sulfide chimneys,b) indurated crusts covering sediments or hyaloclastites, c) Fe-oxides crusts from sulfide mounds and d) primary Fe-oxides precipitated from low-temperature vents
(11) Sediments are mainly soft, clay-rich to sandy rocks recovered using the Scoop or Push Core tools of Jason (but not always). Sediment samples include deep sea clays, variably altered volcanic rock clasts, Fe-oxides, sulfides and elemental S

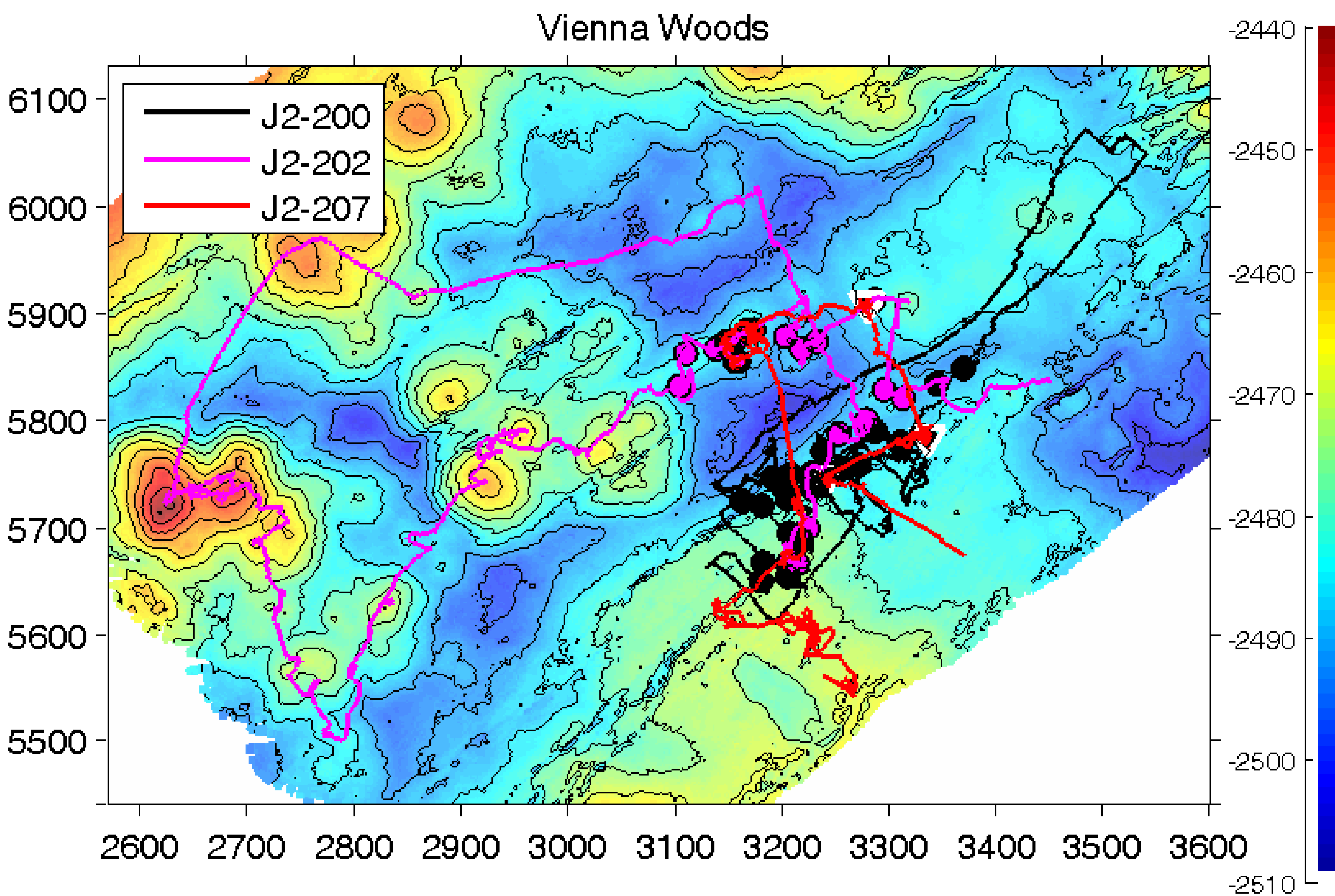

Vienna Woods
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
2500
2700
2900
3100
3300
3500
3700
3900
4100
4300
4500
-2440
-2450
-2460
-2470
-2480
-2490
-2500
-2510
-2520
-2530

Map 1

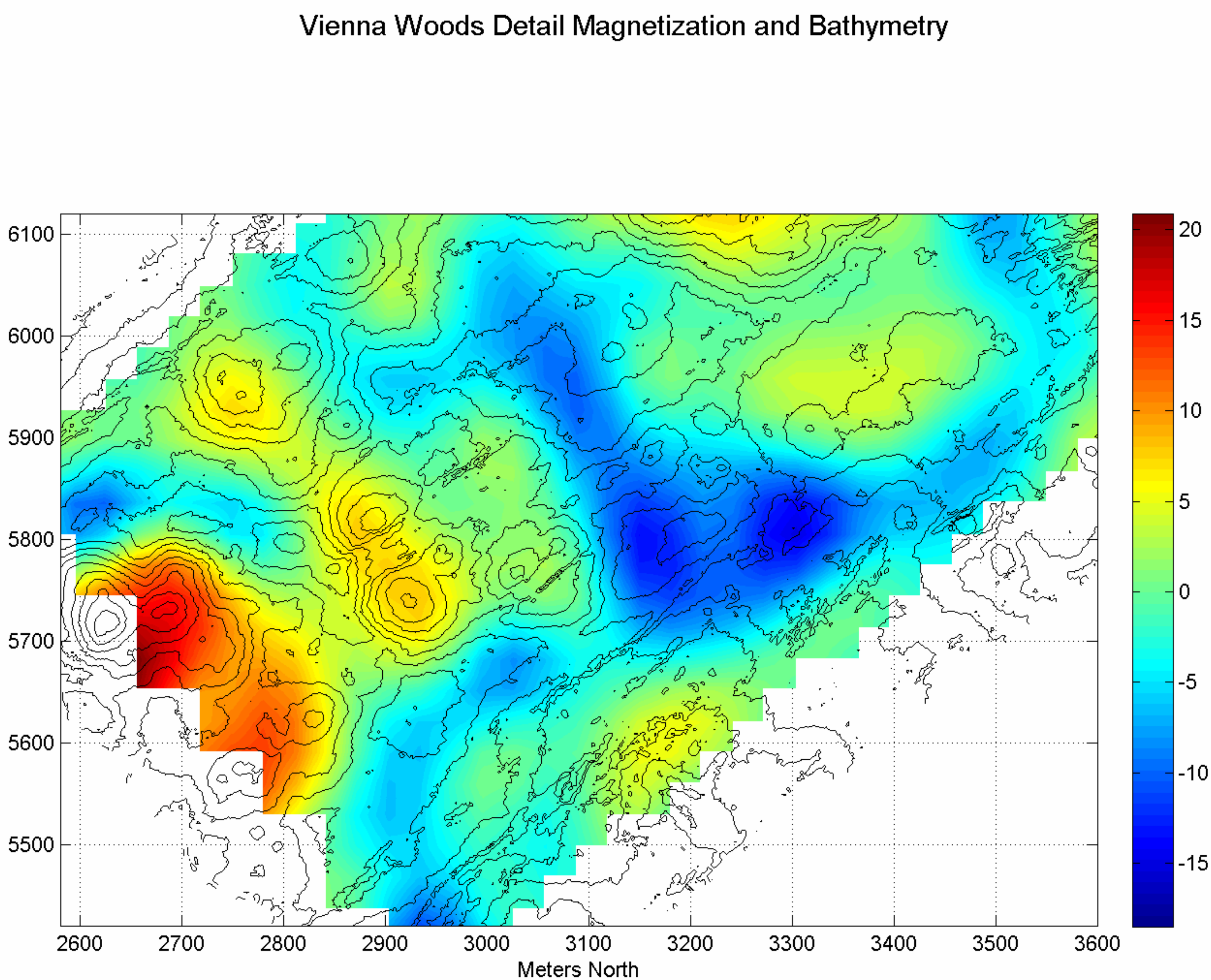


ABE 182/183 Magnetization and Bathymetry
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
2500
3000
3500
4000
4500
Meters North
20
15
10
5
0
-5
-10
-15

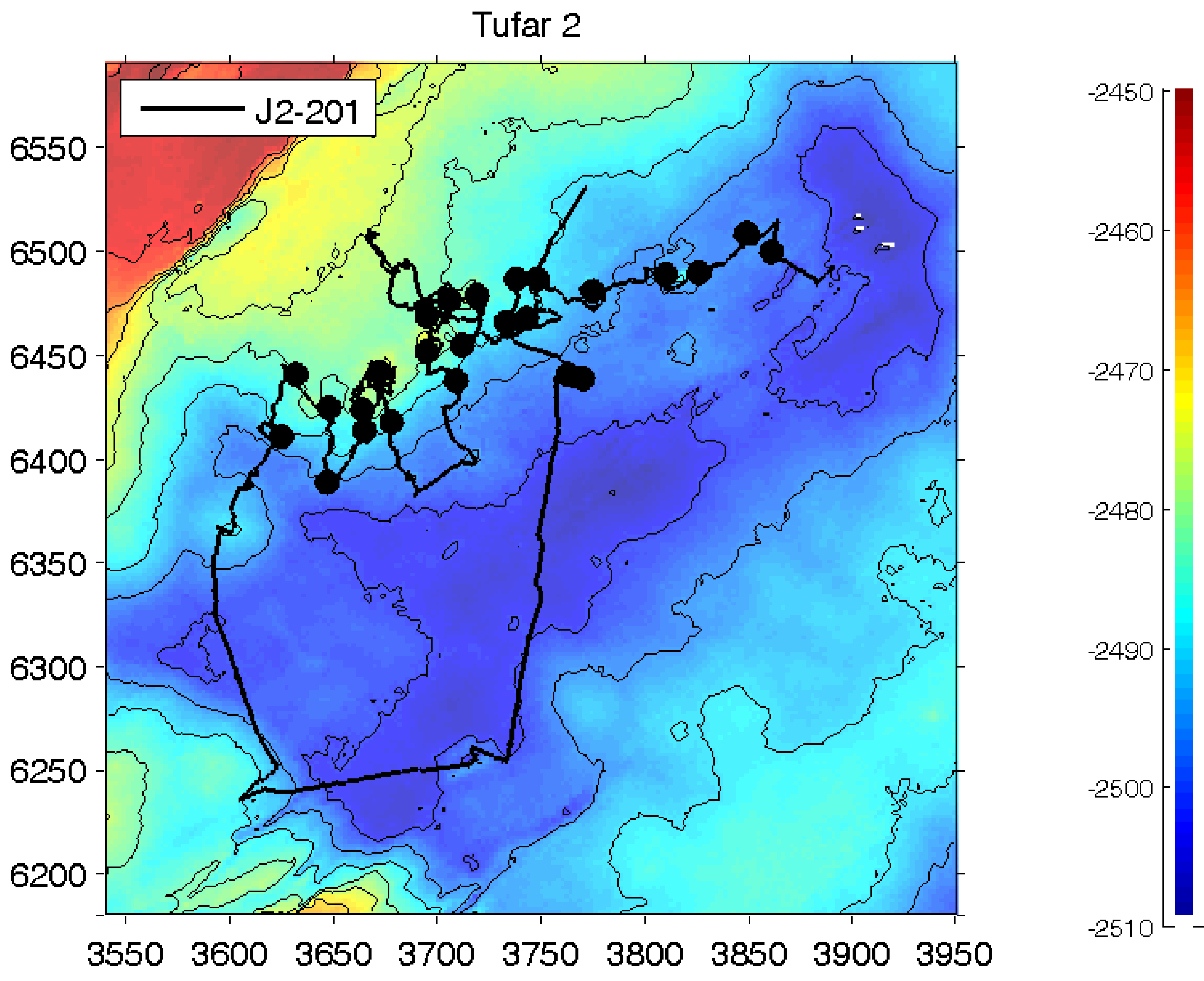
Map 2


Vienna Woods
J2-200
J2-202
J2-207
6100
6000
5900
5800
5700
5600
5500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
-2440
-2450
-2460
-2470
-2480
-2490
-2500
-2510

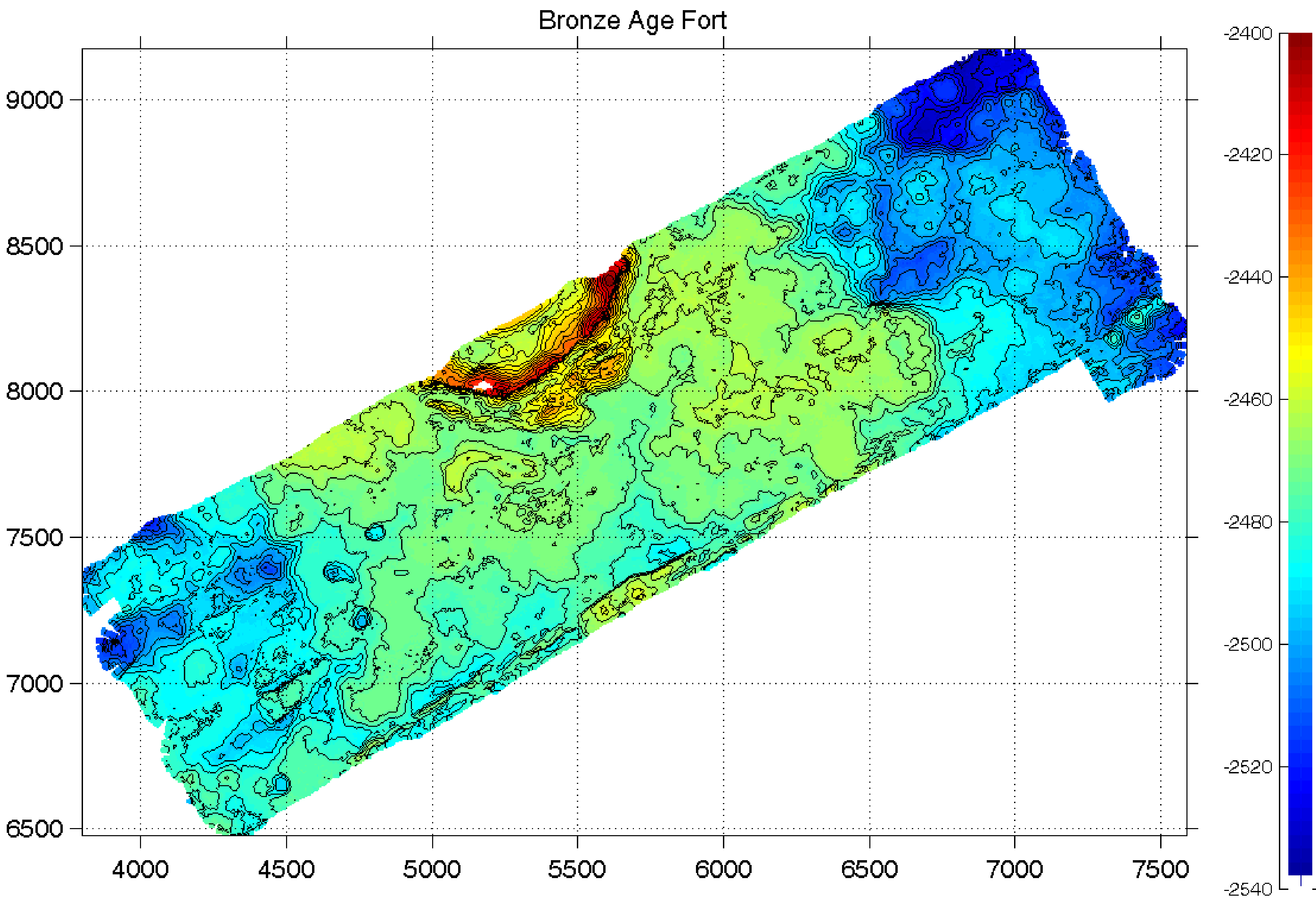
Map 3


Vienna Woods Detail Magnetization and Bathymetry
6100
6000
5900
5800
5700
5600
5500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
Meters North
20
15
10
5
0
-5
-10
-15

Map 4

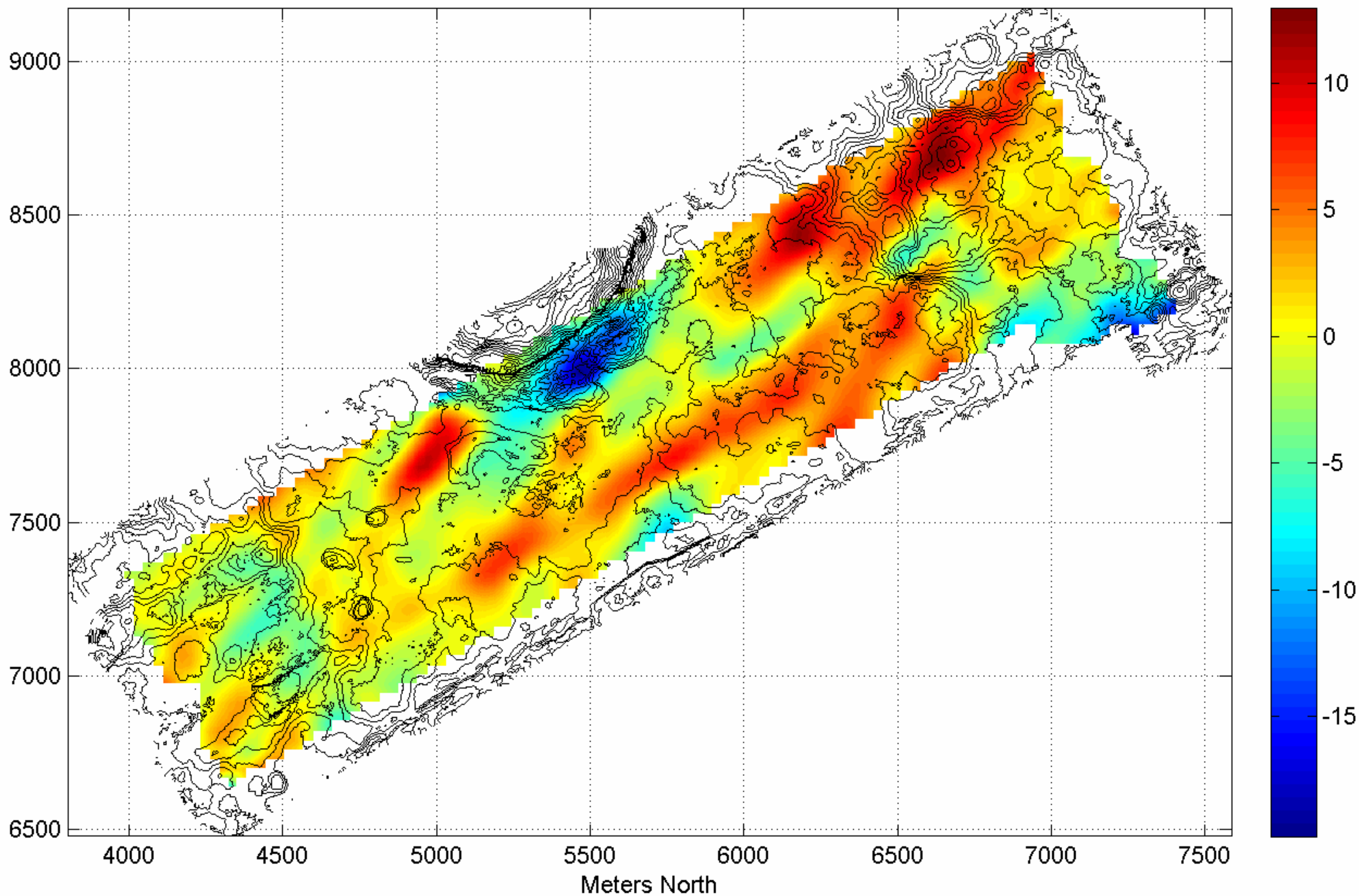

Tufar 2
J2-201
6550
6500
6450
6400
6350
6300
6250
6200
3550
3600
3650
3700
3750
3800
3850
3900
3950
-2450
-2460
-2470
-2480
-2490
-2500
-2510

Map 5

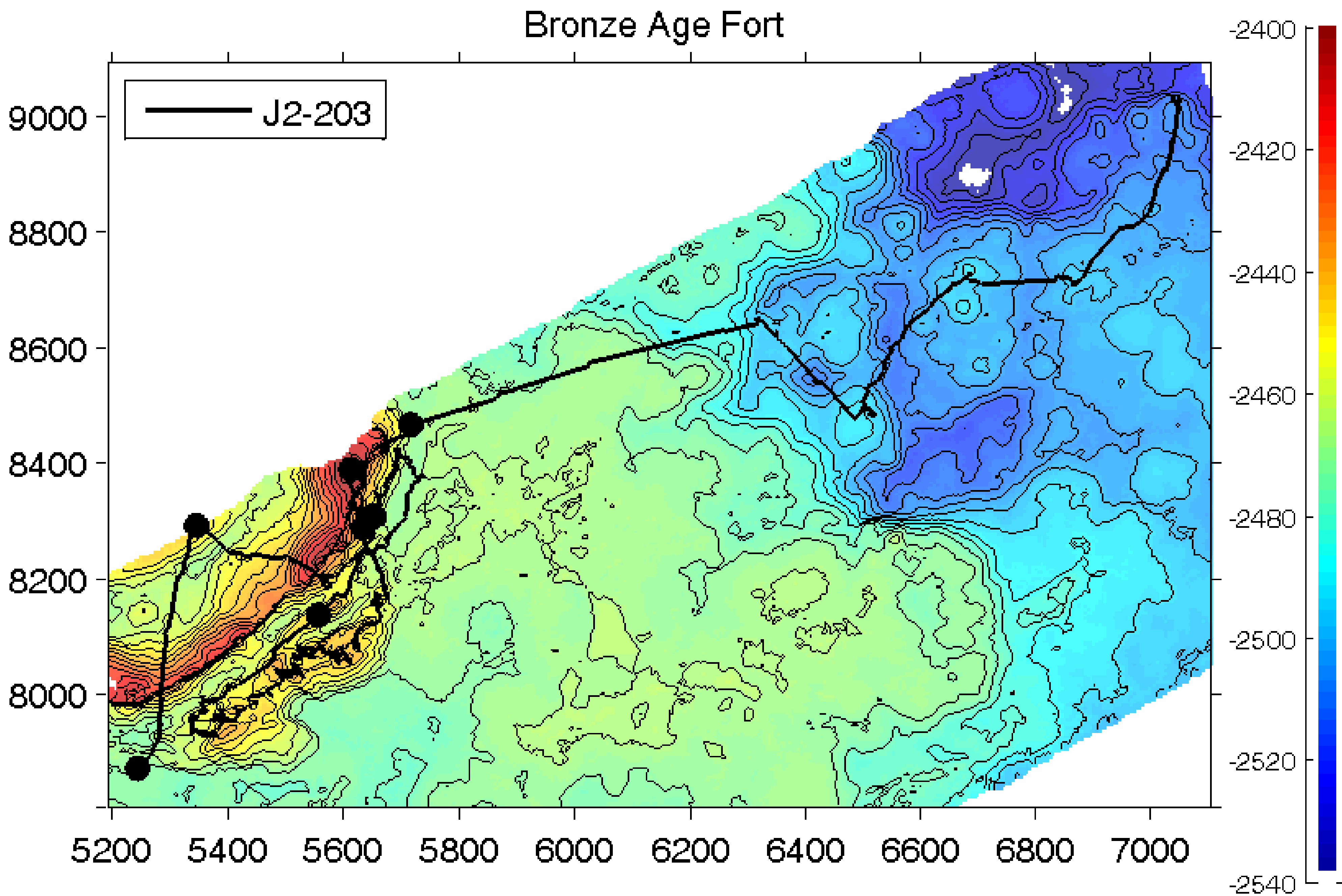

Bronze Age Fort
9000
8500
8000
7500
7000
6500
4000
4500
5000
5500
6000
6500
7000
7500
-2400
-2420
-2440
-2460
-2480
-2500
-2520
-2540

Map 6

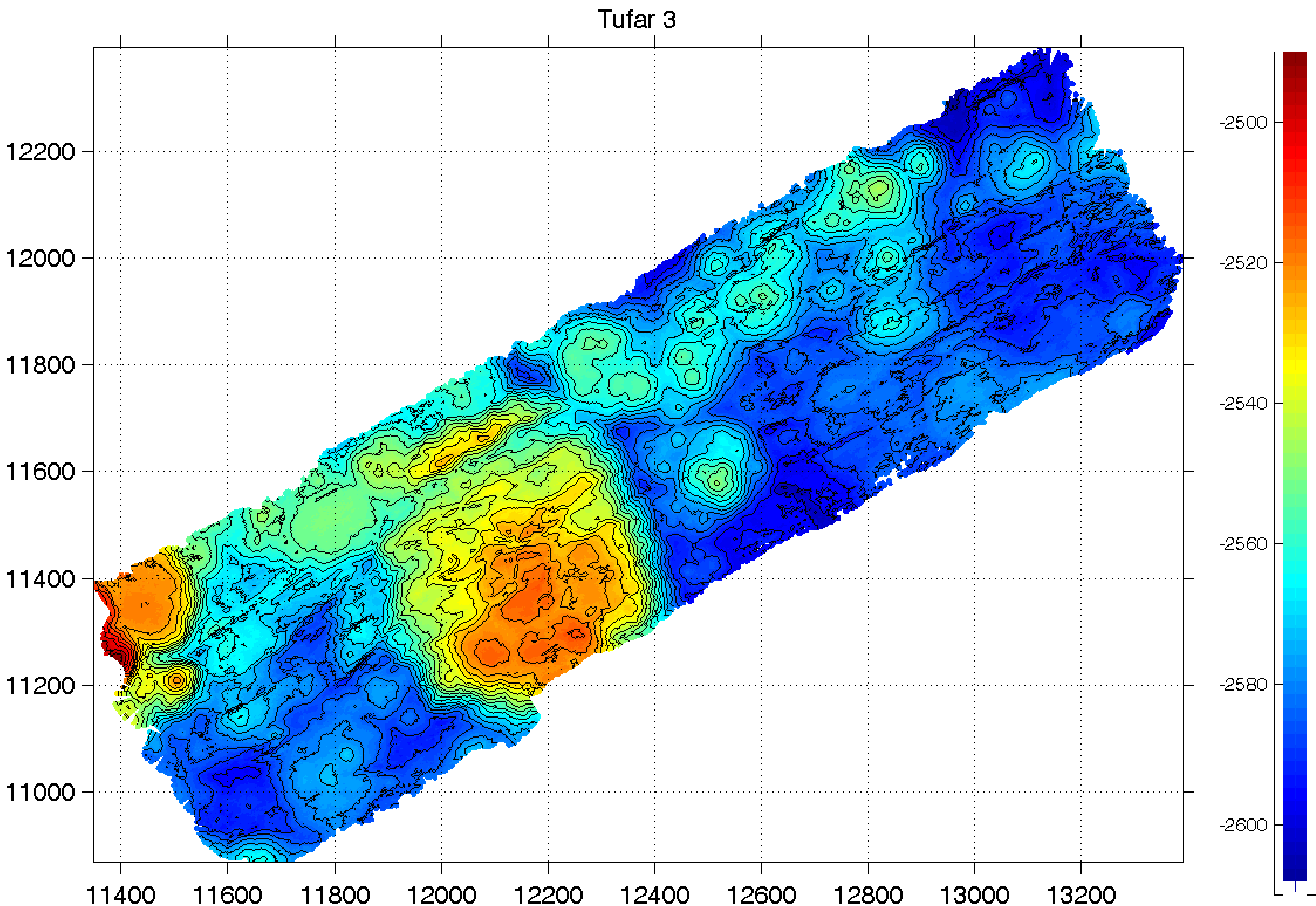
ABE 183 Magnetization and Bathymetry



Map 7


Bronze Age Fort
J2-203
9000
8800
8600
8400
8200
8000
5200
5400
5600
5800
6000
6200
6400
6600
6800
7000
-2400
-2420
-2440
-2460
-2480
-2500
-2520
-2540

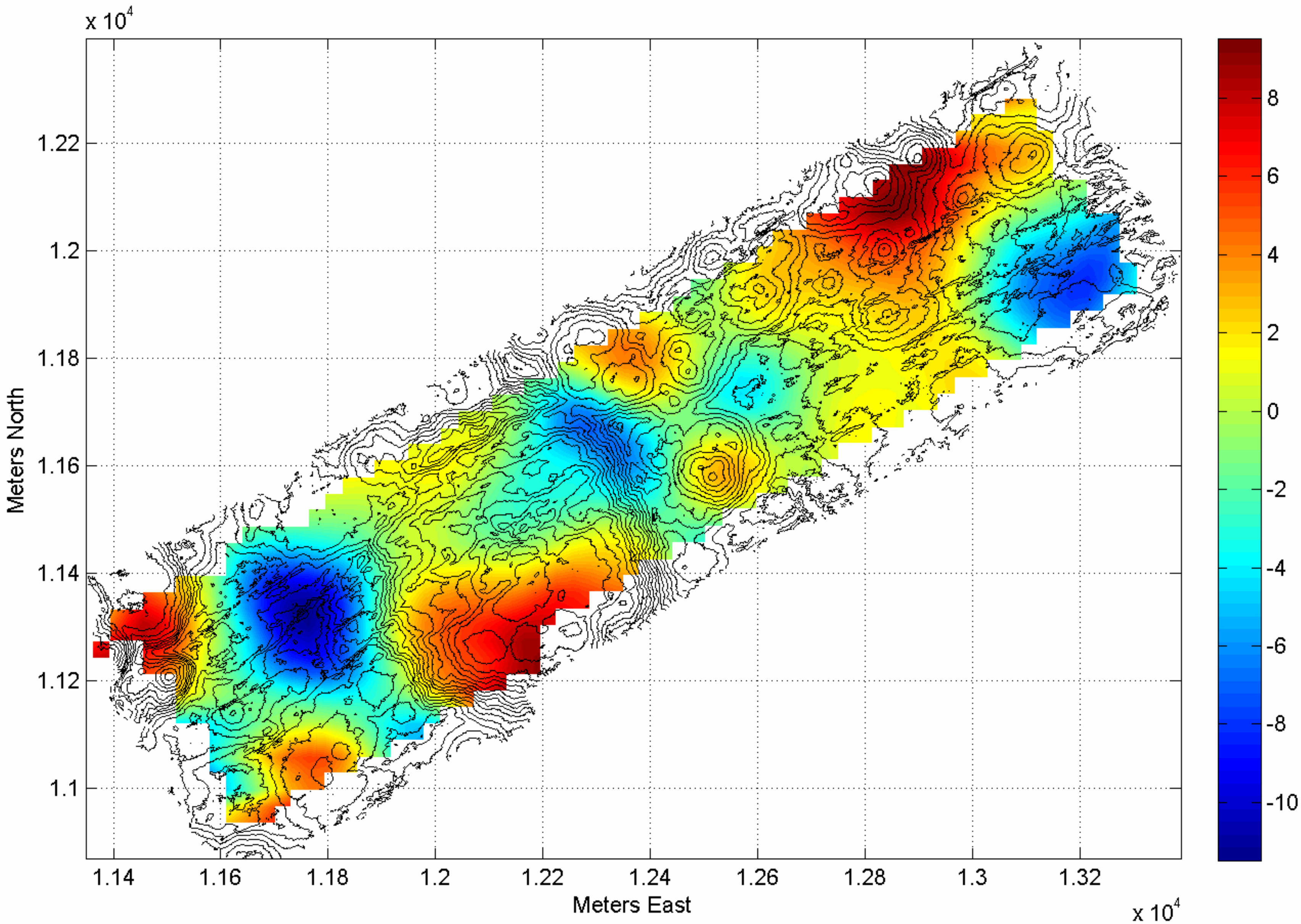
Map 8



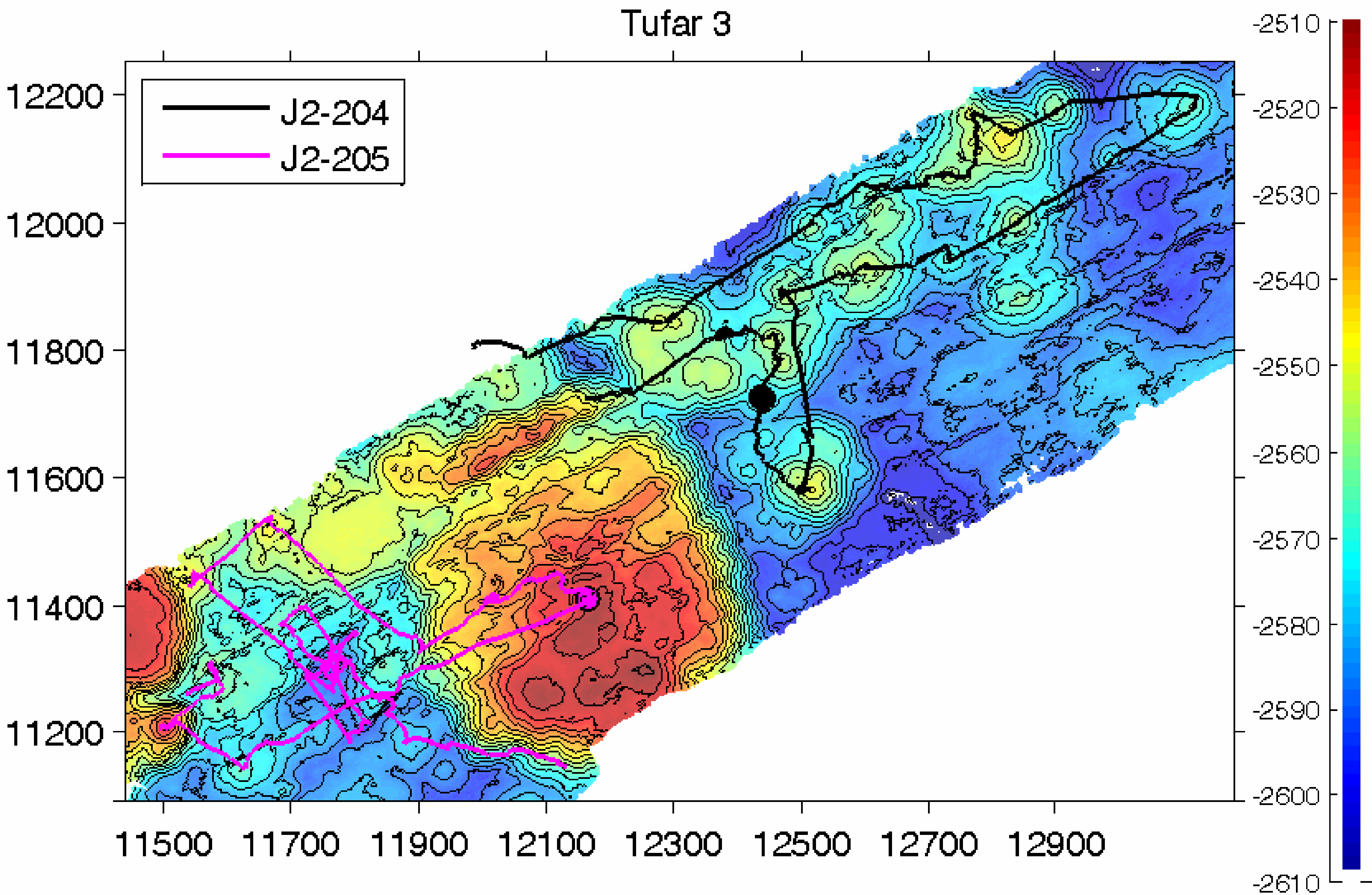
Tufar 3
12200
12000
11800
11600
11400
11200
11000
11400
11600
11800
12000
12200
12400
12600
12800
13000
13200
-2500
-2520
-2540
-2560
-2580
-2600

Map 9

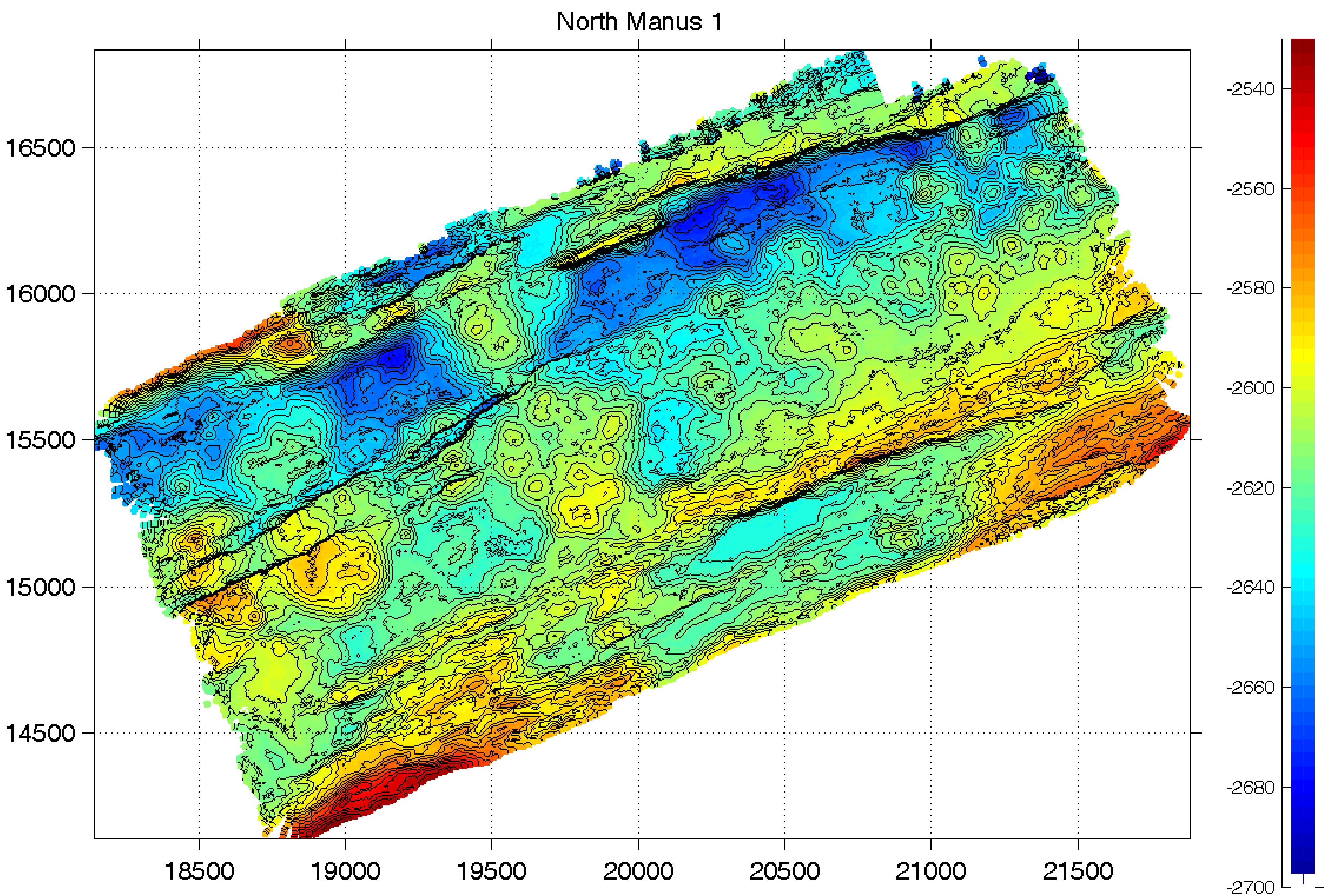
ABE 185 Magnetization and Bathymetry



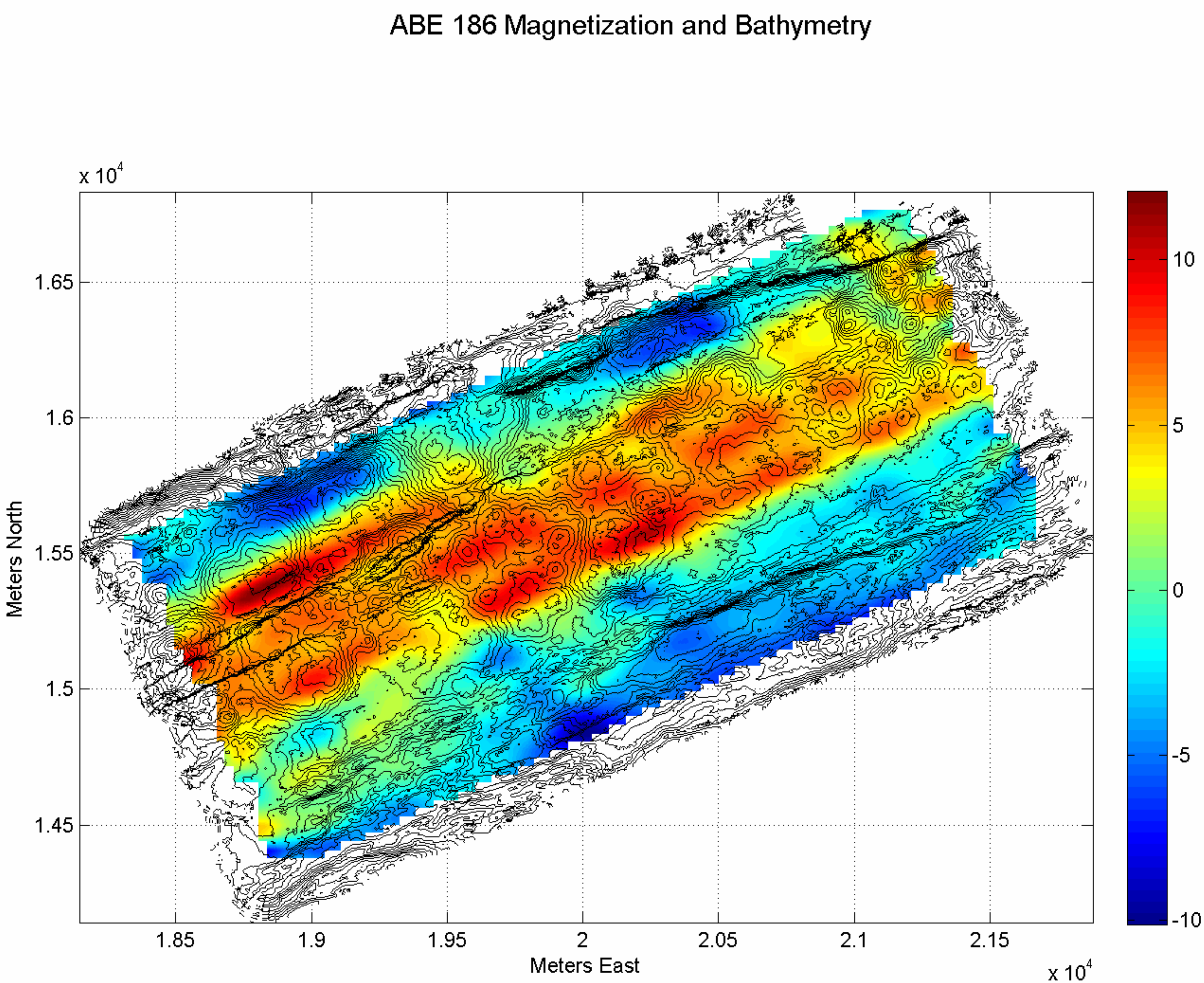
Map 10


Tufar 3
J2-204
J2-205
12200
12000
11800
11600
11400
11200
11500
11700
11900
12100
12300
12500
12700
12900
-2510
-2520
-2530
-2540
-2550
-2560
-2570
-2580
-2590
-2600
-2610

Map 11

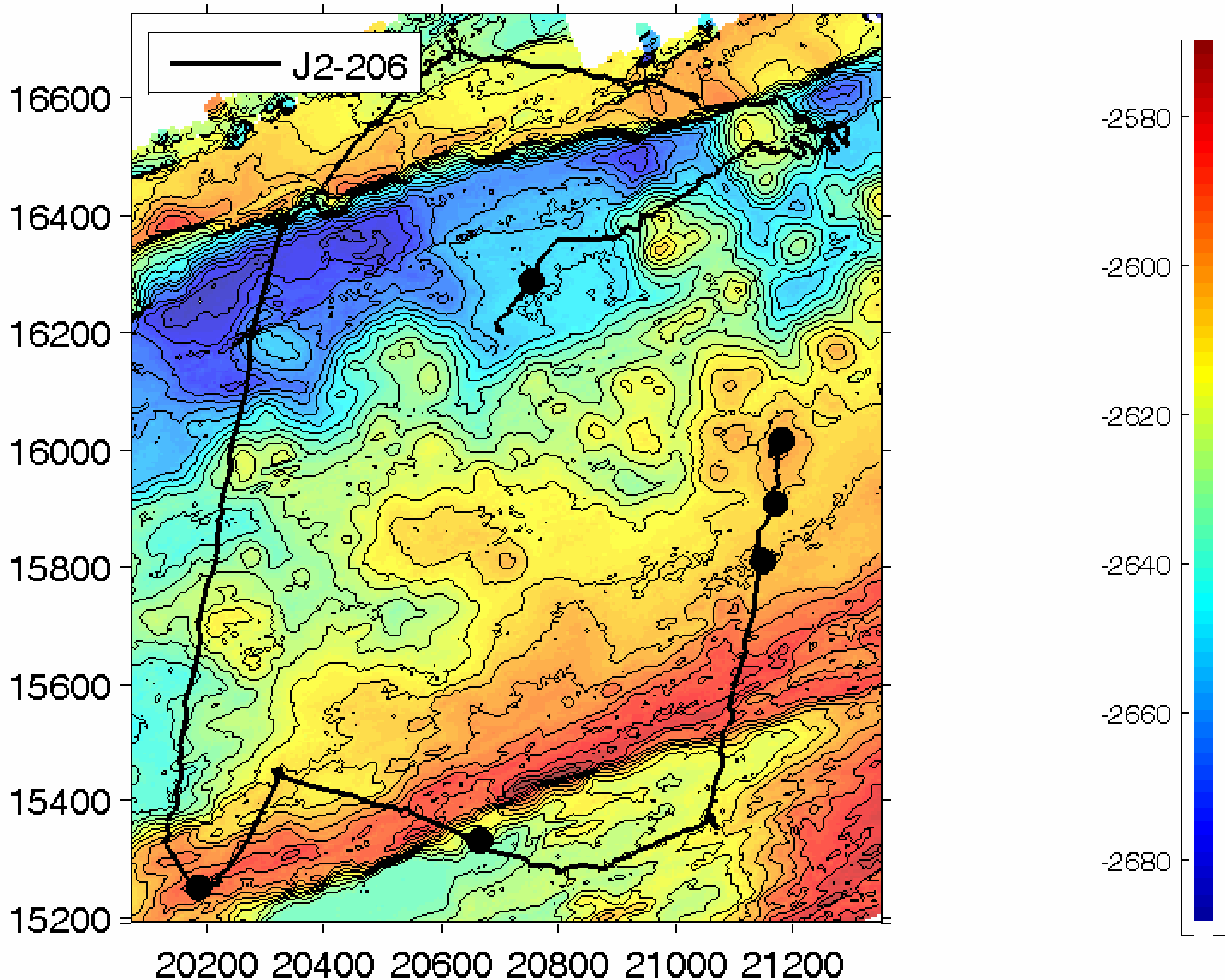

North Manus 1
16500
16000
15500
15000
14500
18500
19000
19500
20000
20500
21000
21500
-2540
-2560
-2580
-2600
-2620
-2640
-2660
-2680
-2700

Map 12

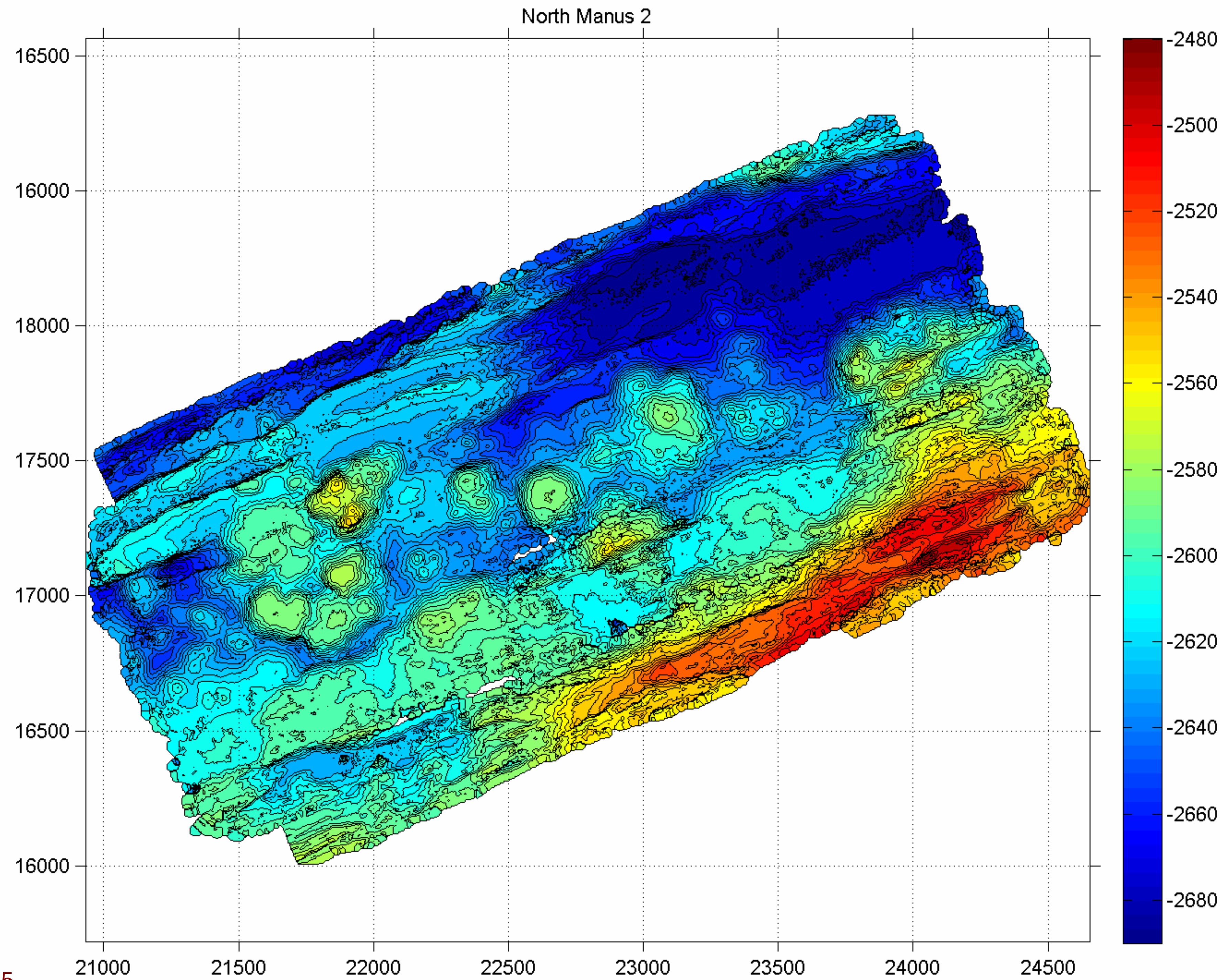

ABE 186 Magnetization and Bathymetry
x 10^4
1.65
1.6
1.55
1.5
1.45
Meters North
1.85
1.9
1.95
2
2.05
2.1
2.15
Meters East
x 10^4
10
5
0
-5
-10

Map 13

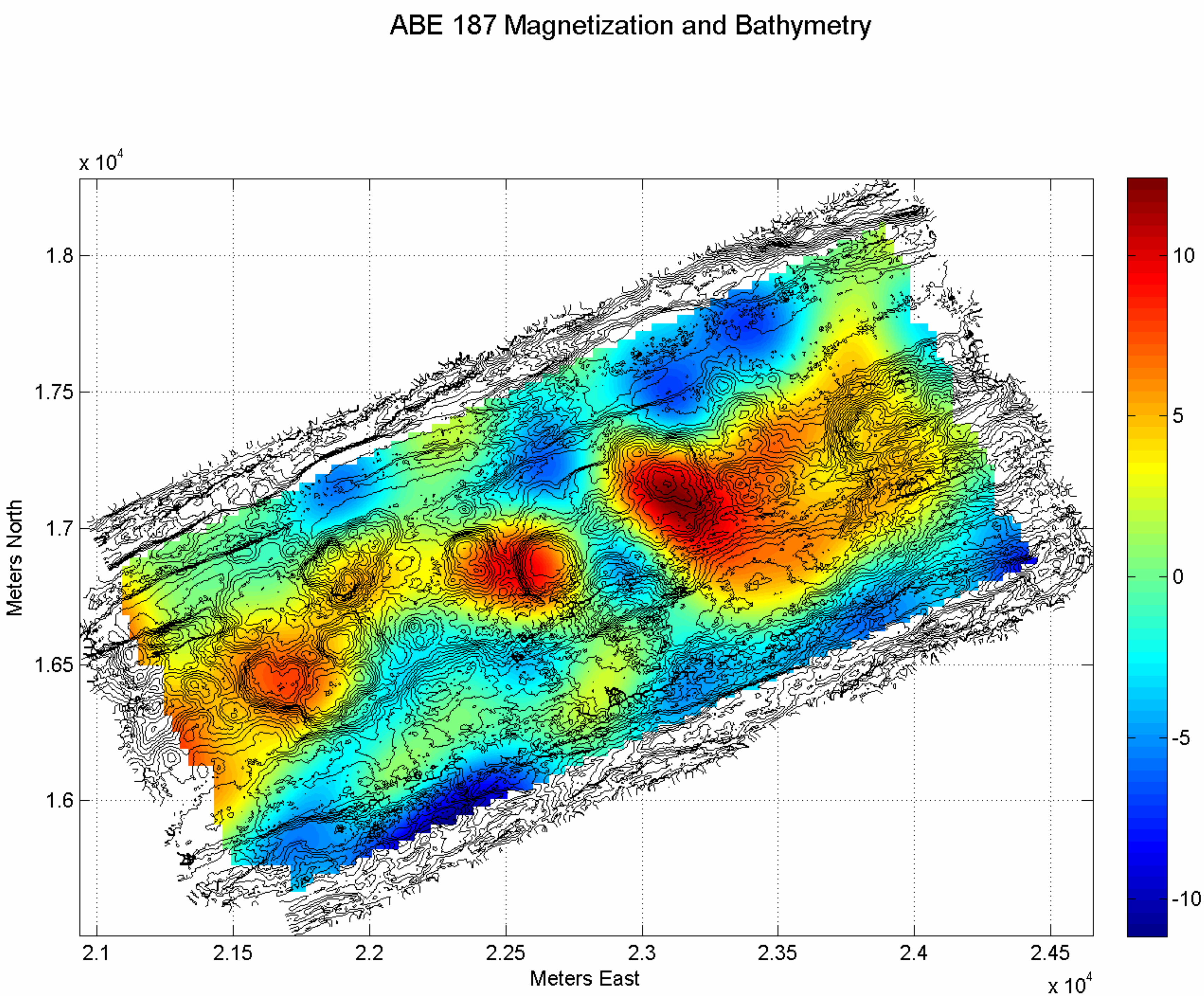
North Manus 1



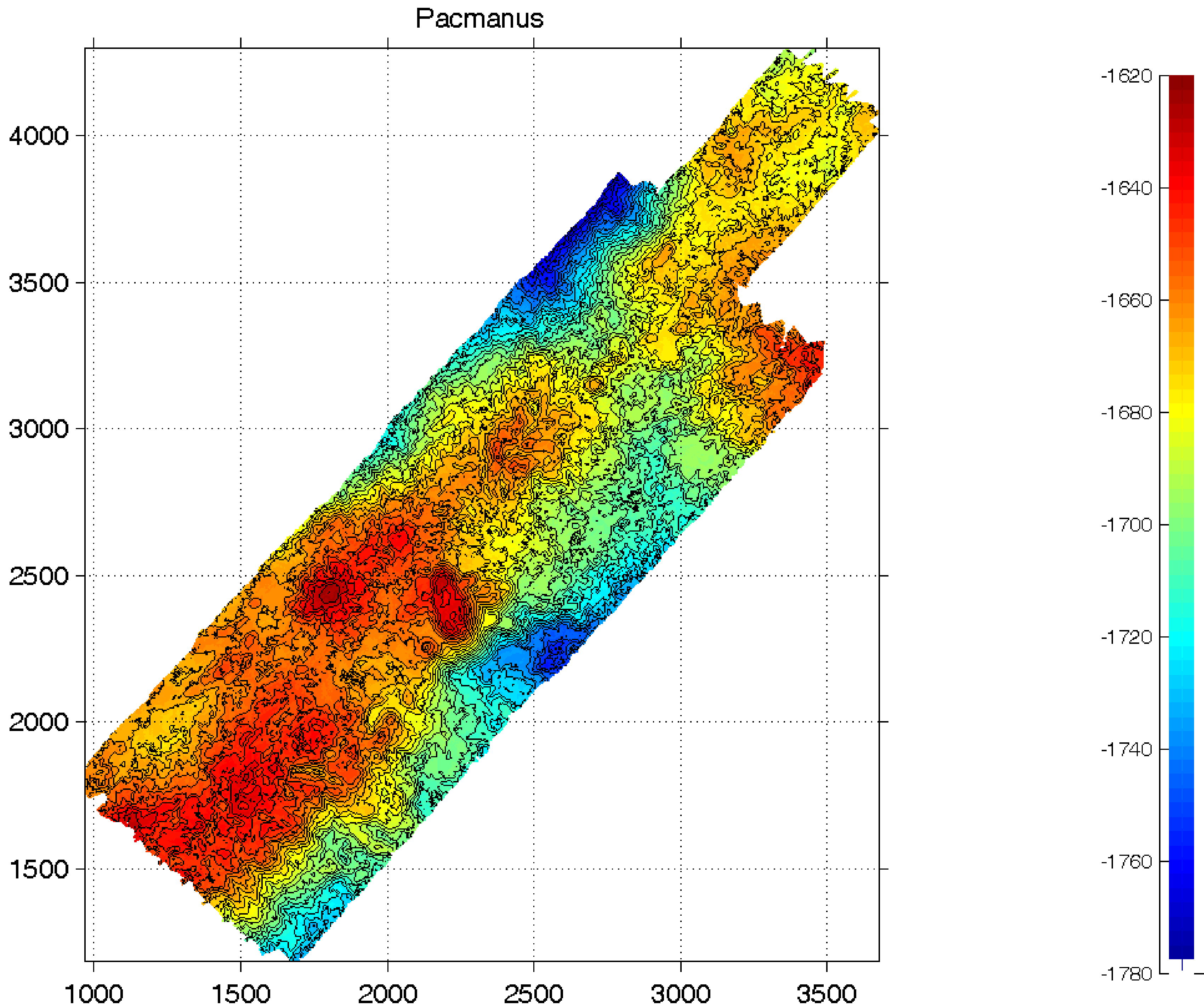
Map 14


North Manus 2
16500
16000
18000
17500
17000
16500
16000
21000
21500
22000
22500
23000
23500
24000
24500
-2480
-2500
-2520
-2540
-2560
-2580
-2600
-2620
-2640
-2660
-2680

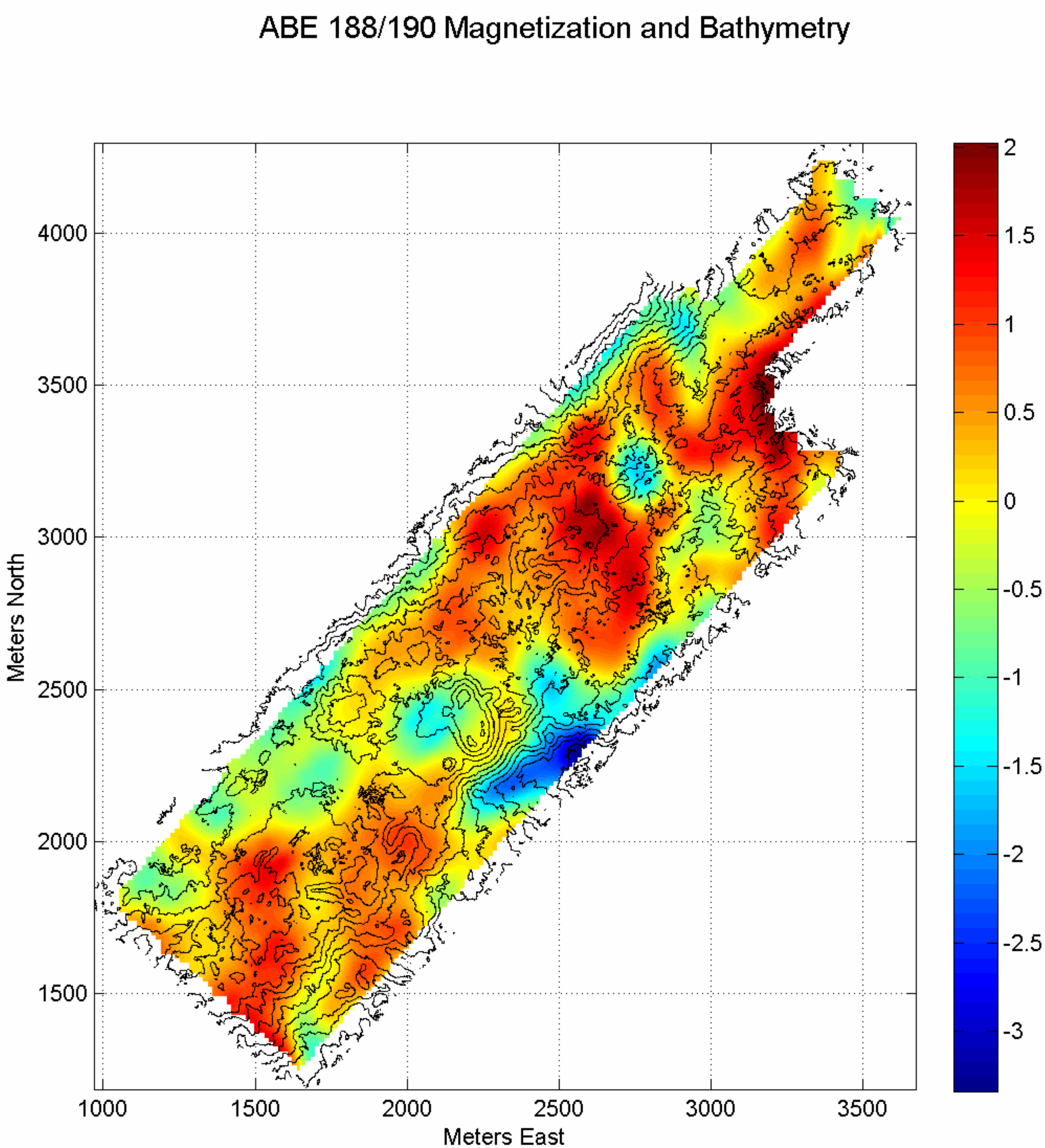
Map 15


ABE 187 Magnetization and Bathymetry
x 10^4
1.8
1.75
1.7
1.65
1.6
Meters North
2.1
2.15
2.2
2.25
2.3
2.35
2.4
2.45
Meters East
x 10^4
10
5
0
-5
-10

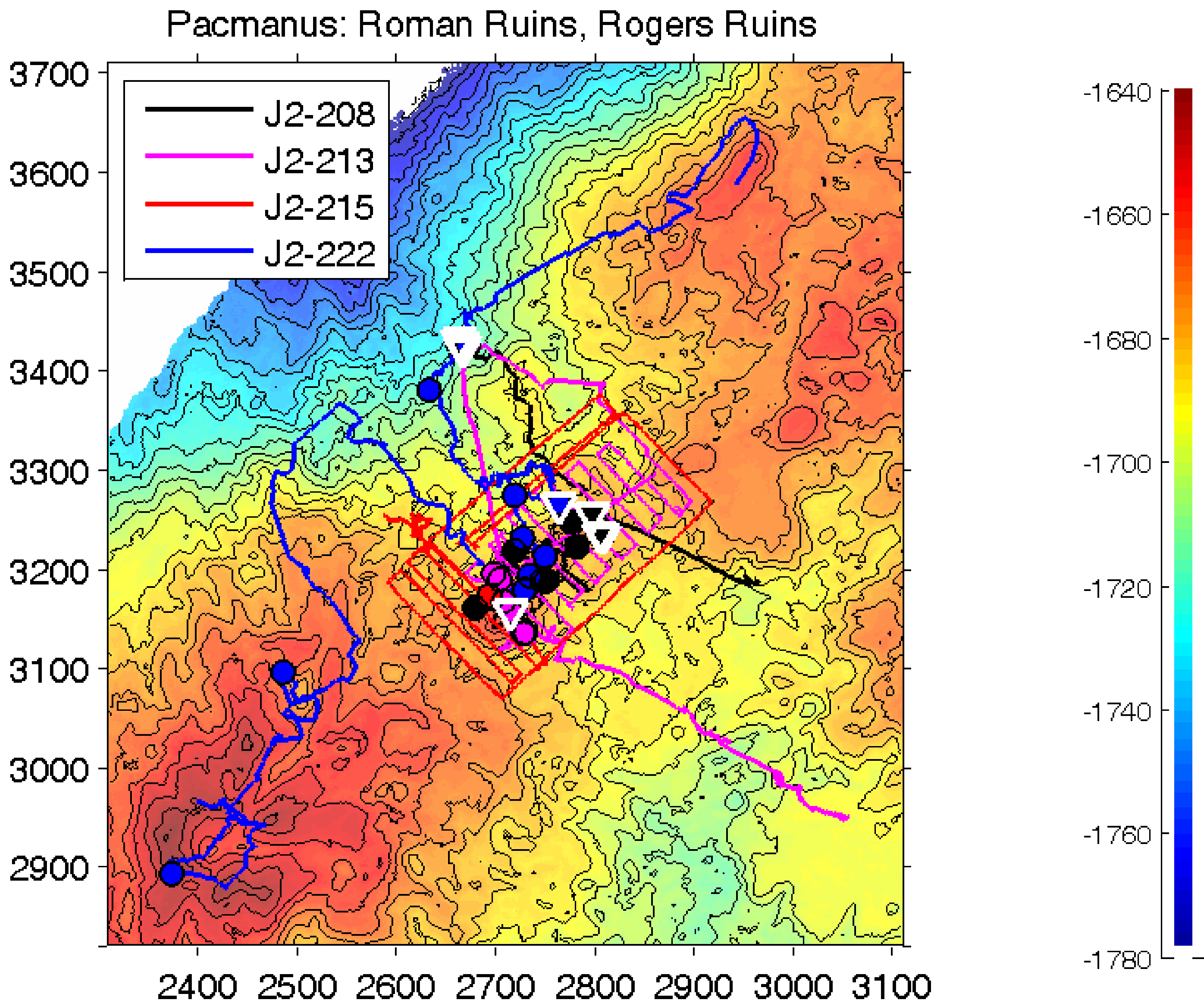
Map 16


Pacmanus
4000
3500
3000
2500
2000
1500
1000
1500
2000
2500
3000
3500
-1620
-1640
-1660
-1680
-1700
-1720
-1740
-1760
-1780

Map 17

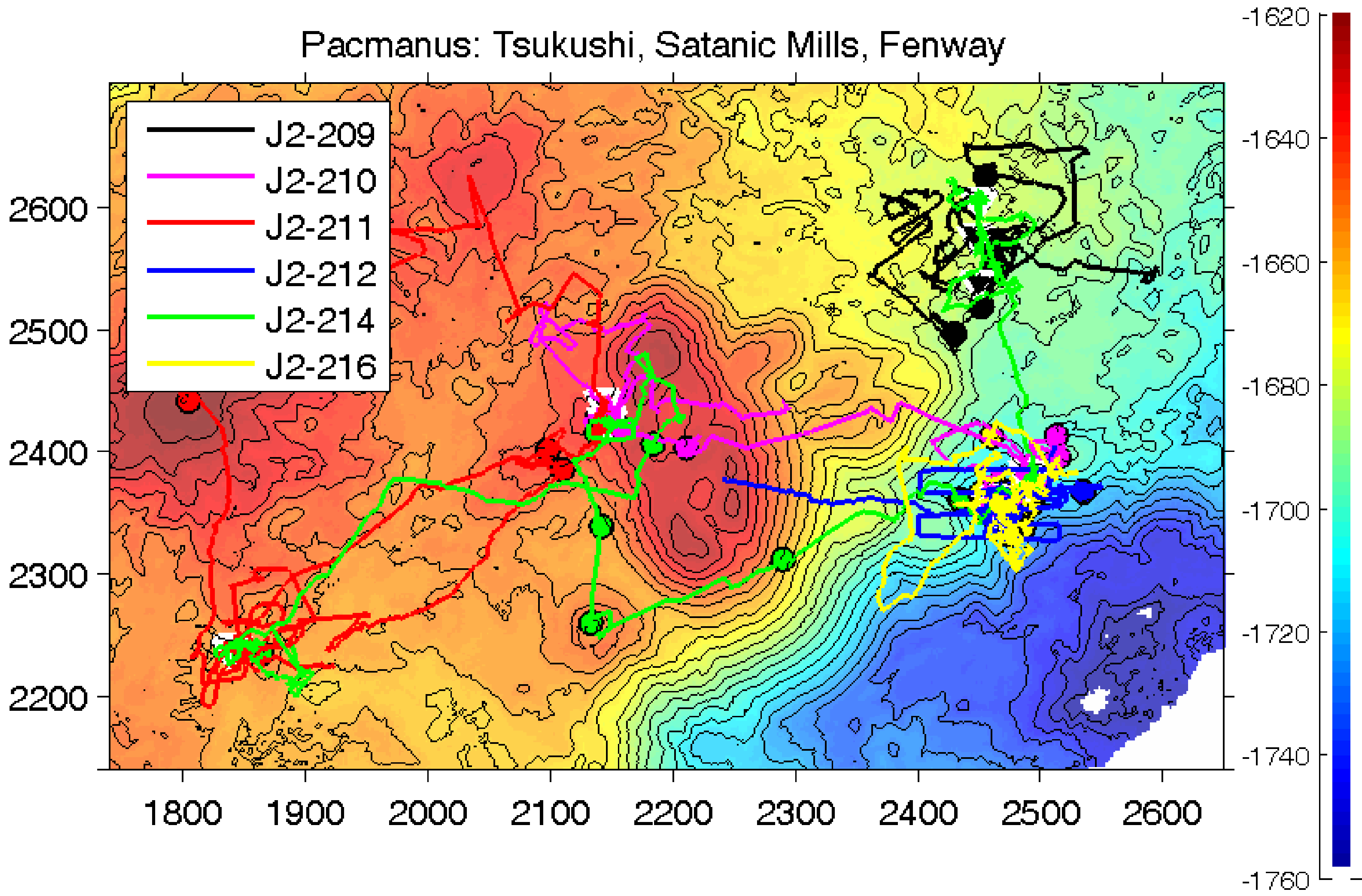

ABE 188/190 Magnetization and Bathymetry
Meters North
4000
3500
3000
2500
2000
1500
1000
1500
2000
2500
3000
3500
Meters East
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3

Map 18

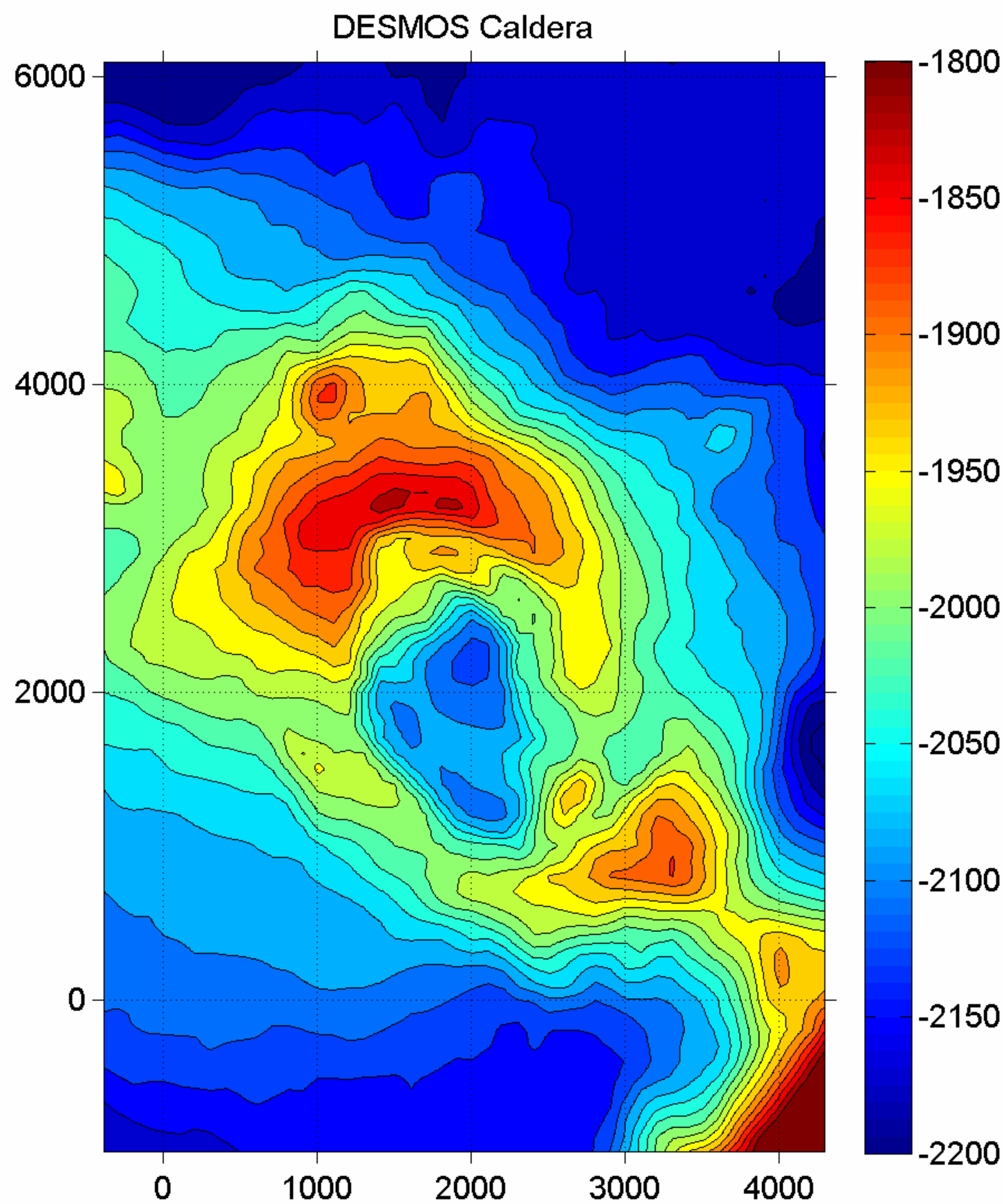


Pacmanus: Roman Ruins, Rogers Ruins
J2-208
J2-213
J2-215
J2-222
3700
3600
3500
3400
3300
3200
3100
3000
2900
2400 2500 2600 2700 2800 2900 3000 3100
-1640
-1660
-1680
-1700
-1720
-1740
-1760
-1780

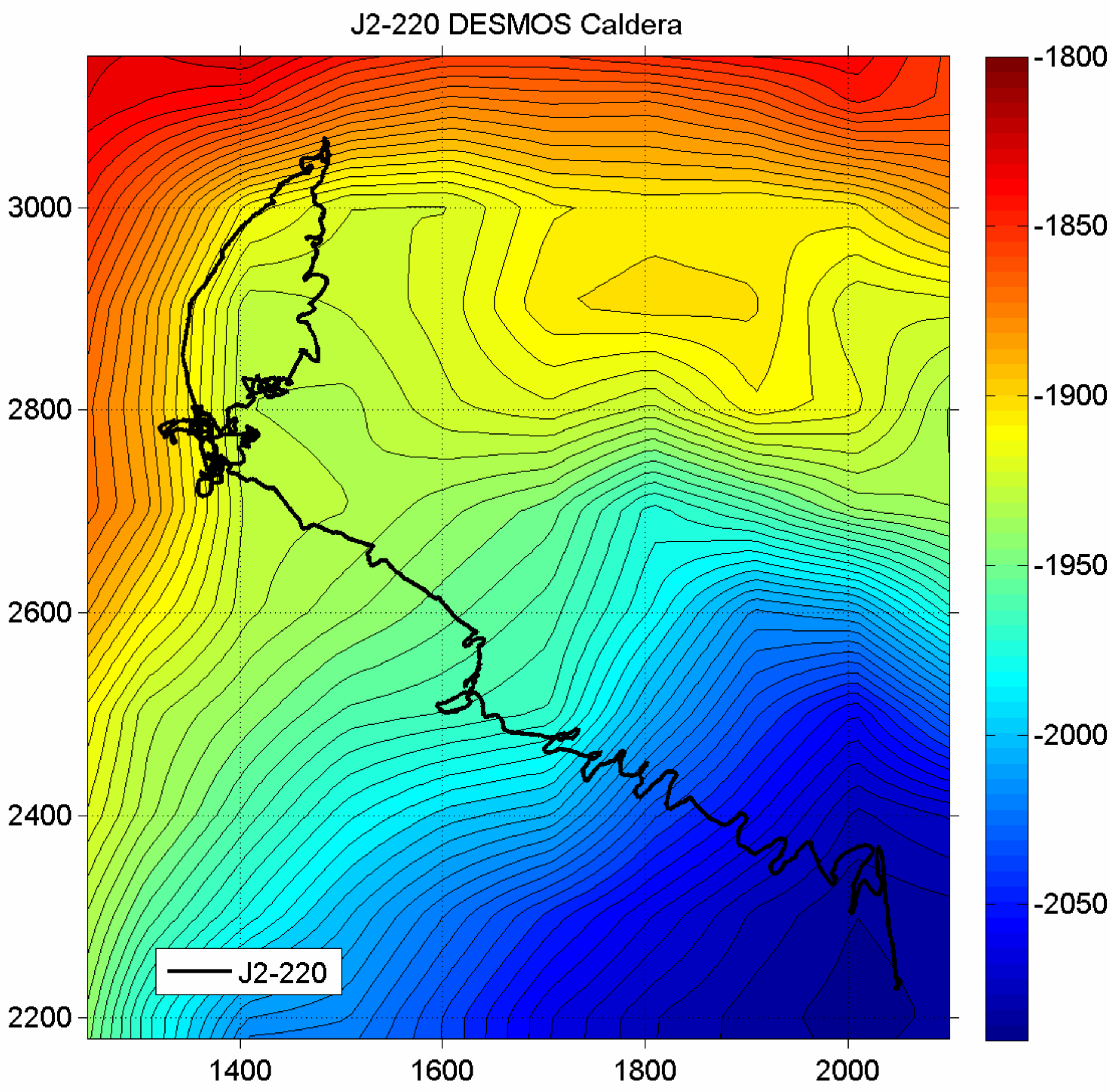
Map 19


Pacmanus: Tsukushi, Satanic Mills, Fenway
J2-209
J2-210
J2-211
J2-212
J2-214
J2-216
2600
2500
2400
2300
2200
1800
1900
2000
2100
2200
2300
2400
2500
2600
-1620
-1640
-1660
-1680
-1700
-1720
-1740
-1760

Map 20

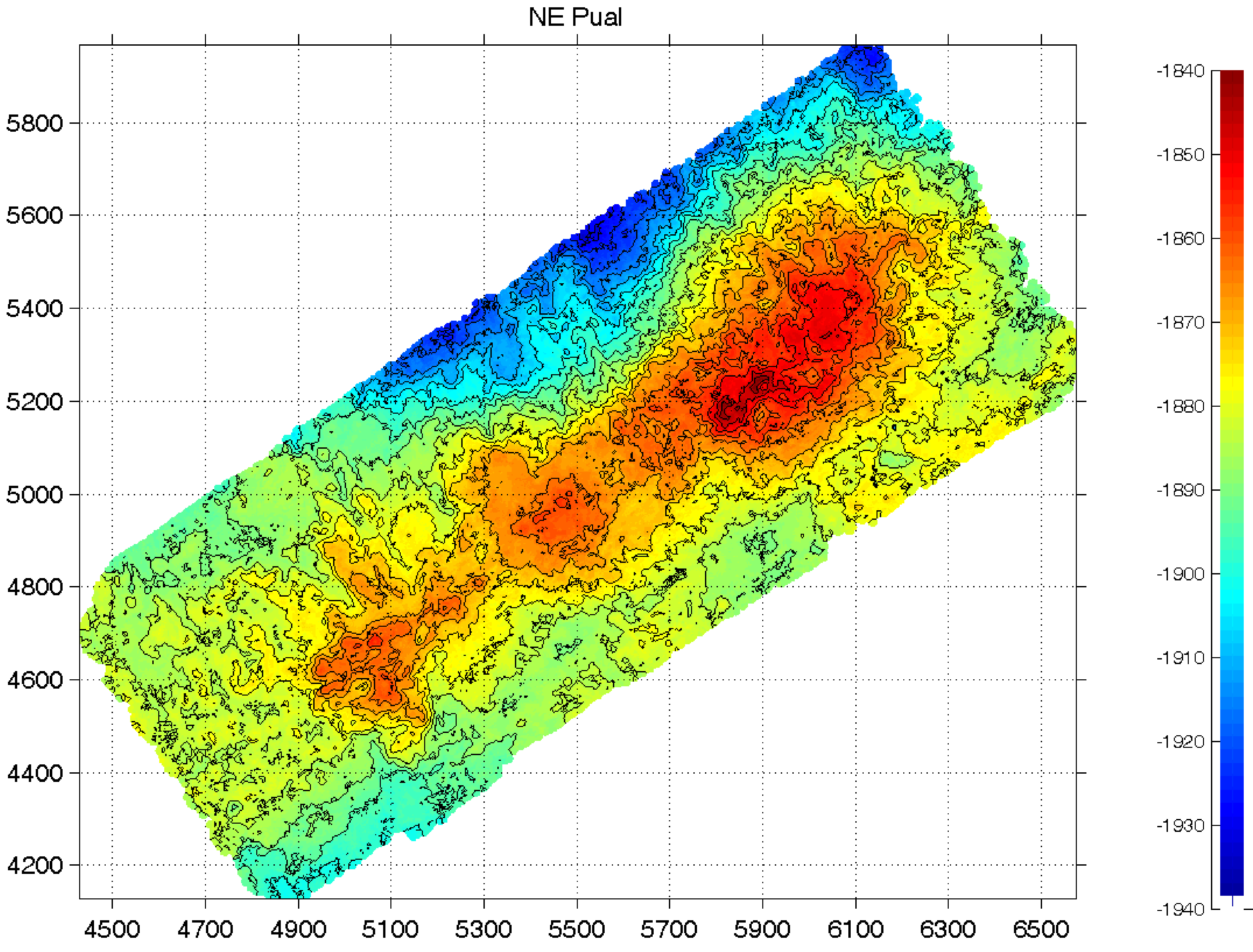

DESMOS Caldera
6000
4000
2000
0
0
1000
2000
3000
4000
-1800
-1850
-1900
-1950
-2000
-2050
-2100
-2150
-2200

Map 21

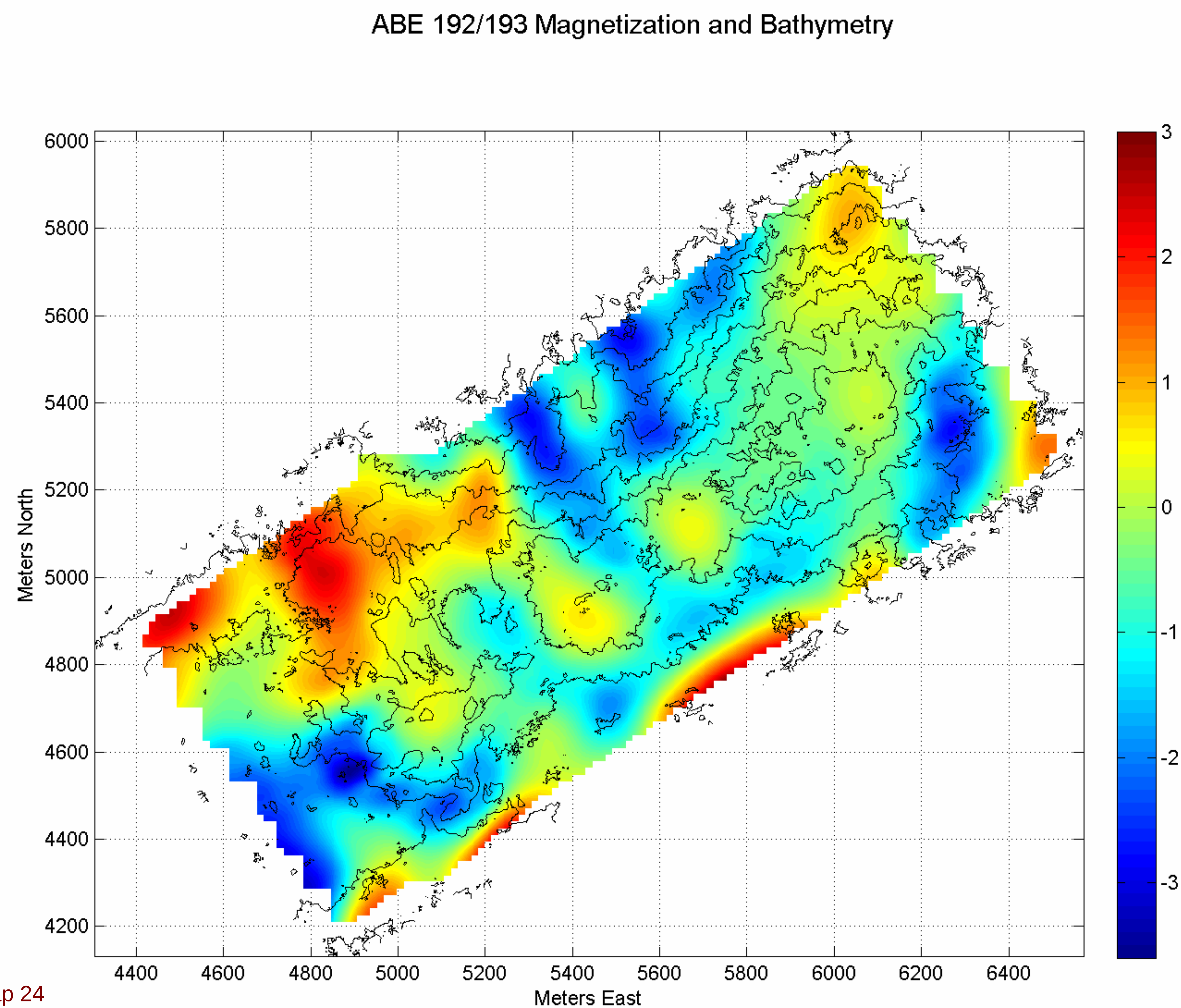


J2-220 DESMOS Caldera
3000
2800
2600
2400
2200
1400
1600
1800
2000
J2-220
-1800
-1850
-1900
-1950
-2000
-2050

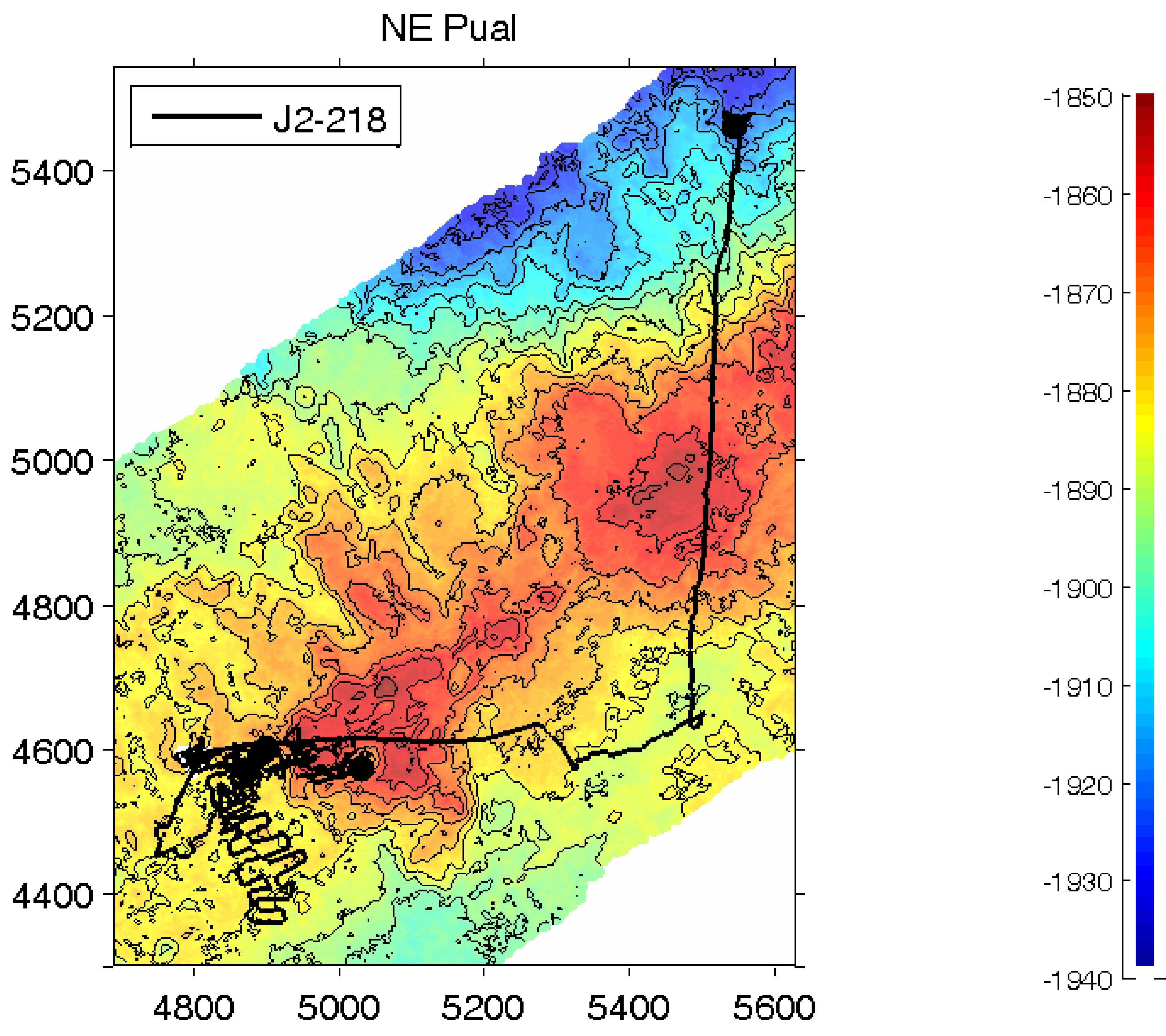
Map 22


NE Pual
5800
5600
5400
5200
5000
4800
4600
4400
4200
4500
4700
4900
5100
5300
5500
5700
5900
6100
6300
6500
-1840
-1850
-1860
-1870
-1880
-1890
-1900
-1910
-1920
-1930
-1940

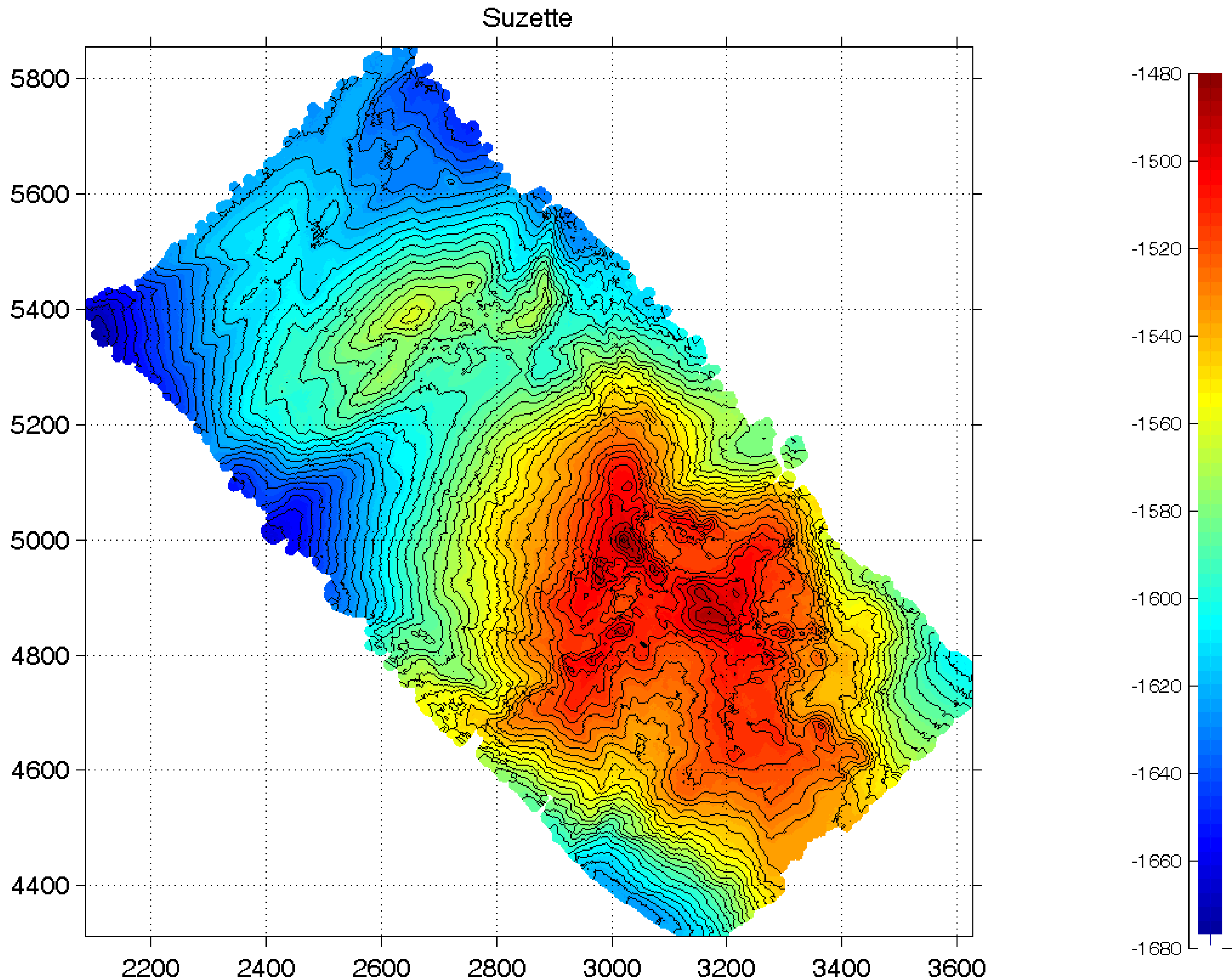
Map 23


ABE 192/193 Magnetization and Bathymetry
Meters North
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
Meters East
4400
4600
4800
5000
5200
5400
5600
5800
6000
6200
6400
3
2
1
0
-1
-2
-3

Map 24

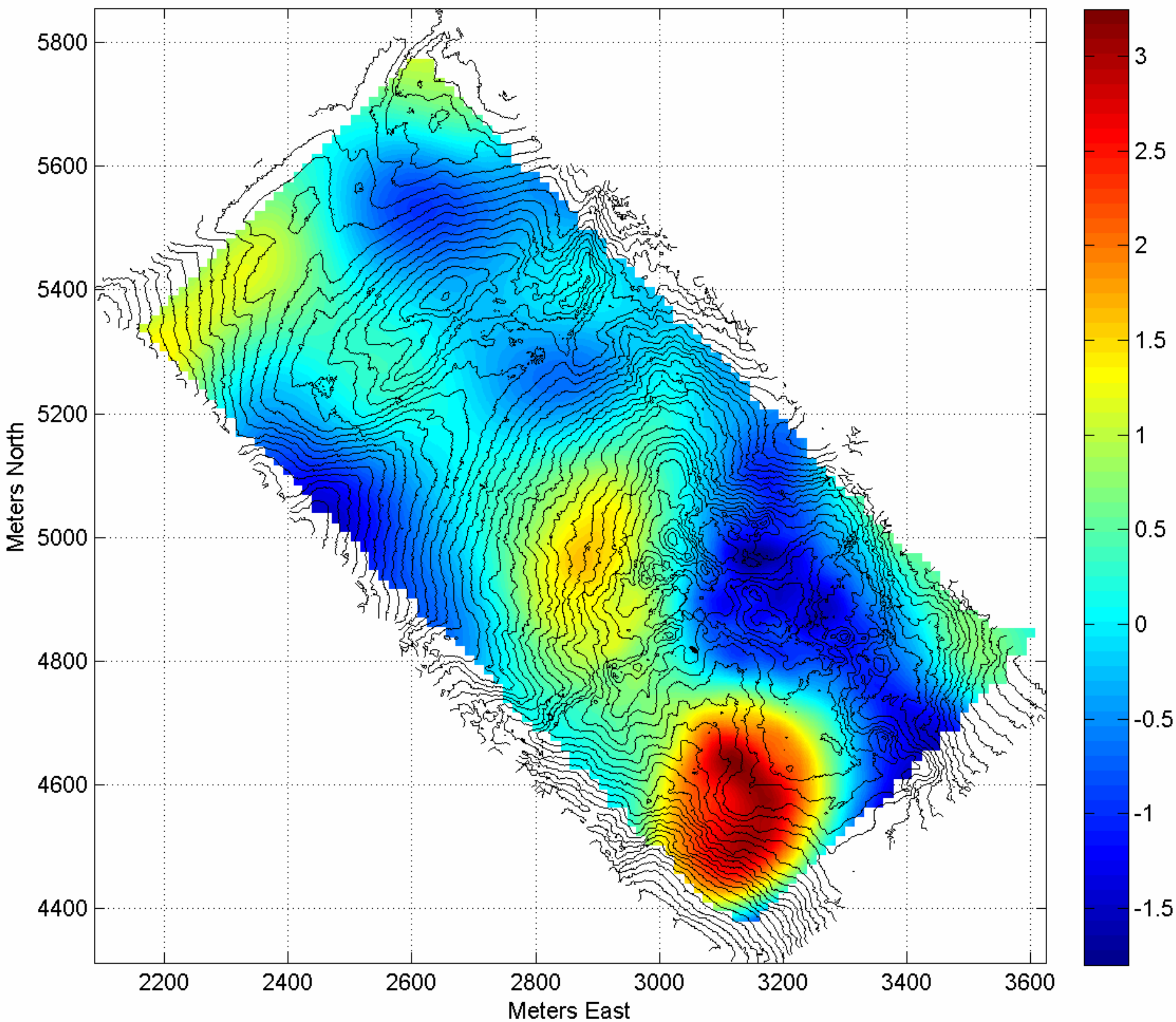

NE Pual
J2-218
5400
5200
5000
4800
4600
4400
4800
5000
5200
5400
5600
-1850
-1860
-1870
-1880
-1890
-1900
-1910
-1920
-1930
-1940

Map 25

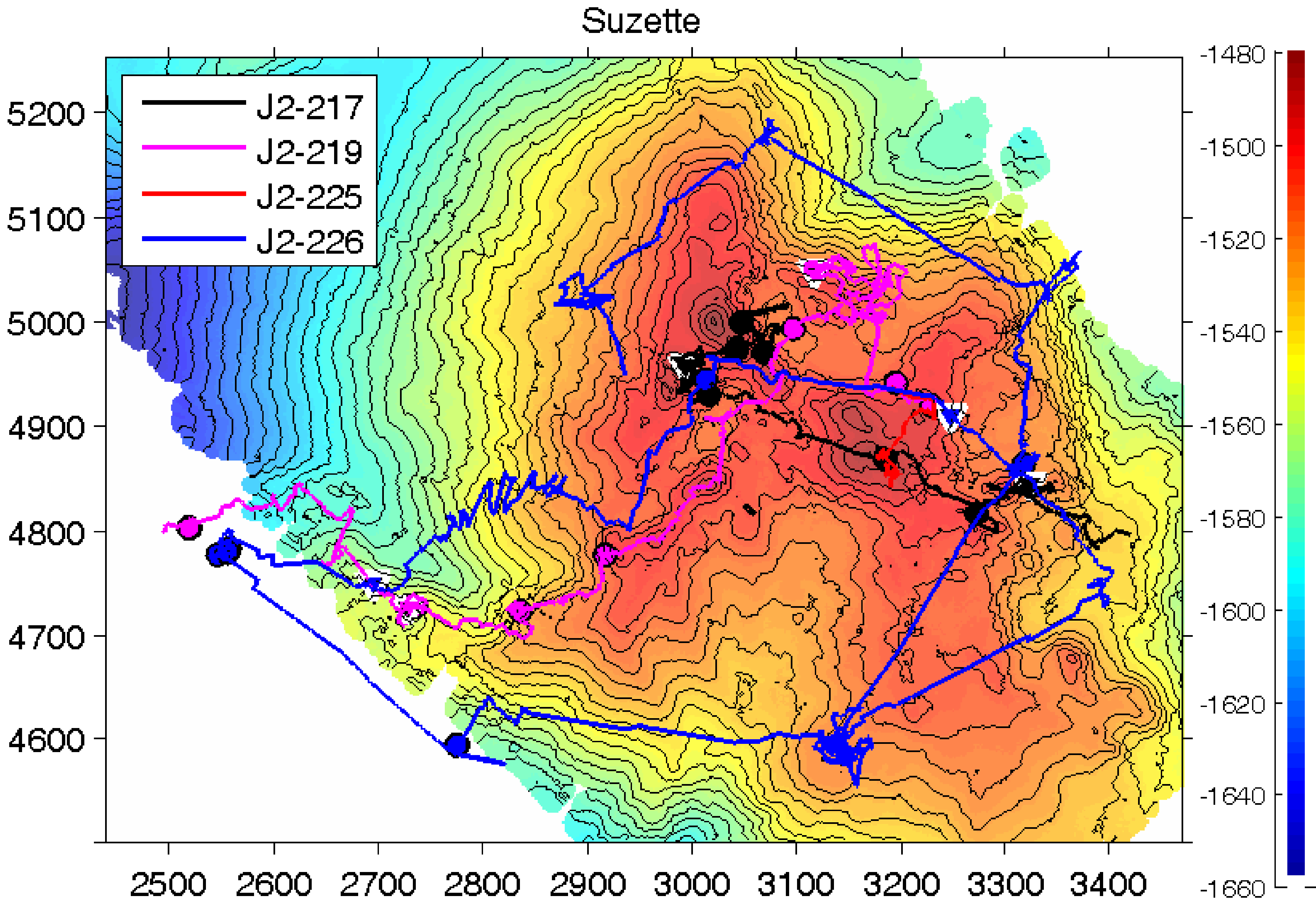

Suzette
5800
5600
5400
5200
5000
4800
4600
4400
2200
2400
2600
2800
3000
3200
3400
3600
-1480
-1500
-1520
-1540
-1560
-1580
-1600
-1620
-1640
-1660
-1680

Map 26

ABE 189 Magnetization and Bathymetry

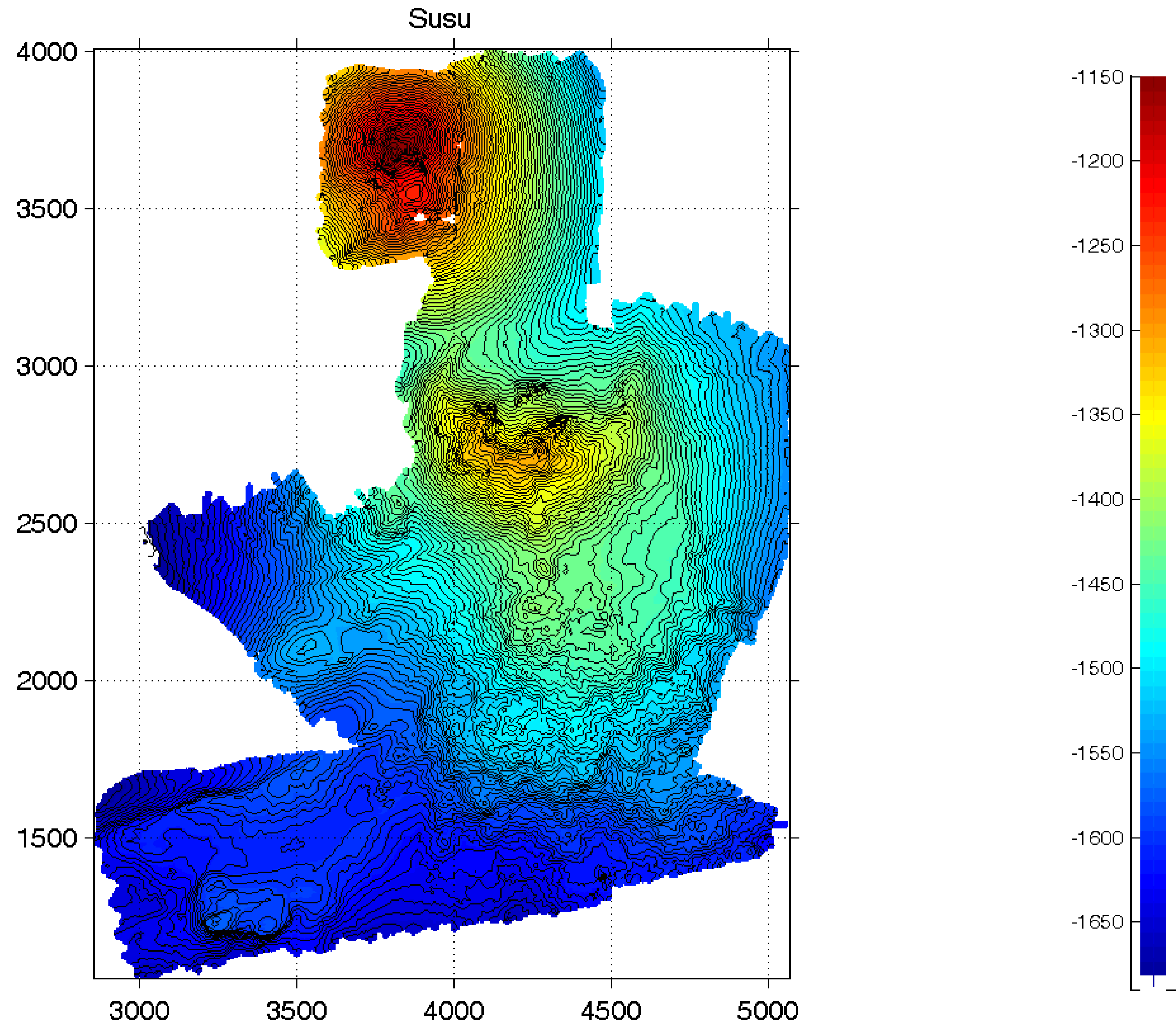


Map 27



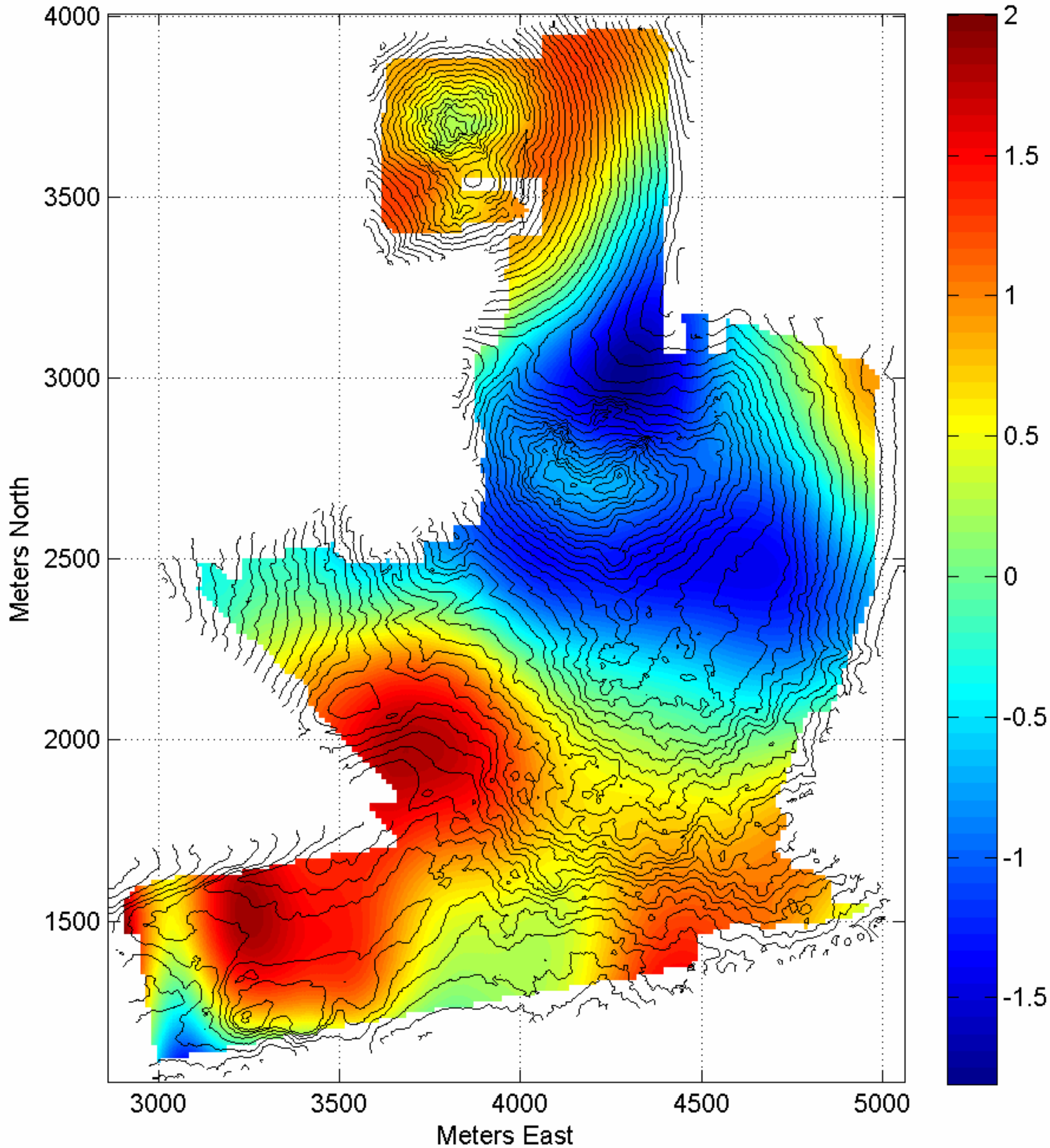
Suzette
J2-217
J2-219
J2-225
J2-226
5200
5100
5000
4900
4800
4700
4600
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
-1480
-1500
-1520
-1540
-1560
-1580
-1600
-1620
-1640
-1660

Map 28

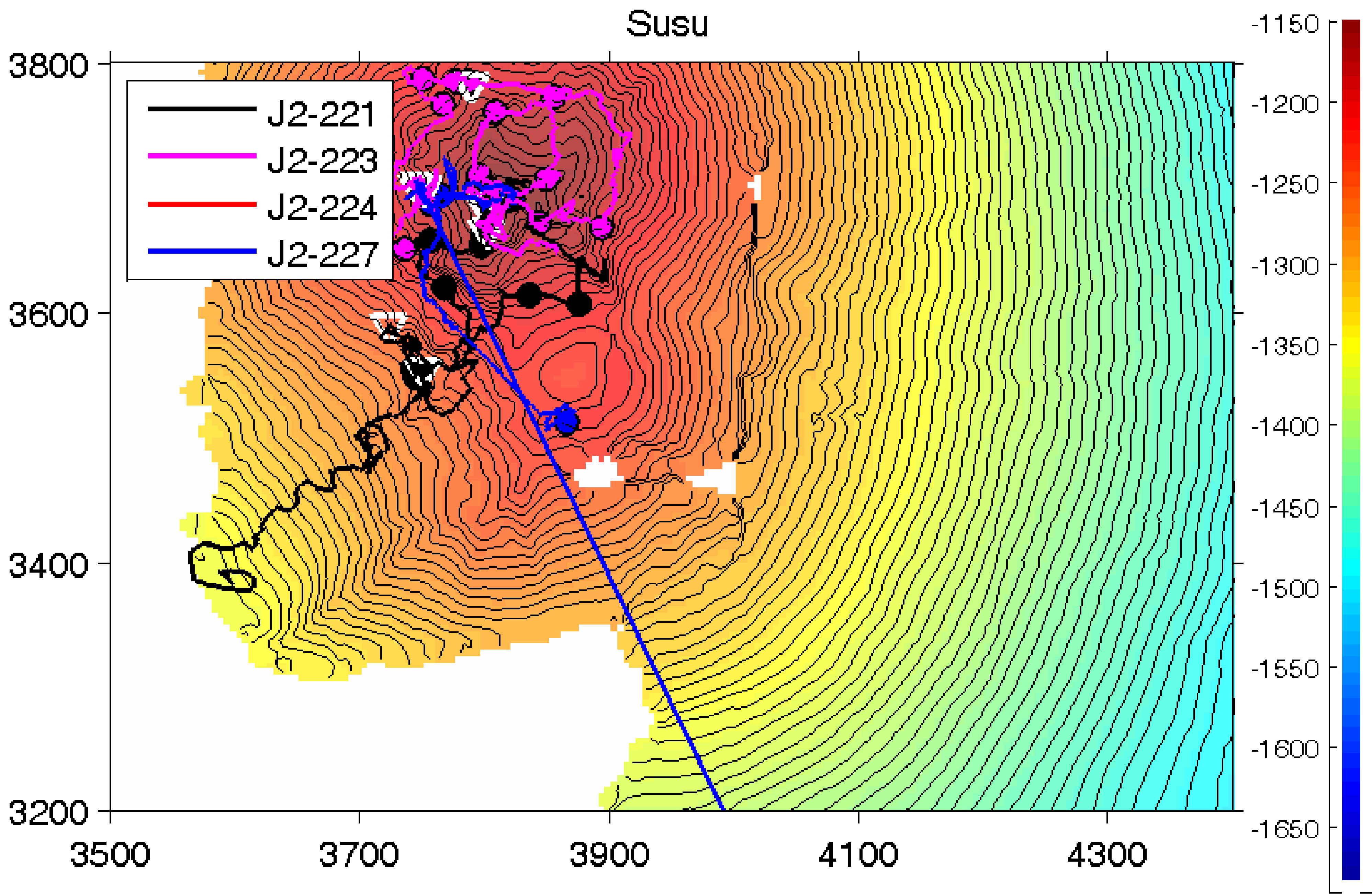

Susu
4000
3500
3000
2500
2000
1500
3000
3500
4000
4500
5000
-1150
-1200
-1250
-1300
-1350
-1400
-1450
-1500
-1550
-1600
-1650

Map 29

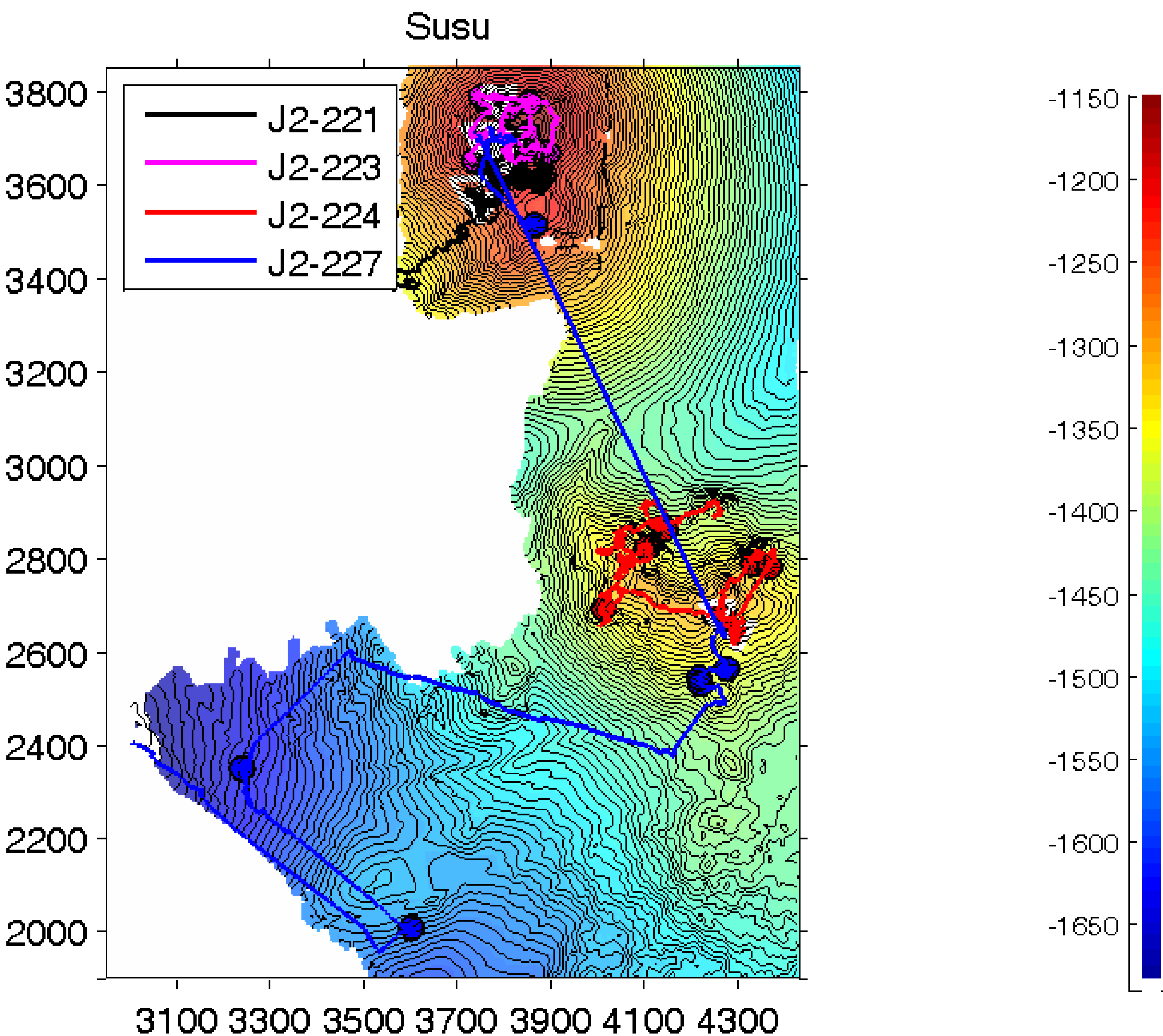
ABE 194/195/198 Magnetization and Bathymetry



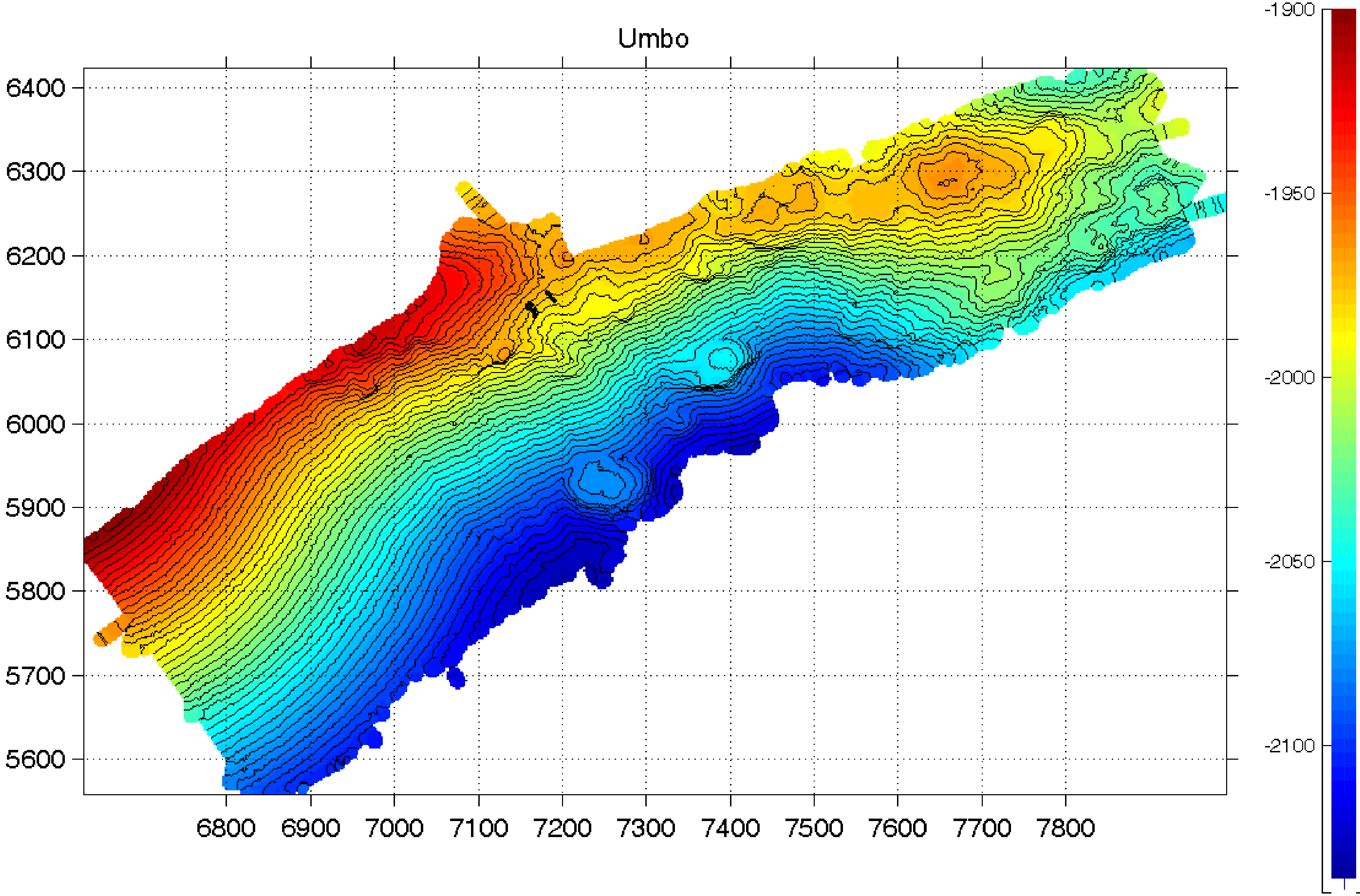
Map 30


Susu
J2-221
J2-223
J2-224
J2-227
3800
3600
3400
3200
3500
3700
3900
4100
4300
-1150
-1200
-1250
-1300
-1350
-1400
-1450
-1500
-1550
-1600
-1650

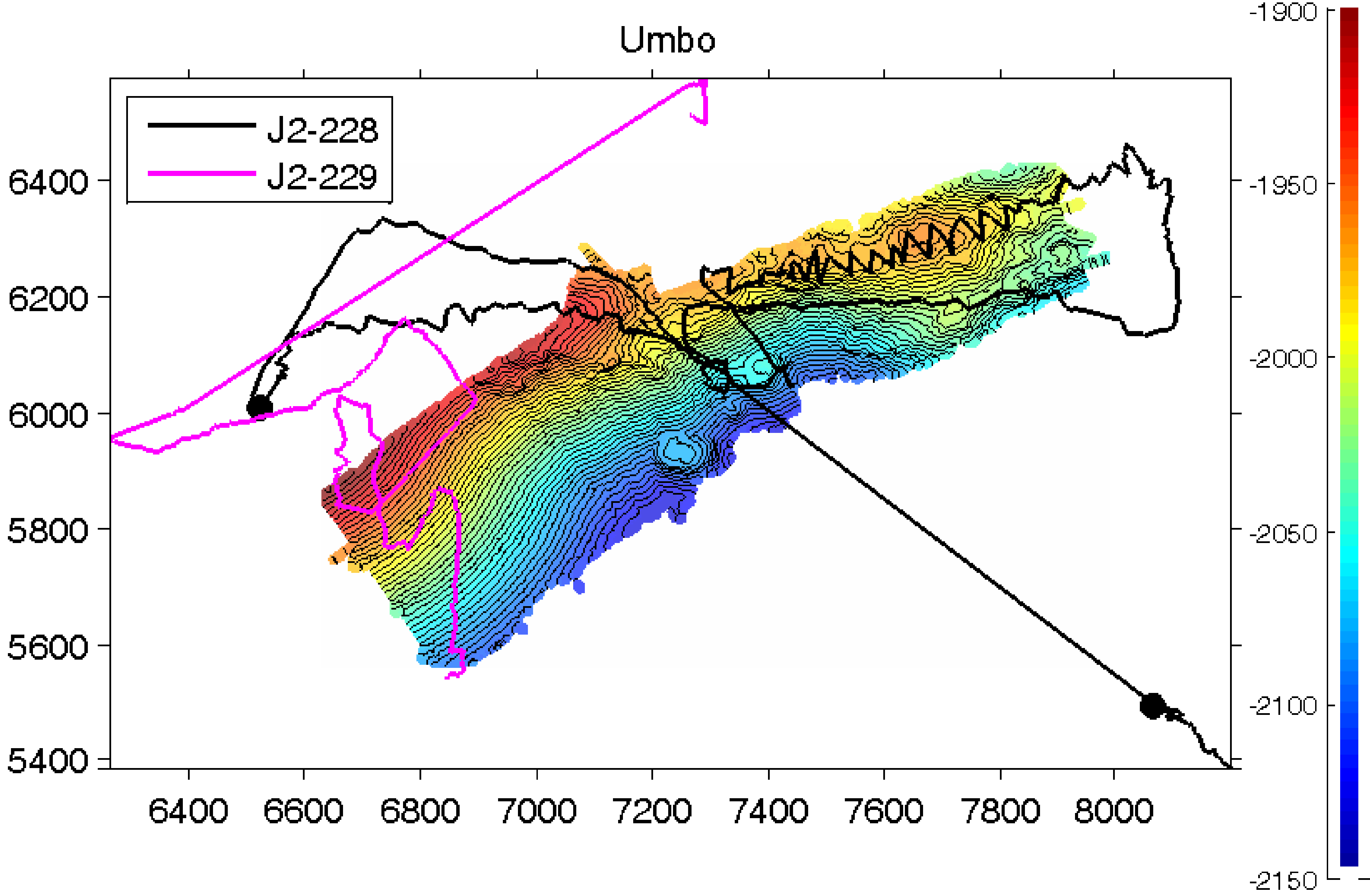
Map 31


Susu
J2-221
J2-223
J2-224
J2-227
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
3100 3300 3500 3700 3900 4100 4300
-1150
-1200
-1250
-1300
-1350
-1400
-1450
-1500
-1550
-1600
-1650

Map 32


Umbo
6400
6300
6200
6100
6000
5900
5800
5700
5600
6800
6900
7000
7100
7200
7300
7400
7500
7600
7700
7800
-1900
-1950
-2000
-2050
-2100

Map 33


Umbo
J2-228
J2-229
6400
6200
6000
5800
5600
5400
6400
6600
6800
7000
7200
7400
7600
7800
8000
-1900
-1950
-2000
-2050
-2100
-2150

Map 34

Sample # (Dive#_Stn#_Type)		**Vvan #**	**Date**	**Time (UTC)**	**Marker#**	**Local X**	**Local Y**	**Depth (m)**	**Del X**	**Del Y**	**Renav X**	**Renav Y**	**Renav Depth**	**Heading**	**Altitude (m)**	**Type/Collection Meth'd**	**Comments/Description**
J2-200-1-R1	Vienna Woods	300	7/22	15:15		3328	5780	2482	3	4	**3331**	**5784**	**2483**	**143**	**2.3**	Relict Sulfide Chimney/ Grab	Tip of ~ 1-2 m tall single, Zn-rich, relict chimney.
J2-200-2-R1	Vienna Woods	423	7/22	15:43		3346	5835	2482	-2	-2	**3344**	**5833**	**2482**	**028**	**4.3**	Relict Sulfide Chimney/ Grab	Tip of ~ 1-2 m tall single, Zn-rich, relict chimney.
J2-200-3-R1	Vienna Woods	536	7/22	16:22		3369	5847	2483	0	0	**3369**	**5847**	**2484**	**279**	**3.7**	Relict Sulfide Chimney/ Grab	Small parasitic spire from near base of large (>10 m) sulfide edifice.
J2-200-4-R1	Vienna Woods	1229	7/22	21:52		3227	5749	2475	0	0	**3227**	**5749**	**2475**	**018**	**4.7**	Relict Sulfide Chimney/ Grab	Tip of Zn-rich, small bulbous sulfide mound at base of large spire.
J2-200-5-R1	Vienna Woods	1409	7/22	23:00		3272	5757	2478	0	0	**3272**	**5757**	**2482**	**098**	**2.1**	Relict Sulfide Chimney/ Grab	Outer Zn-rich sulfide chimney wall from base of large sulfide edifice.
J2-200-6-R1	Vienna Woods	1465	7/22	23:35		3286	5791	2485	1	-2	**3287**	**5789**	**2484**	**162**	**5.8**	Relict Sulfide Chimney/ Grab	Parasitic spire from mid-way up large (>5 m) sulfide edifice that has partly collapsed.
J2-200-7-R1	Vienna Woods	1640	7/22	23:45		3311	5778	2482	-1	-1	**3310**	**5777**	**2482**	**014**	**2.7**	Collapsed Chimney/ Grab	Tip of one spire [multi-spired] from large (>10 m) collapsed chimney
J2-200-7-R2	Vienna Woods	1658	7/22	23:47		3311	5778	2482	-1	-1	**3310**	**5777**	**2483**	**014**	**2.7**	Collapsed Chimney/ Grab	2nd piece from same structure (part of main chimney edifice vs. parasitic chimlet?).
J2-200-8-R1	Vienna Woods	1898	7/23	0:50		3237	5772	2484	1	-2	**3238**	**5770**	**2484**	**123**	**1.6**	Relict Sulfide Chimney/ Grab	Tip (?) of ~ 2m Zn-rich, relict sulfide chimney (tip knocked off during sampling).
J2-200-9-R1	Vienna Woods	1964	7/23	1:10		3257	5754	2480	0	0	**3257**	**5754**	**2478**	**130**	**1.7**	Collapsed Chimney/ Grab	Weathered, Zn-Fe relict collapsed sulfide rubble, next to > 3m collapsed edifice.
J2-200-10-R1	Vienna Woods	2154	7/23	2:10		3227	5732	2480	0	3	**3227**	**5735**	**2479**	**161**	**1.8**	Collapsed Chimney/ Grab	Small tip of chimney from collapsed sulfide talus/pile
J2-200-11-R1	Vienna Woods	2215	7/23	2:30		3197	5738	2478	1	1	**3198**	**5739**	**2477**	**206**	**3.7**	Hydrothermal Talus/ Breccia/ Grab	Cu-sulfide [and late-stage clay/sulfate] cemented breccia from sulfide/talus rubble.
J2-200-12-R1	Vienna Woods	2294	7/23	2:55		3193	5743	2480	-2	2	**3191**	**5745**	**2480**	**154**	**4.5**	Collapsed Chimney/ Grab	Zn-rich sulfide spire section from mid-way up large (>5 m) collapsed chimney
J2-200-13-R1	Vienna Woods	2315	7/23	3:02		3204	5723	2477	1	2	**3205**	**5725**	**2463**	**180**	**16.7**	Relict Sulfide Chimney/ Grab	Small, thin-walled chimlet from tip of large multi-spired chimney
J2-200-14-R1	Vienna Woods	2400	7/23	3:34		3216	5686	2376	2	0	**3218**	**5686**	**2475**	**173**	**1.6**	Relict Sulfide Chimney/ Grab	One [of two] spire from small (~1 m) relict chimney
J2-200-15-R1	Vienna Woods	2439	7/23	3:49		3204	5691	2473	3	2	**3207**	**5693**	**2474**	**239**	**1.6**	Collapsed Chimney/ Grab	Piece of Cpy-rich sulfide from basal section of collapsed sulfide chimney/talus.
J2-200-16-R1	Vienna Woods	2480	7/23	4:03		3179	5718	2476	2	1	**3181**	**5719**	**2477**	**265**	**4.6**	Relict Sulfide Chimney/ Grab	Tip of spire from top of multi-spired tall (>5 m) and wide (>2 m) relict chimney
J2-200-17-R1	Vienna Woods	2492	7/23	4:23		3172	5728	2479	-9	-5	**3163**	**5723**	**2479**	**294**	**0.8**	Collapsed Chimney/ Grab	Spire from base of several ~2 m tall chimneys. Rubble/talus piece (?)
J2-200-18-R1	Vienna Woods	2519	7/23	5:04		3183	5663	2471	-1	3	**3182**	**5666**	**2471**	**150**	**3.8**	Relict Sulfide Chimney/ Grab	Zn-rich Spire from top of one of many multi-spired chimneys
J2-200-19-R1	Vienna Woods	2533	7/23	5:16		3203	5652	2472	2	1	**3205**	**5653**	**2473**	**228**	**1.4**	Relict Sulfide Chimney/ Grab	~ 50 cm tall chimney, growing directly from basement (lightly sedimented)
J2-200-20-R1	Vienna Woods	2542	7/23	5:38		3177	5651	2472	3	-2	**3180**	**5649**	**2473**	**306**	**2.3**	Relict Sulfide Chimney/ Grab	~ 50 cm tall chimney, growing directly from basement (lightly sedimented)
J2-200-21-R1	Vienna Woods	2624	7/23	7:03		3208	5748	2482	0	0	**3208**	**5748**	**2482**	**300**	**0.8**	Relict Sulfide Chimney/ Grab	Exterior piece, mid-way up from partially collapsed, Fe-oxide stained chimney
J2-200-22-R1	Vienna Woods	2658	7/23	7:27		3241	5742	2483	-1	10	**3240**	**5752**	**2483**	**253**	**1.6**	Relict Sulfide Chimney/ Grab	Chimney from base of large (>6 m) sulfide edifice atop basal mound.
J2-201-1-R1	Tufar 2	2911	7/24	8:41		3860	6500	2490	1	-1	**3861**	**6499**	**2490**	**303**	**1.0**	Relict Sulfide Chimney/ Grab	Top of ~ 50 cm tall chimney growing out from sedimented pillow basalt
J2-201-2-R1	Tufar 2	3021	7/24	9:18		3849	6509	2490	0	-1	**3849**	**6508**	**2490**	**197**	**1.3**	Relict Sulfide Chimney/ Grab	~ 50 cm tall chimney growing out from sedimented pillow basalt
J2-201-3-R1	Tufar 2	3188	7/24	9:54		3825	6488	2489	1	1	**3826**	**6489**	**2489**	**223**	**1.1**	Collapsed Chimney/ Grab	Small sulfide knob from (top?) of relict, collapsed and broken spire
J2-201-4-R1	Tufar 2	3215	7/24	10:03		3812	6487	2481	-2	1	**3810**	**6488**	**2481**	**120**	**9.0**	Relict Sulfide Chimney/ Grab	Spire from periphery at top of >7 m tall inactive chimney.
J2-201-4-R2	Tufar 2	3276	7/24	10:07		3812	6487	2481	-2	1	**3810**	**6488**	**2481**	**120**	**9.0**	Relict Sulfide Chimney/ Grab	2nd piece from same structure - about 20 cm below apex of chimney on periphery.

J2-201-5-R1	Tufar 2	3273	7/24	10:20		3776	6480	2487	-1	0	**3775**	**6480**	**2487**	**239**	**1.4**	Collapsed Chimney/ Grab	Zn-Sulfide talus/chimney rubble from base of large sulfide mounds hosting few spires.
J2-201-6-R1	Tufar 2	3337	7/24	10:37		3747	6485	2484	1	1	**3748**	**6486**	**2484**	**241**	**1.5**	Relict Sulfide Chimney/ Grab	Spire from bulbous sulfide mound/chimmney w/ in Fe-oxide rich sedimented area
J2-201-7-R1	Tufar 2	3380	7/24	10:55		3743	6468	2484	0	-1	**3743**	**6467**	**2484**	**333**	**1.7**	Relict Sulfide Chimney/ Grab	Spire from ~ 1m chimney within cmplex of multiple sulfide edifices
J2-201-8-R1	Tufar 2	3592	7/24	11:37		3718	6472	2481	-6	-18	**3712**	**6454**	**2483**	**319**	**4.7**	Relict Sulfide Chimney/ Grab	Sulfide chimney from small bulbous sulfide mounds at base of complex.
J2-201-9-R1	Tufar 2	3650	7/24	12:05		3720	6475	2478	-1	3	**3719**	**6478**	**2479**	**279**	**3.0**	Collapsed Chimney/ Grab	Pieces of exterior crust from talus remnants of relict chimney at base ~12 m chimney.
J2-201-10-R1	Tufar 2	3718	7/24	12:25		3707	6476	2480	-1	0	**3706**	**6476**	**2480**	**130**	**1.3**	Relict Sulfide Chimney/ Grab	Small spire from within talus pile of large fallen chimney
J2-201-11-R1	Tufar 2	3832	7/24	12:52		3705	6464	2480	-10	4	**3695**	**6468**	**2478**	**160**	**1.0**	Hydrothermal Talus/ Breccia/ Grab	Py/Cpy rich talus piece on E slope of large mound
J2-201-12-R1	Tufar 2	3918	7/24	13:14		3695	6452	2474	0	-1	**3695**	**6451**	**2474**	**033**	**2.0**	Hydrothermal Talus/ Breccia/ Grab	Zn-rich sulfide collapsed chimney/talus from S slope of large mound
J2-201-13-R1	Tufar 2	3964	7/24	13:23		3705	6434	2485	4	3	**3709**	**6437**	**2485**	**180**	**2.7**	Hydrothermal Talus/ Breccia/ Grab	Zn-rich sulfide rubble from talus of large fallen chimney (basal piece?)
J2-201-14-R1	Tufar 2	4099	7/24	14:14		3679	6419	2479	-1	-2	**3678**	**6417**	**2482**	**342**	**3.4**	Relict Sulfide Chimney/ Grab	Top-half of ~ 60 cm relict sulfide chminey atop sulfide basal mound ~ 1 m tall/diameter
J2-201-15-R1	Tufar 2	4199	7/24	14:34		3673	6439	2470	-1	2	**3672**	**6441**	**2470**	**150**	**4.8**	Relict Sulfide Chimney/ Grab	Small, knobly spire from periphery of multi-spired edifice on side of >7 m sulfide chimney/mound
J2-201-16-R1	Tufar 2	4287	7/24	14:52		3663	6423	2478	1	0	**3664**	**6423**	**2477**	**185**	**3.5**	Relict Sulfide Chimney/ Grab	Large parasitic spire from side of ~3 m tall chimney; field of many relict chmineys. Navigation questionable.
J2-201-17-R1	Tufar 2	4347	7/24	15:15		3665	6414	2483	0	-1	**3665**	**6413**	**2483**	**337**	**3.0**	Collapsed Chimney/ Grab	Zn-rich sulfide, crumbled and picked up from base of relict chimneys
J2-201-18-R1	Tufar 2	4408	7/24	15:30		3646	6388	2490	1	0	**3647**	**6388**	**2490**	**287**	**2.7**	Relict Sulfide Chimney/ Grab	Small Zn-sulfide sampled from exterior, base of relict ~ 1m chimney.
J2-201-19-R1	Tufar 2	4487	7/24	15:55		3649	6425	2478	-1	-1	**3648**	**6424**	**2479**	**019**	**4.5**	Relict Sulfide Chimney/ Grab	Spire broken from off mid-section of larger chimney complex (WHOI has tip).
J2-201-20-R1	Tufar 2	4544	7/24	16:13		3631	6439	2479	1	1	**3632**	**6440**	**2479**	**220**	**1.1**	Relict Sulfide Chimney/ Grab	Tip broken from bulbous, knobly ~ 3m sulfide chimney/mound
J2-201-21-R1	Tufar 2	4614	7/24	16:34		3627	6412	2485	-2	-2	**3625**	**6410**	**2486**	**018**	**2.2**	Relict Sulfide Chimney/ Grab	Large sulfide-silica-sulfate piece grabbed from small knob on (sulfide?) mound
J2-201-22-R1	Tufar 2	4979	7/24	18:42		3762	6437	2488	3	1	**3765**	**6438**	**2488**	**357**	**2.5**	Relict Sulfide Chimney/ Grab	Py-rich small chimney from mid-way up larger multi-spired edifice
J2-201-22-R2	Tufar 2	5090	7/24	19:20		3768	6437	2488	-12	1	**3756**	**6438**	**2490**	**310**	**1.0**	Hydrothermal Talus/ Breccia/ Grab	Small broken Zn-rich pieces from rubble pile at base of talus scree. ~4 m from 22-R1.
J2-201-23-R1	Tufar 2	5158	7/24	19:48		3730	6461	2481	3	4	**3733**	**6465**	**2478**	**317**	**4.7**	Relict Sulfide Chimney/ Grab	Tip of large chimney from multi-spired chimney complex.
J2-201-24-R1	Tufar 2	5230	7/24	19:58		3737	6480	2482	1	6	**3738**	**6486**	**2482**	**14**	**1.8**	Relict Sulfide Chimney/ Grab	Tip from one of many, single spired <2 m chimneys upon sedimented mound.
J2-202-1-R1	Vienna Woods	5620	7/25	10:00		3311	5814	2485	2	5	**3313**	**5819**	**2485**	**245**	**2.1**	Sediment/ Grab	Coalesced sediment piece from base of large, active (~ 255 °C) sulfide mound
J2-202-2-R1	Vienna Woods	5651	7/25	10:09		3296	5828	2485	-1	-1	**3295**	**5827**	**2485**	**345**	**1.4**	Hydrothermal Talus/ Breccia/ Grab	Weathered/Altered clay-silica-oxide (formerly sulfide-rich?) 'apron' from Fe-oxide rich horizon
J2-202-3-R1	Vienna Woods	5770	7/25	10:45		3287	5911	2483	-1	0	**3286**	**5911**	**2483**	**290**	**1.1**	Relict Sulfide Chimney/ Grab	Spire knocked from small (<2 m) chimney complex.
J2-202-4-R1	Vienna Woods	5934	7/25	11:12		3233	5873	2482	-1	-1	**3232**	**5872**	**2482**	**204**	**5.1**	Relict Sulfide Chimney/ Grab	Colonized, sulfide protrusion from large (~ 50 cm) flange off mid-section of chimney.
J2-202-5-R1	Vienna Woods	6025	7/25	11:35		3217	5860	2484	1	5	**3218**	**5865**	**2484**	**240**	**3.0**	Collapsed Chimney/ Grab	Peripheral chimney from vertical mid-section of large (> 5m) fallen chimney
J2-202-6-R1	Vienna Woods	6094	7/25	11:41		3205	5878	2484	-2	-1	**3203**	**5877**	**2484**	**217**	**4.4**	Relict Sulfide Chimney/ Grab	Small spire broken off side of chimney; about half-way up structure

J2-202-7-R1	Vienna Woods	6202	7/25	12:18		3167	5880	2480	6	2	**3173**	**5882**	**2480**	**333**	**3.6**	Active Sulfide Chimney/ Grab	Anh-rich piece of exterior active smoker. Breaking off piece resulted in venting from crack.
J2-202-8-R1	Vienna Woods	6280	7/25	12:37		3152	5871	2484	4	2	**3156**	**5873**	**2484**	**345**	**1.8**	Relict Sulfide Flange/ Grab	Flange/ledge formed at very base of ~6 m tall chimney edifice.
J2-202-9-R1	Vienna Woods	6350	7/25	12:52		3154	5849	2487	5	5	**3159**	**5854**	**2487**	**209**	**1.4**	Relict Sulfide Chimney/ Grab	Inactive spire piece from base of small (broken) chimney
J2-202-10-R1	Vienna Woods	6410	7/25	13:05		3135	5861	2484	3	4	**3138**	**5865**	**2484**	**248**	**2.0**	Sediment/ Grab	Clay-silica-sulfate precipitate encrusted in Mn-oxide casing (early or late?) lying within sulfide-sediment mound.
J2-202-11-R1	Vienna Woods	6460	7/25	13:12		3112	5825	2481	-2	36	**3110**	**5861**	**2480**	**190**	**1.4**	Relict Sulfide Chimney/ Grab	Parasite spire from base and side of ~8 m tall incative chimney complex.
J2-202-12-R1	Vienna Woods	6560	7/25	13:31		3100	5832	2487	4	-1	**3104**	**5831**	**2487**	**245**	**1.4**	Relict Sulfide Chimney/ Grab	Exterior piece from side of lone, partially broken sulfide chimney
J2-202-13-R1	Vienna Woods	7600	7/25	20:25		3282	5798	2485	-3	1	**3279**	**5799**	**2485**	**120**	**0.7**	Volcanic Rock/ Grab	Partly altered basalt, glassy rind in places; interior tubes of drained lava flows.
J2-202-14-R1	Vienna Woods	7653	7/25	20:42		3256	5786	2487	-3	0	**3253**	**5786**	**2486**	**177**	**1.0**	Sediment / Grab	Mn-oxide coating inner amorphous oxide-clay mass from exterior of base of large, collapsed sulfide chimney.
J2-202-15-R1	Vienna Woods	7731	7/25	21:25		3224	5698	2476	0	0	**3224**	**5698**	**2476**	**316**	**0.7**	Collapsed Chimney/ Grab	Large (>50 cm diameter) basal piece of Zn-rich (w/ Py veins?) massive chimney.
J2-202-16-R1	Vienna Woods	7861	7/25	21:44		3207	5668	2474	-1	-2	**3206**	**5666**	**2474**	**149**	**1.9**	Relict Sulfide Chimney/ Grab	Zn-sulfide spire from mid-section of small (~ 2 m) chimney (part of larger complex)
J2-202-17-R1	Vienna Woods	7907	7/25	21:54		3219	5666	2467	-5	-1	**3214**	**5665**	**2467**	**074**	**7.0**	Relict Sulfide Chimney/ Grab	Top (~30 cm) of protruding spire from large (~8 m) inactive chimney
J2-203-1-R1	Bronze Age Fort	8926	7/26	15:53		5716	8462	2462	1	2	**5717**	**8464**	**2461**	**240**	**3.2**	Volcanic Rock/ Grab	Altered, non-glassy basalt from rubble front. Some surface colonization.
J2-203-2-R1	Bronze Age Fort	9005	7/26	16:43		5614	8386	2400	-1	1	**5613**	**8387**	**2402**	**235**	**0.7**	Volcanic Rock/ Grab	Protruding, glassy, fresh pillowbud from edige of outcrop. Navigation questionable.
J2-203-3-R1	Bronze Age Fort	9076	7/26	17:16		5634	8287	2433	0	-1	**5634**	**8286**	**2436**	**205**	**4.0**	Relict Sulfide Chimney/ Grab	Tip of ~ 4-5 m chimney from extinct sulfide field (> 10 large-ish spires).
J2-203-4-R1	Bronze Age Fort	9520	7/26	20:27		5560	8135	2445	-3	0	**5557**	**8135**	**2445**	**045**	**1.2**	Volcanic Rock/ Grab	Altered basalt from top of 'hogback' or 'razorback' wall (~ 15 m high)
J2-203-5-R1	Bronze Age Fort	9682	7/26	21:24		5652	8307	2444	0	-1	**5652**	**8306**	**2444**	**326**	**2.0**	Relict Sulfide Chimney/ Grab	Tip of 1 m relict chimney; from small complex hosted on basalt rubble.
J2-203-5-R2	Bronze Age Fort	9702	7/26	21:28		5652	8307	2444	0	-1	**5652**	**8306**	**2444**	**326**	**2.0**	Relict Sulfide Chimney/ Grab	Complete sample of 1 m tall Zn-rich relict chimney.
J2-203-6-R1	Bronze Age Fort	10140	7/26	23:41		5327	8295	2425	19	-5	**5346**	**8290**	**2429**	**319**	**3.1**	Volcanic Rock/ Grab	Basalt w/ bi-modal vesicle population taken from basal section of most NW wall.
J2-203-7-R1	Bronze Age Fort	10349	7/27	0:54		5245	7866	2468	-1	4	**5244**	**7870**	**2467**	**191**	**0.7**	Volcanic Rock/ Grab	Hackly sheet flow. Partly glassy, folded sheet flow from SW of wall
J2-203-7-R2	Bronze Age Fort	10380	7/27	0:59		5245	7866	2468	-1	4	**5244**	**7870**	**2467**	**191**	**0.7**	Volcanic Rock/ Grab	2nd sample of same sheet flow
J2-204-1-R1	Tufar 3	10938	7/27	14:37		12445	11725	2570	-8	-1	**12437**	**11724**	**2570**	**141**	**---**	Relict Sulfide Chimney/ Grab	Small relict spire from atop of small (volcanic?) mound.
J2-204-1-R2	Tufar 3	10959	7/27	14:44		12445	11725	2570	-5	-3	**12440**	**11722**	**2569**	**096**	**1.8**	Active Sulfide Chimney/ Grab	Active, juvenile chimney (194 C); distance ~ 1 m from inactive 1-R1.
J2-205-1-R1	Tufar 3	13648	7/28	19:20		12166	11404	2520	-1	4	**12165**	**11408**	**2520**	**202**	**1.0**	Volcanic Rock/ Grab	Pillow w/ glassy rind. Some plg-olv phencrysts. Incipid alteration to clay.
J2-206-1-R1	Vienna Woods [Unnamed]	14230	7/29	10:34		20728	16237	2640	27	48	**20755**	**16285**	**2640**	**032**	**1.0**	Pumice/ Grab	Pumice from surface of sediment
J2-206-2-R1	Vienna Woods [Unnamed]	15486	7/29	17:34		20171	15242	2587	16	10	**20187**	**15252**	**2585**	**249**	**1.2**	Volcanic Rock/ Grab	Weathered pillow from sedimented axial ridge
J2-206-3-R1	Vienna Woods [Unnamed]	15820	7/29	19:30		20663	15331	2421	3	1	**20666**	**15332**	**2621**	**002**	**3.4**	Hydrothermal Talus/ Breccia/ Grab	Altered brecciated clasts (volcanic? Perlitic textures) cemented by minor sulfide (Py)
J2-206-4-R1	Vienna Woods [Unnamed]	16230	7/29	22:00		21180	16011	2594	1	3	**21181**	**16014**	**2592**	**163**	**1.6**	Volcanic Rock/ Grab	Small piece of broken pillow from small, irregular largely sedimented mound

J2-206-5-R1	Vienna Woods [Unnamed]	16427	7/29	23:18		21170	15906	2602	0	0	**21170**	**15906**	**2602**	**318**	**3.1**	Sediment/ Grab	Orange, friable/soft clay-oxide encrusted in Mn-oxide from small exposed volcanic face on sedimented mound
J2-206-6-R1	Vienna Woods [Unnamed]	16500	7/29	23:38		21149	15808	2605	0	0	**21149**	**15808**	**2605**	**231**	**0.8**	Pumice/ Grab	Pumice piece from small trench with sea cucumbers
J2-207-1-W1-IGT7	Vienna Woods	16899	7/30	14:46		3243	5747	2470	-2	-3	**3241**	**5744**	**2470**	**043**	**5.5**	IGT water sample	From open conduit venting clear fluid; top of main chimney stack w/ other venting spires adjacent. T (max) 282°C
J2-207-1-W2-IGT3	Vienna Woods	16950	7/30	15:00		3243	5747	2470	-2	-3	**3241**	**5744**	**2470**	**044**	**5.5**	IGT water sample	Replicate fluid sample. Outside temp taken ~ 31 °C. T (max 282 °C.
J2-207-1-R1	Vienna Woods	16970	7/30	15:08		3243	5747	2470	-2	-3	**3241**	**5744**	**2470**	**045**	**5.5**	Active Sulfide Chimney/ Grab	Wtz-lined open conduit; peripheral spire from top of large (>5 m) active chimney. PAIR to three fluids from station #1.
J2-207-1-W3-M2	Vienna Woods	17000	7/30	15:15		3243	5747	2470	-2	-3	**3241**	**5744**	**2470**	**044**	**5.5**	MAJOR water sample	Replicate fluid sample. No temperature taken.
J2-207-2-R1	Vienna Woods	17164	7/30	15:59		3336	5785	2474	-2	-4	**3334**	**5781**	**2474**	**017**	**8.3**	Active Sulfide Chimney/ Grab	Tip of peripheral spire from heavily colonized (snails), tall (~ 8 m?) chimney. PAIR to one fluid from Stn #2.
J2-207-2-W1-IGT4	Vienna Woods	17190	7/30	16:08		3336	5786	2474	0	-4	**3336**	**5782**	**2475**	**017**	**8.3**	IGT water sample	From spire for a fluid-solid pair. Clear fluid. T (max) 273°C. PAIR to one fluid from Stn #2.
J2-207-3-W1-IGT8	Vienna Woods	17393	7/30	17:01		3277	5904	2475	2	2	**3279**	**5906**	**2475**	**271**	**8.0**	IGT water sample	Clear fluid from orifice of small spire from large chimney. T (max) 285°C.
J2-207-3-R1	Vienna Woods	17445	7/30	17:18		3277	5904	2475	2	2	**3279**	**5906**	**2475**	**271**	**8.0**	Active Sulfide Chimney/ Grab	Sample of sulfide chimney tip from auxillary spire. I don't think this is a solid-fluid pair after preliminary description of sample.
J2-207-3-W2-IGT6	Vienna Woods	17474	7/30	17:38		3277	5904	2475	2	2	**3279**	**5906**	**2474**	**271**	**8.0**	IGT water sample	Clear smoker from 2 cm wide conduit. Sample was friable and I don't think it is an exact fluid-solid pair to 3-R1. T (max) 240 °C.
J2-207-4-R1	Vienna Woods	17683	7/30	18:25		3143	5877	2484	5	-5	**3148**	**5872**	**2484**	**067**	**1.0**	Sediment/ Grab	Solid, platey sediment at base of chimney
J2-207-5-R1	Vienna Woods	17781	7/30	18:50		3149	5876	2485	1	-9	**3150**	**5867**	**2485**	**024**	**1.1**	Relict Sulfide/ Grab	Fragments of base of small, bulbous relict sulfide (massive?) from surface of large pillow basalt
J2-207-5-R2	Vienna Woods	17791	7/30	18:54		3149	5876	2485	1	-9	**3150**	**5867**	**2485**	**028**	**1.4**	Relict Sulfide/ Grab	2nd piece from adjacent section of relict sulfide.
J2-207-6-R1	Vienna Woods	17871	7/30	19:15		3147	5867	2487	9	-13	**3156**	**5854**	**2487**	**066**	**1.3**	Volcanic Rock/ Grab	Moderately vesicular basalt from near base of sulfide chimney
J2-207-7-R1	Vienna Woods	18076	7/30	20:12		3173	5882	2482	0	1	**3173**	**5883**	**2483**	**300**	**1.3**	Volcanic Rock/ Grab	Underside of old pillow flow from section under a relict sulfide chimney
J2-207-8-R1	Vienna Woods	18200	7/30	20:35		3170	5882	2480	-4	0	**3166**	**5882**	**2480**	**314**	**4.1**	Active Sulfide Chimney/ Grab	Extremely friable, fragments of young (4 days) Anh-Sph active "beehive" chimney
J2-208-1-R3	Roman Ruins	19160	8/02	11:35	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**2.0**	Active Sulfide Chimney/ Volunteer	Volunteer sulfide spire from Stn #1. Fell in during approach to station from tall edifice.
J2-208-1-T1	Roman Ruins	19190	8/02	11:44	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.9**	Temperature Measurement	Jason T probe. 307 °C. Orifice of black smoker spire from rotund chimney edifice [part of sulfide wall complex].
J2-208-1-T2	Roman Ruins	19200	8/02	11:47	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.9**	Temperature Measurement	Jason T probe. 277 °C. Orifice of grey smoker of same chimney complex.
J2-208-1-W1-IGT8	Roman Ruins	19225	8/02	11:57	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	IGT water sample	Grey/black smoker fluid from top of rotund edifice. Pair to 1-T2 and sulfide 1-R1. T (max) 312 °C.
J2-208-1-W2-IGT5	Roman Ruins	19243	8/02	12:03	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	IGT water sample	Replicate fluid sample. T (max) 314 °C.
J2-208-1-W3-M4	Roman Ruins	19290	8/02	12:23	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	MAJOR water sample	Replicate fluid sample. No T measurement taken.
J2-208-1-R1	Roman Ruins	19311	8/02	12:51	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	Active Sulfide Chimney/ Grab	Small remaining piece of black smoker spire for PAIR to three fluids from Station 208-1. Sample mostly lost. Cpy-lined.
J2-208-1-T3	Roman Ruins	19393	8/02	12:58	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	Temperature Measurement	Jason T probe. 6 °C. From outside surface of chimney conduit.
J2-208-1-T4	Roman Ruins	19403	8/02	13:00	2	2793	3256	1677	4	-2	**2797**	**3254**	**1677**	**275**	**1.3**	Temperature Measurement	Jason T probe. 315 °C. In fluid conduit after sampling for fluids.

J2-208-1-R2	Roman Ruins	19422	8/02	13:03	2	2794	3254	1677	3	0	**2797**	**3254**	**1677**	**280**	**1.3**	Relict Sulfide Chimney/ Grab	Relict beehive knob from main "wall" of sulfide complex. Pervasive (white) microbial mat on exterior.
J2-208-1-Mkr2	Roman Ruins	19446	8/02	13:10	2	2794	3254	1677	3	0	**2797**	**3254**	**1677**	**280**	**1.3**	Marker [Roman Ruins]	Marker #2 placed at base of large active chimney complex where station 208-1 samples taken.
J2-208-1-R4	Roman Ruins	19461	8/02	13:11	2	2794	3254	1677	3	0	**2797**	**3254**	**1677**	**280**	**1.3**	Relict Sulfide Chimney/ Volunteer	2nd volunteer sulfide chimeny from Stn #1. Fell in whilst deploying marker from right (north) side of complex.
J2-208-2-T1	Roman Ruins	19694	8/02	14:30	1	2802	3235	1675	3	-1	**2805**	**3234**	**1676**	**333**	**2.9**	Temperature Measurement	Jason T probe. 282 °C. Top of bulbous beehive at top of 1 - 2 m tall sulfide complex.
J2-208-2-W1-IGT1	Roman Ruins	19731	8/02	14:43	1	2802	3235	1675	3	-1	**2805**	**3234**	**1675**	**333**	**2.9**	IGT water sample	Grey/black smoker fluid from beehive. T (max) 271 °C.
J2-208-2-W2-IGT2	Roman Ruins	19754	8/02	14:53	1	2802	3235	1675	3	-1	**2805**	**3234**	**1675**	**333**	**2.9**	IGT water sample	Replicate fluid sample. T (max) 272 °C.
J2-208-2-W3-M2	Roman Ruins	19778	8/02	15:04	1	2802	3235	1675	3	-1	**2805**	**3234**	**1676**	**333**	**2.9**	MAJOR water sample	Replicate fluid sample. No T measurement taken.
J2-208-2-R1	Roman Ruins	19801	8/02	15:13	1	2802	3235	1675	4	-1	**2806**	**3234**	**1675**	**333**	**2.9**	Inactive Sulfide Chimney/ Grab	External shell of small beehive, next to beehive sampled for fluids, but this sample does not have venting.
J2-208-2-R2	Roman Ruins	19820	8/02	15:16	1	2802	3235	1675	3	-1	**2805**	**3234**	**1676**	**333**	**2.9**	Active Sulfide Chimney/ Grab	External shell of beehive from which fluids at station 208-2 were taken. Interior friable and crumbled; not a good fluid-solid pair.
J2-208-2-R3	Roman Ruins	19832	8/02	15:20	1	2802	3235	1675	3	-2	**2805**	**3233**	**1676**	**333**	**2.9**	Inactive Sulfide Chimney/ Grab	External shell of beehive from base of wall of complex. In proximity (<1 m) to samples 2-R1 and 2-R2.
J2-208-2-R4	Roman Ruins	19850	8/02	15:24	1	2801	3234	1675	6	-1	**2807**	**3233**	**1675**	**298**	**3.1**	Relict Sulfide Chimney/ Grab	Collapsed, relict beehive from base of sulf. complex; approx 2 m from 2-R1, R2 and R3. [Still shimmering after sampling - 40 °C, hot and only recently active?]
J2-208-2-T2	Roman Ruins	19868	8/02	15:30	1	2801	3234	1675	6	0	**2807**	**3234**	**1675**	**298**	**3.1**	Temperature Measurement	Jason T probe. 264 °C. From orifice of grey smoker close to (~1 m) from relict 2-R4.
J2-208-2-Mkr1	Roman Ruins	19924	8/02	15:38	1	2802	3233	1675	5	1	**2807**	**3234**	**1675**	**306**	**4.0**	Marker [Roman Ruins]	Marker #1 placed at base of sulfide complex, closest to sample 2-R4
J2-208-3-R1	Roman Ruins	19962	8/02	15:56		2778	3225	1683	4	-4	**2782**	**3221**	**1683**	**326**	**2.1**	Hydrothermal Talus/ Breccia/ Grab	Rock from talus pile at base of sulfide rampart; i) mineralized and altered volcanic breccia or ii) degraded massive sulfide?
J2-208-4-R1	Roman Ruins	20093	8/02	16:26		2746	3188	1681	3	-1	**2749**	**3187**	**1680**	**044**	**1.6**	Relict Sulfide Chimney/ Grab	Outer ~ 2 cm of exterior layers of relict sulfide spire from base of large, mostly inactive chimney. No interior layers.
J2-208-4-R2	Roman Ruins	20130	8/02	16:29		2745	3189	1680	2	-2	**2747**	**3187**	**1681**	**040**	**1.5**	Relict Sulfide Chimney/ Grab	Tip of spire from relict ~1.5 m chimney next to sample 4-R2.
J2-208-4-T1	Roman Ruins	20165	8/02	16:38		2741	3192	1681	6	-5	**2747**	**3187**	**1681**	**041**	**0.8**	Temperature Measurement	Jason T probe. 236 °C. In orifice of white smoker from small spire next to relict samples 4-R2.
J2-208-5-R1	Roman Ruins	20458	8/02	18:10		2680	3164	1670	-1	-4	**2679**	**3160**	**1670**	**130**	**2.5**	Volcanic Rock/ Grab	Relatively fresh volcanic pillow flow from edge of flat-topped conical hill.
J2-208-6-T1	Roman Ruins	20538	8/02	18:33		2692	3170	1669	0	-3	**2692**	**3167**	**1669**	**048**	**3.0**	Temperature Measurement	Jason T probe. 106 °C. Temp of clear fluid directly out of sedimented (+ Fe-oxide casing) fissure.
J2-208-6-T2	Roman Ruins	20617	8/02	18:45		2693	3171	1669	1	1	**2694**	**3172**	**1669**	**049**	**1.8**	Temperature Measurement	Jason T probe. 277 °C. Fluid from orifice of grey smoker from small (~ 1 m) Fe-oxide coated sulfide chimney
J2-208-7-T1	Roman Ruins	20746	8/02	19:13	4	2708	3169	1666	-1	1	**2708**	**3170**	**1666**	**250**	**4.7**	Temperature Measurement	Jason T probe. 316 °C. In conduit of small black smoker spire from side of large (>5 m) chimney.
J2-208-7-Mkr4	Roman Ruins	20770	8/02	19:19	4	2708	3169	1667	-1	1	**2708**	**3170**	**1666**	**247**		Marker [Roman Ruins]	Marker #4 at base of black smoker chimney complex where T sampled, in case we return for fluid sampling on future dive.

J2-208-8-T1	Roman Ruins	20964	8/02	19:59		2723	3192	1681	-1	1	**2722**	**3193**	**1681**	**149**	**1.3**	Temperature Measurement	Jason T probe. 266 °C. Grey smoker fluid from wide conduit [fissure] from hydro- thermally stained pillows at base of scarp.
J2-208-9-T1	Roman Ruins	21107	8/02	20:35		2719	3217	1681	0	0	**2719**	**3217**	**1681**	**104**	**2.8**	Temperature Measurement	Jason T probe. 39 °C. Exterior surface of white, microbially-coated beehive knob from top of small sulfide chimney.
J2-208-9-R1	Roman Ruins	21177	8/02	20:54		2719	3217	1681	0	0	**2719**	**3217**	**1681**	**104**	**2.8**	Active Sulfide Chimney/ Grab	Exterior ~3 cm skin of [active] sulfide chimney. Heavy surface microbial deposits. Several pieces.
J2-208-9-T3	Roman Ruins	21218	8/02	21:01		2719	3217	1681	0	0	**2719**	**3217**	**1681**	**104**	**2.8**	Temperature Measurement	Jason T probe. 196 °C. Interior of [sampled] white , beehive knob from top of small sulfide chimney.
J2-208-10-R1	Roman Ruins	21447	8/02	22:11		2776	3246	1677	0	0	**2776**	**3246**	**1677**	**053**	**3.8**	Active Sulfide Chimney/ Grab	Piece of massive sulfide (Py + minor ZnS) from base of wall w/ sulfide encrustations and well-developed diffuse flow chimneys.
J2-208-10-T1	Roman Ruins	21490	8/02	22:19		2776	3246	1677	0	1	**2776**	**3247**	**1677**	**053**	**3.8**	Temperature Measurement	Jason T probe. 54 °C. High temp measured from flow within and around altered pillow and sulfide edifices.
J2-208-11-N1	Roman Ruins	21720	8/02	23:51		2678	3431	1707	-2	2	**2676**	**3433**	**1707**	**272**	**9.5**	NISKIN water sample	Niskin samples of local bottom water from Rogers Ruins vent field. T = 2.4 °C. Eh = 142 mV (rebounding to background).
J2-209-1-R1	Satanic Mills	22110	8/03	11:47	3	2448	2574	1685	-1	0	**2447**	**2574**	**1685**	**188**	**3.2**	Active Sulfide Chimney/ Grab	Tip of black smoker chimney. PAIR to three fluids. Cpy and Py lined conduits.
J2-209-1-W1-IGT7	Satanic Mills	22129	8/03	11:52	3	2448	2574	1685	-1	0	**2447**	**2574**	**1685**	**188**	**3.2**	IGT water sample	Grey/black smoker from tip of ~3 m chimney. T (max) 293 °C. Pair to sulfide 209-1-R1.
J2-209-1-W1-IGT6	Satanic Mills	22152	8/03	12:00	3	2448	2574	1685	-1	0	**2447**	**2574**	**1685**	**188**	**3.2**	IGT water sample	Replicate fluid sample. T (max) 295 °C.
J2-209-1-W3-M4	Satanic Mills	22179	8/03	12:10	3	2448	2574	1685	-1	0	**2447**	**2574**	**1685**	**188**	**3.2**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-209-1-R2	Satanic Mills	22220	8/03	12:25	3	2448	2574	1685	0	0	**2448**	**2574**	**1685**	**188**	**3.2**	Relict Sulfide Chimney/ Grab	Tall, relict sulfide spindle; close to 209-1-R1. Cpy w/ oxidation products.
J2-209-1-Mkr3	Satanic Mills	22444	8/03	13:37	3	2446	2574	1685	2	1	**2448**	**2575**	**1685**	**163**	**4.4**	Marker [Satanic Mills]	Marker #3. Deployed post-sampling upon return to edifice N side of active edifice.
J2-209-2-N1	Satanic Mills	22285	8/03	12:44		2432	2561	1685	-2	-2	**2430**	**2559**	**1682**	**230**	**4.0**	NISKIN water sample	Niskin bottle fired from bottom of depression; N of Satanic Mills vent field.
J2-209-2-N2	Satanic Mills	22297	8/03	12:47		2432	2561	1685	-2	-2	**2430**	**2559**	**1685**	**230**	**0.8**	NISKIN water sample	Niskin bottle fired from bottom of depression; N of Satanic Mills vent field.
J2-209-3-R1	Satanic Mills	22655	8/03	14:45		2454	2621	1683	1	2	**2455**	**2623**	**1683**	**027**	**2.7**	Volcanic Rock/ Grab	Black, holohyaline lava, numerous vesicles. Some surface staining. From area of seafloor w/ shimmering flow.
J2-209-4-T1	Satanic Mills	22940	8/03	16:40		2461	2542	1684	-1	-3	**2460**	**2539**	**1687**	**025**	**1.5**	Temperature Measurement	Jason T probe 136 °C. Clear fluid emanating from fissure between pillow flows. Small white diffuser smokers and Ifremeria snails.
J2-209-4-T2	Satanic Mills	22993	8/03	16:50		2461	2544	1684	-1	-4	**2460**	**2540**	**1687**	**025**	**1.5**	Temperature Measurement	Jason T probe. 219 °C. Grey smoker fluids from the white diffuser smoker.
J2-209-5-R1	Satanic Mills	23103	8/03	17:22		2452	2523	1684	0	-6	**2452**	**2517**	**1689**	**347**	**4.8**	Active Sulfide Chimney/ Grab	Tip of spire from small (~1 m) white smoker from fissure in basement. Temp (int) 212 °C; (ext) 5.6 °C.
J2-209-6-R1	Satanic Mills	23183	8/03	17:56	5	2450	2537	1688	0	0	**2450**	**2537**	**1688**	**349**	**1.3**	Active Sulfide Chimney/ Grab	Multi-conduit, large active Fe-Zn spire. PAIR to two fluids.
J2-209-6-W1-IGT4	Satanic Mills	23344	8/03	18:40	5	2450	2537	1688	0	0	**2450**	**2537**	**1688**	**349**	**1.3**	IGT water sample	Focused fluid from orifice left open after sampling for sulfide. T (max) 241 °C
J2-209-6-W2-M2	Satanic Mills	23413	8/03	18:54	5	2450	2537	1688	0	0	**2450**	**2537**	**1688**	**349**	**1.3**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-209-6-R2	Satanic Mills	23486	8/03	19:12	5	2450	2537	1688	-1	-1	**2449**	**2536**	**1688**	**349**	**1.3**	Hydrothermal Talus/ Breccia/ Grab	Relict, altered/weathered sulfide. Much textural and mineralogical info. not preserved. From base of chimney complex.
J2-209-6-R3	Satanic Mills	23538	8/03	19:20	5	2450	2537	1688	-2	1	**2448**	**2538**	**1688**	**349**	**1.3**	Relict Sulfide Chimney/ Grab	Inactive "Palmate" sulfide chimney w/ complex outer sulfide textures. Is a frond from top of palm-like branching chimney.

J2-209-6-Mkr5	Satanic Mills	23569	8/03	19:22	5	2450	2537	1688	1	-1	**2451**	**2536**	**1688**	**349**	**1.3**	Marker [Satanic Mills]	Marker #5 in proximity (~1 m) to small triple-spired chimney edifice. Directly on volcanic substrate.
J2-209-7-R1	Satanic Mills	23880	8/03	21:01		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Active Sulfide Chimney/ Grab	Small tip (cpy-lined) from black smoker chimney at periphery of large smoker complex.
J2-209-7-T1	Satanic Mills	238911	8/03	21:07		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Temperature Measurement	Jason T probe. 271 °C. From orifice of sampled chimney (209-7-R1).
J2-209-7-R2	Satanic Mills	23980	8/03	21:14		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Relict Sulfide Chimney/ Grab	Piece of cpy-rich multi-conduited, relict spire from base of the same smoker complex.
J2-209-7-R3	Satanic Mills	24001	8/03	21:21		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Relict Sulfide Chimney/ Grab	Cpy-lined, small relict spire from talus pile at base of chimney complex
J2-209-7-R4	Satanic Mills	24017	8/03	21:21		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Relict Sulfide Chimney/ Grab	Cpy-lined, small relict spire from talus pile at base of chimney complex
J2-209-7-R5	Satanic Mills	24080	8/03	21:31		2464	2572	1689	0	-2	**2464**	**2570**	**1689**	**020**	**0.7**	Relict Sulfide Chimney/ Grab	Cpy-lined, Zn-Fe-rich relict spire from talus pile at base of chimney complex.
J2-209-8-R1	Satanic Mills	24136	8/03	21:49		2464	2549	1688	0	1	**2464**	**2550**	**1688**	**256**	**2.2**	Hydrothermal Talus/ Breccia/ Grab	Large breccia of grey clastic altered volcanic lava cemented between Cu-rich and Qtz veins.
J2-209-9-R1	Satanic Mills	24242	8/03	22:26		2427	2495	1689	3	0	**2430**	**2495**	**1689**	**296**	**1.8**	Volcanic Rock/ Grab	Glassy, aphyric, lobate flow w/ minor surface staining from heavily sedimented terrain.
J2-210-1-T1	Snowcap	25010	8/04	12:20	6	2147	2427	1643	0	-3	**2147**	**2424**	**1643**	**201**	**1.1**	Temperature Measurement	Jason T probe. 107 °C. Clear fluid discharging from crack at mid-point of large chimney complex.
J2-210-1-W1-IGT8	Snowcap	25022	8/04	12:31	6	2147	2427	1643	0	-3	**2147**	**2424**	**1643**	**201**	**1.1**	IGT water sample	Clear fluid sample from same locale as temperature meas. T (max) 120 °C.
J2-210-1-W2-IGT5	Snowcap	25058	8/04	12:39	6	2147	2427	1643	0	-3	**2147**	**2424**	**1643**	**201**	**1.1**	IGT water sample	Replicate fluid sample. T (max) 152 °C. Snorkle came away from orifice during sample.
J2-210-1-W3-M2	Snowcap	25084	8/04	12:49	6	2147	2427	1643	0	-3	**2147**	**2424**	**1643**	**201**	**1.1**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-210-1-Mkr6	Snowcap	25108	8/04	12:58	6	2147	2427	1643	-1	-2	**2146**	**2425**	**1643**	**201**	**1.1**	Marker [Snowcap]	Marker #6 at base of chimney complex sampled for fluids and inactive sulfides.
J2-210-1-R1	Snowcap	25134	8/04	13:00	6	2148	2424	1643	-2	1	**2146**	**2425**	**1643**	**253**	**1.9**	Relict Sulfide Chimney/ Grab	Relict, Zn-sulfide spire tip from periphery of large sulfide chimney complex.
J2-210-2-R1	Snowcap	25190	8/04	13:25		2156	2422	1642	-2	-1	**2154**	**2421**	**1642**	**088**	**2.8**	Sulfur/ Grab	Predominantly amorphous sulfur (dark grey). Forms vein within 2-R2 type rock
J2-210-2-R2	Snowcap	25284	8/04	13:51		2150	2420	1643	1	-3	**2151**	**2417**	**1643**	**150**	**3.5**	Volcanic Rock/ Grab	Fresh, sparsely phyric (plg?) volcanic lava. Isolated and loose from slope of sedimented ridge w/ bacterial mats.
J2-210-3-R1	Snowcap	25520	8/04	15:08		2209	2398	1635	2	4	**2211**	**2402**	**1635**	**209**	**0.1**	Sediment/ Scoop	Sediment scoop of white sediment material from top of ridge. Recovered only coarse gravel.
J2-210-4-W1-IGT2	Fenway	25881	8/04	17:18		2490	2376	1716	1	-2	**2491**	**2374**	**1716**	**354**	**2.6**	IGT water sample	Fluid sample fired in seawater. No T measurement.
J2-210-4-R1	Fenway	25930	8/04	17:36		2491	2376	1716	0	-1	**2491**	**2375**	**1716**	**354**	**2.6**	Collapsed Chimney/ Grab	Inactive (Cu-rich central; Zn-rich external) relict spire from larger chimney complex next to sampled fluids.
J2-210-5-R1	Fenway	26104	8/04	18:15		2514	2394	1701	1	0	**2515**	**2394**	**1702**	**007**	**2.5**	Volcanic Rock/ Grab	Fractured volcanic lava, moderately surface staining. Colonized w/ extensive mussel and alvinellid populations.
J2-210-5-T1	Fenway	26141	8/04	18:18		2514	2394	1701	-1	-1	**2513**	**2393**	**1702**	**000**	**2.6**	Temperature Measurement	Jason T probe. 5.5°C. Measurement at surface of lava where biology is extensive
J2-210-5-T2	Fenway	26157	8/04	18:21		2514	2394	1701	-2	-1	**2512**	**2393**	**1702**	**000**	**2.6**	Temperature Measurement	Jason T probe. 20.5 °C. Measurement of fluids at depth 15 cm beneathe seafloor.
J2-210-5-T3	Fenway	26164	8/04	18:25		2514	2394	1701	-4	-2	**2510**	**2392**	**1702**	**000**	**2.6**	Temperature Measurement	Jason T probe. 8.2°C. At surface in dense patch of alvinellid worms.
J2-210-5-T4	Fenway	26172	8/04	18:27		2514	2394	1701	-4	-2	**2510**	**2392**	**1702**	**000**	**2.6**	Temperature Measurement	Jason T probe. 12.9°C. Inserted into sediment beneath community of alvinellid.
J2-210-6-R1	Fenway	26270	8/04	18:56		2513	2411	1699	0	1	**2513**	**2412**	**1699**	**220**	**1.4**	Sediment/ Scoop	Scoop at top of ridge. Recovered clastic sediment of angular lava, pumice, Pele's Hair and FeOOH platey precipitates.

J2-210-6-T1, T2	Fenway	26315	8/04	19:05		2517	2409	1698	-1	3	**2516**	**2412**	**1699**	**222**	**1.7**	Temperature Measurement	Jason T probe. 3.0 °C (surface); 11.4 °C (inserted) into sediment on top of ridge.
J2-210-7-R1	Fenway	26442	8/04	19:44		2489	2383	1710	1	0	**2490**	**2383**	**1710**	**319**	**4.1**	Inactive Sulfide Chimney Tip/ Grab	Tip of small Py, Sph (Wtz?) sulfide chimlet from base of larger complex. Fresh, but no flow apparent (sealed tip, active chimney).
J2-210-7-R2	Fenway	26465	8/04	19:53		2490	2383	1710	0	0	**2490**	**2383**	**1710**	**319**	**4.1**	Active Sulfide Chimney/ Grab	Mid-section of larger, active part of same chimney as 7-R1. Flow started once sampled. Colonized with *Alvin.* snails.
J2-210-7-W1-IGT1	Fenway	26560	8/04	20:17		2490	2383	1710	0	0	**2490**	**2383**	**1710**	**319**	**4.1**	IGT water sample	Grey-Clear fluid from opened orifice at base of chimney which sampled for sulfide. PAIR sample. T (max) 296, T (avg) 280 °C.
J2-210-7-W2-M4	Fenway	26580	8/04	20:26		2490	2383	1710	0	0	**2490**	**2383**	**1710**	**319**	**4.1**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-210-7-R3	Fenway	26639	8/04	20:38		2490	2383	1710	0	0	**2490**	**2383**	**1710**	**319**	**4.1**	Relict Sulfide Chimney/ Grab	Talus of former sulfide chimney. Py and Sph, two-layer wall.
J2-210-N1	Fenway	26786	8/04	21:26		2427	2388	1698	0	0	**2427**	**2388**	**1698**	**115**	**3.0**	NISKIN water sample	In water column at top of scarp.
J2-210-N2	Fenway	26795	8/04	21:27		2427	2388	1698	0	0	**2427**	**2388**	**1698**	**115**	**3.0**	NISKIN water sample	In water column at top of scarp.
J2-210-8-R1	Fenway	26916	8/04	22:08		2459	2367	1717	3	3	**2462**	**2370**	**1717**	**211**	**0.9**	Massive Anhydrite/ Grab	Euhedral, massive anhydrite exposed on seafloor at/near base of sedimented scarp/ slope.
J2-210-8-R2	Fenway	26944	8/04	22:14		2459	2367	1717	3	3	**2462**	**2370**	**1717**	**211**	**0.9**	Massive Anhydrite/ Grab	Euhedral, massive anhydrite exposed on seafloor at/near base of sedimented scarp/ slope.
J2-210-8-R3	Fenway	26950	8/04	22:17		2459	2367	1717	5	0	**2464**	**2367**	**1716**	**211**	**0.9**	Relict Sulfide Chimney/ Grab	Highly weathered and altered, Fe-oxide-rich relict sulfide exposed on sedimented slope w/ abundant massive anh(?); next to 8-R1, 8-R2.
J2-210-9-T1	Fenway	26989	8/04	22:28		2462	2356	1708	1	0	**2463**	**2356**	**1708**	**169**	**3.3**	Temperature Measurement	Jason T probe. 190°C. Tip of ~ 1 cm diameter chimlet venting black smoker fluids. Entraining seawater.
J2-210-9-R1	Fenway	27005	8/04	22:34		2462	2356	1708	2	0	**2464**	**2356**	**1708**	**169**	**3.3**	Active Sulfide Chimney/ Grab	~ 1 cm diameter, extremely small (~20 g) sample of Cpy-lined open conduit chimlet.
J2-210-10-Mkr7	Fenway	27067	8/04	22:51	7	2462	2357	1708	2	-3	**2464**	**2354**	**1708**	**167**	**3.3**	Marker [Fenway]	Marker #7 at base of newly discovered, highly active, high temperature sulfide chimney complex.
J2-210-10-T1	Fenway	27200	8/04	23:25	7	2462	2353	1705	2	-3	**2464**	**2350**	**1706**	**033**	**4.5**	Temperature Measurement	Jason T probe. 353°C. Inserted into orifice encased in thick black smoke; phase seperating fluid.
J2-211-1-T1	Tsukushi	27520	8/05	10:24		1861	2238	1658	-1	2	**1860**	**2240**	**1658**	**167**	**1.8**	Temperature Measurement	Jason T probe. 26°C. Flow between cracks from oxide encrusted debris near relict chimney field on volcanic (?) mound.
J2-211-2-T1	Tsukushi	27800	8/05	12:02		1838	2237	1660	2	0	**1840**	**2237**	**1660**	**274**	**0.9**	Temperature Measurement	Jason T probe. 59°C. Flow from crack from oxide coated sulfidic mound.
J2-211-2-W1-IGT7	Tsukushi	27856	8/05	12:12		1838	2237	1660	1	0	**1839**	**2237**	**1660**	**274**	**0.9**	IGT water sample	Fluid from cracks in sulfide mound. T (max) 61 °C.
J2-211-2-W2-IGT6	Tsukushi	27889	8/05	12:26		1838	2237	1660	1	0	**1839**	**2237**	**1660**	**274**	**0.9**	IGT water sample	Replicate fluid sample. T (max) 62 °C.
J2-211-2-R1	Tsukushi	27932	8/05	12:42		1838	2237	1660	-1	0	**1837**	**2237**	**1660**	**274**	**0.9**	Sediment/ Grab	Piece of ~1 cm thick ferrihydrite exterior layer from mound; coated w/ colloform Mn-oxide.
J2-211-2-R2	Tsukushi	27956	8/05	12:47		1838	2237	1660	-1	-1	**1837**	**2236**	**1660**	**274**	**0.9**	Volcanic Rock/ Grab	Fresh pillow lava fragment exposed at aurface at base of mound.
J2-211-3-R1	Tsukushi	28173	8/05	14:10		1805	2440	1626	0	0	**1805**	**2440**	**1626**	**307**	**0.6**	Volcanic Rock/ Grab	Mostly fresh, glassy to aphanitic lava from top of a [volcanic] dome.
J2-211-4-R1	Snowcap	28650	8/05	17:25		2139	2428	1639	0	0	**2139**	**2428**	**1640**	**083**	**3.8**	Inactive Sulfide Chimney/ Grab	Tip of relict spire from apex of large chimney edifice. Some active, shimmering flow from complex.
J2-211-4-R2	Snowcap	28698	8/05	17:40		2139	2428	1639	0	0	**2139**	**2428**	**1639**	**083**	**3.8**	Inactive Sulfide Chimney/ Grab	Adjacent non-venting spire from the same chimney complex. Flow commenced upon sampling sulfide. Later paired to fluids.
J2-211-4-T1	Snowcap	28745	8/05	18:03		2139	2428	1639	0	0	**2139**	**2428**	**1639**	**083**	**3.8**	Temperature Measurement	Jason T probe. 173°C. From orifice 4-R2.
J2-211-4-T2	Snowcap	28769	8/05	18:09		2139	2428	1639	0	0	**2139**	**2428**	**1639**	**083**	**3.8**	Temperature Measurement	Jason T probe. 177°C. From orifice 4-R1.
J2-211-5-R1	Snowcap	28870	8/05	18:37		2140	2414	1646	-2	0	**2138**	**2414**	**1646**	**073**	**0.2**	Sulfur / Grab	Native sulfur from flow exposed on seafloor. Mostly amorphous (grey), some ortho (yellow).

J2-211-6-R1	Snowcap	28989	8/05	19:02		2143	2421	1645	0	1	**2143**	**2422**	**1645**	**171**	**0.9**	Volcanic Rock/ Grab	bedded, looks like hyaloclastite
J2-211-7-T1	Snowcap	29170	8/05	19:59		2111	2385	1651	0	-1	**2111**	**2384**	**1651**	**355**	**1.4**	Temperature Measurement	Jason T probe. 63°C. Shimmering water at base of Sulfide chimney complex
J2-211-7-R1	Snowcap	29190	8/05	20:04		2111	2385	1651	-1	-1	**2110**	**2384**	**1651**	**355**	**1.4**	Relict Sulfide Chimney/ Grab	Inactive sulfide spire from base of same sulfide complex.
J2-211-8-R1	Snowcap	29250	8/05	20:35		2097	2400	1649	1	0	**2098**	**2400**	**1649**	**290**	**0.7**	Volcanic Rock/ Grab	Weathered volcanic substratum from variably sedimented and Fe-oxide coated ridge.
J2-211-9-W1-IGT4	Snowcap	29758	8/05	23:23		2143	2440	1639	0	0	**2143**	**2440**	**1639**	**160**	**4.6**	IGT water sample	Clear fluid from open conduit; PAIR to sulfide 211 4-R2. T (max) 180 °C.
J2-211-9-W2-IGT3	Snowcap	29779	8/05	23:34		2143	2440	1639	0	-1	**2143**	**2439**	**1639**	**160**	**4.6**	IGT water sample	Replicate fluid sample. T (max) 174 °C.
J2-211-9-W3-M4	Snowcap	29816	8/05	23:46		2143	2440	1639	0	0	**2143**	**2440**	**1639**	**160**	**4.6**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-212-1-R1	Fenway	30414	8/06	13:10	7	2466	2349	1706	-3	3	**2463**	**2352**	**1706**	**047**	**3.6**	Active Sulfide Chimney/ Grab	Exterior ~ 5 cm, Py-Anh-rich piece from side of large Fenway chimney complex. From "Big Papi" black smoker spire.
J2-212-1-T1	Fenway	30420	8/06	13:16	7	2466	2349	1706	-3	3	**2463**	**2352**	**1706**	**047**	**3.6**	Temperature Measurement	Jason T probe. 353 °C. Interior open conduit orifice from "Big Papi"
J2-212-2-W1-IGT8	Fenway	30519	8/06	14:26	7	2465	2349	1707	4	0	**2469**	**2349**	**1707**	**294**	**3.2**	IGT water sample	Fluid from small orifice from side of chimney complex venting black smoke. T (max) 329 °C.
J2-212-2-W2-IGT5	Fenway	30599	8/06	14:42	7	2465	2349	1707	4	0	**2469**	**2349**	**1707**	**291**	**3.7**	IGT water sample	Replicate fluid sample. T (max) 343 °C.
J2-212-2-W3-M4	Fenway	30630	8/06	14:51	7	2465	2349	1707	4	0	**2469**	**2349**	**1707**	**291**	**3.7**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-212-2-R1	Fenway	30681	8/06	15:02	7	2465	2349	1707	4	0	**2469**	**2349**	**1708**	**313**	**2.9**	Active Sulfide Chimney/ Grab	Small exterior piece of black smoker chimney spire from Fenway chimney complex. No fluid pairs.
J2-212-2-R2	Fenway	30708	8/06	15:12	7	2465	2349	1707	4	0	**2469**	**2349**	**1707**	**313**	**2.9**	Active Sulfide Chimney/ Grab	2nd piece. Similar to 2-R1. From same chimney; Exterior piece.
J2-212-3-R1	Fenway	30771	8/06	15:43		2471	2356	1706	3	0	**2474**	**2356**	**1708**	**224**	**5.8**	Relict Sulfide Chimney/ Grab	Sealed spire from adjacent to a clear (145 °C) smoker at base of large sulfide edifice. Marker 7 visible in camera.
J2-212-3-R2	Fenway	30790	8/06	15:46		2471	2356	1706	3	0	**2474**	**2356**	**1709**	**224**	**5.8**	Relict Sulfide Chimney/ Grab	Replicate solid sample.
J2-212-4-R1	Fenway	30869	8/06	16:18		2458	2353	1712	-1	-3	**2457**	**2350**	**1712**	**107**	**3.4**	Hydrothermal Talus/ Breccia/ Grab	Cpy+Anh-rich talus from base of the main Fenway vent field.
J2-212-5-R1	Fenway	30950	8/06	16:51		2471	2366	1716	-1	1	**2470**	**2367**	**1716**	**226**	**1.7**	Hydrothermal Talus/ Breccia/ Grab	Second Cpy+Anh talus piece from NE area beneath base of the main active mound.
J2-212-6-W1-IGT2	Fenway	31083	8/06	17:34		2464	2354	1706	-1	-1	**2463**	**2353**	**1706**	**075**	**5.1**	IGT water sample	Fluid from vigorous black smoker; encased in thick particle cloud. T (max) 358 °C
J2-212-6-W2-IGT1	Fenway	31123	8/06	17:48		2464	2354	1706	-1	-1	**2463**	**2353**	**1706**	**075**	**5.1**	IGT water sample	Replicate fluid sample. T (max) 356 °C.
J2-212-6-W3-M2	Fenway	31160	8/06	18:05		2464	2354	1706	-1	-1	**2463**	**2353**	**1706**	**075**	**5.1**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-212-6-R1	Fenway	31192	8/06	18:13		2464	2354	1706	-1	-1	**2463**	**2353**	**1706**	**075**	**5.1**	Active Sulfide Chimney/ Grab	Py-Anh-Cpy broken fragments from exterior of large (> 15 cm diameter) black smoker chimney where fluids sampled. No interior section. No true fluid-sulfide pair.
J2-212-6-R2	Fenway	31220	8/06	18:18		2464	2354	1706	-1	-1	**2463**	**2353**	**1706**	**075**	**5.1**	Active Sulfide Chimney/ Grab	Second exterior section of massive sulfide chimney wall; next to 213-6-R1.
J2-212-7-R1	Fenway	31345	8/06	18:54		2457	2351	1712	-1	1	**2456**	**2352**	**1712**	**138**	**3.1**	Massive Anhydrite/ Grab	Massive anhydrite intergrown w/ sulfide talus from scarp base of Fenway mound.
J2-212-8-T1, T2	Fenway	31402	8/06	19:08		2457	2348	1711	-1	1	**2456**	**2349**	**1711**	**144**	**2.6**	Temperature Measurement	Jason T probe. 17.6 °C (surface), 42°C (inserted). In soft, sedimented and microbially coated mound.
J2-212-8-R1	Fenway	31430	8/06	19:21		2457	2348	1711	-1	1	**2456**	**2349**	**1711**	**144**	**2.6**	Sediment/ Scoop	Scoop bag of sediment from atop microbial-rich mound.
J2-212-9-R1	Fenway	31480	8/06	19:41		2459	2352	1710	0	0	**2459**	**2352**	**1710**	**108**	**3.3**	Relict Sulfide Chimney/ Grab	Tip of small Zn-Fe-rich sulfide spire; periphery/ parasitic spire from larger white diffuser complex.
J2-212-9-T1	Fenway	31520	8/06	19:50		2459	2352	1710	0	0	**2459**	**2352**	**1708**	**108**	**3.3**	Temperature Measurement	Jason T probe. 241 °C. From white spire venting clear fluid at top of the diffuser complex.

J2-212-9-R2	Fenway	31560	8/06	19:58		2462	2350	1708	0	0	**2462**	**2350**	**1709**	**108**	**5.4**	Active Sulfide Chimney/ Grab	Large, active spire w/ exterior microbial coating. Venting 241 °C fluid. Top of diffuser oomplex.
J2-212-10-R1	Fenway	31795	8/06	21:16		2533	2367	1717	2	-1	**2535**	**2366**	**1717**	**304**	**1.8**	Relict Sulfide Chimney/ Grab	Relict "toadstool" sulfide to E of Fenway. Sph (+ Gal?) bse w/ Ba-rich flange.
J2-212-11-N1	Fenway	32218	8/06	23:44		2242	2380	1633	0	-4	**2242**	**2376**	**1633**	**184**	**1.9**	NISKIN water sample	Bottom water from NW of Fenway field. Ambient T = 2.4 °C; Eh = 50 mV
J2-212-misc	Fenway	-	8/06	-		-	-	-			**-**	**-**	**-**	**-**	**-**	Active Sulfide Chimney/ Volunteer	Piece of (likely) active Py-rich chimney that fell into basket from adjacent spire during sampling.
J2-213-1-R1	Roman Ruins	32620	8/07	12:36		2730	3137	1682	0	-2	**2730**	**3135**	**1682**	**321**	**3.3**	Hydrothermal Talus/ Breccia/ Grab	Piece of loose talus/ altered rock from slope of rugged, broken volcanic terrain.
J2-213-1-R2	Roman Ruins	32639	8/07	12:39		2730	3137	1682	-2	-3	**2728**	**3134**	**1682**	**321**	**3.3**	Volcanic Rock/ Grab	Fresh volcanic flow; from same locale as 213-1-R1.
J2-213-2-R1	Roman Ruins	32747	8/07	13:20	4	2709	3169	1667	-1	-3	**2708**	**3166**	**1667**	**309**	**1.3**	Active Sulfide Chimney/ Grab	Tip of Cpy-lined, active black smoker; from top of ~2 m tall single conduit (?) smoker.
J2-213-3-R1	Roman Ruins	32883	8/07	14:22		2722	3162	1660	-7	-6	**2715**	**3156**	**1660**	**187**	**9.2**	Active Sulfide Chimney/ Grab	Cpy-lined black somoker spire; from side of larger chimney complex. PAIR to three fluids (station 3).
J2-213-3-W1-IGT7	Roman Ruins	32922	8/07	14:25		2722	3162	1660	-7	-6	**2715**	**3156**	**1660**	**187**	**9.2**	IGT water sample	From exposed orifice, discharging black smoke, after sampling 213-3-R1. T (max) 276 °C. Aborted mid-sampling due to Jason motion.
J2-213-3-W2-IGT6	Roman Ruins	32939	8/07	14:38		2722	3162	1660	-7	-6	**2715**	**3156**	**1660**	**187**	**9.2**	IGT water sample	Replicate fluid sample. T (max) 278 °C.
J2-213-3-W3-M4	Roman Ruins	32976	8/07	14:49		2722	3162	1660	-7	-6	**2715**	**3156**	**1660**	**187**	**9.2**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-213-4-R1	Roman Ruins	33071	8/07	15:26		2707	3189	1683	-3	-1	**2704**	**3188**	**1683**	**258**	**2.0**	Volcanic Rock/ Grab	Slightly weathered volcanic piece from base next to inactive sulfide mound (stump).
J2-213-5-R1	Roman Ruins	33194	8/07	16:12		2706	3201	1688	-8	-7	**2698**	**3194**	**1688**	**294**	**0.9**	Volcanic Rock/ Grab	Altered rock from Fe-oxide and microbially stained volcanic outcrop/wall.
J2-213-6-R1	Rogers Ruins	33420	8/07	17:33	8	2669	3430	1709	-2	-10	**2667**	**3420**	**1710**	**258**	**3.7**	Active Sulfide Chimney/ Grab	Two conduit spire w/ Cpy and Wtz from large off-shoot from top of large, actively venting black smoker edifice. PAIR to three fluids.
J2-213-6-W1-IGT3	Rogers Ruins	33496	8/07	17:59	8	2668	3430	1709	-1	-10	**2667**	**3420**	**1710**	**234**	**5.3**	IGT water sample	Fluid pair to active black smoker sulfide chimney. T (max) 320 °C.
J2-213-6-W2-IGT4	Rogers Ruins	33542	8/07	18:10	8	2668	3430	1709	-1	-10	**2667**	**3420**	**1710**	**234**	**5.3**	IGT water sample	Replicate fluid sample. T (max) 320 °C.
J2-213-6-W3-M2	Rogers Ruins	33589	8/07	18:24	8	2668	3430	1709	-1	-10	**2667**	**3420**	**1710**	**234**	**5.3**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-213-6-Mkr8	Rogers Ruins	33619	8/07	18:34	8	2671	3430	1710	-2	-6	**2669**	**3424**	**1710**	**261**	**5.2**	Marker [Rogers Ruins]	Marker #8 at base of very large active chimney complex where sampled for fluids and solids (pairs).
J2-213-7-R1	Rogers Ruins	33690	8/07	18:48		2673	3427	1714	-1	-4	**2672**	**3423**	**1714**	**251**	**2.7**	Inactive Sulfide Chimney/ Grab	White "diffuser" spire from bse of the chimney complex; close to marker 8.
J2-213-7-T1	Rogers Ruins	33730	8/07	19:00		2673	3427	1714	-1	-4	**2672**	**3423**	**1714**	**251**	**2.7**	Temperature Measurement	Jason T probe. 202 °C. From orifice exposed after 213-7-R1 was sampled.
J2-214-1-T1	Satanic Mills	34780	8/08	10:18		2450	2603	1682	-3	0	**2447**	**2603**	**1682**	**050**	**1.4**	Temperature Measurement	Jason T probe. 279 °C. From grey smoker, sampled for solids and fluids at station 3.
J2-214-2-R1	Satanic Mills	34927	8/08	10:55		2463	2549	1688	1	-3	**2464**	**2546**	**1688**	**253**	**3.2**	Hydrothermal Talus/ Breccia/ Grab	Altered and prevalently veined (Cpy-rich) stockwork from exposed surface at base of largely inacive chimney complex.
J2-214-2-R2	Satanic Mills	34960	8/08	11:05		2463	2549	1688	0	-3	**2463**	**2546**	**1688**	**253**	**3.2**	Hydrothermal Talus/ Breccia/ Grab	2nd piece of altered stockwork.
J2-214-3-W1-IGT8	Satanic Mills	35161	8/08	12:26		2452	2601	1682	-3	2	**2449**	**2603**	**1682**	**022**	**1.3**	IGT water sample	Small, low-lying chimney complex, a top volcanics. Orifice of grey smoker, exposed after spire was broken off. T (max) 281 °C.
J2-214-3-W2-IGT5	Satanic Mills	35177	8/08	12:34		2452	2601	1682	-3	2	**2449**	**2603**	**1682**	**022**	**1.3**	IGT water sample	Replicate fluid sample. T (max) 288 °C.
J2-214-3-W3-M4	Satanic Mills	35213	8/08	12:46		2452	2601	1682	-3	2	**2449**	**2603**	**1683**	**044**	**0.8**	MAJOR water sample	Replicate fluid sample. No T measurement. Hard to see tell-tale sign of flow.
J2-214-3-R1	Satanic Mills	35240	8/08	12:54		2452	2601	1682	-3	2	**2449**	**2603**	**1683**	**041**	**0.7**	Active Sulfide Chimney/ Grab	Base of grey smoker chimney broken prior to fluid sampling. PAIR to three fluids at station 3.

J2-214-4-W1-IGT1	Fenway	35459	8/08	14:24		2490	2382	1710	0	1	**2490**	**2383**	**1711**	**244**	**7.3**	IGT water sample	Fluid from black smoker orifice. This should be fluid and solid PAIR to samples taken earlier dive 210, station 7. T (max) 329 °C.
J2-214-5-R1	Snowcap [Transit]	35568	8/08	14:56		2434	2360	1709	0	0	**2434**	**2360**	**1709**	**245**	**2.8**	Clastic rock/ Grab	Crust of clastic rock of tube pumice and Pele's hair w/ Mn-oxide coating. Slope of Fe-, Mn-oxide and microbial mats.
J2-214-6-R1	Snowcap [Transit]	35610	8/08	15:13		2432	2360	1707	3	0	**2435**	**2360**	**1708**	**255**	**3.5**	Volcanic Rock/ Grab	Massive lava. Glassy w/ incipient alteration, from same outcrop as 214-5-R1.
J2-214-7-R1	Snowcap	35790	8/08	16:18		2286	2314	1667	4	-3	**2290**	**2311**	**1668**	**247**	**5.5**	Volcanic Rock/ Grab	Massive lava. Aphyric; moderately vesicular; stretched vesicles. From pervasively sedimented slope.
J2-214-8-R1	Snowcap [South Crater]	35915	8/08	17:06		2127	2273	1660	6	-14	**2133**	**2259**	**1660**	**343**	**-**	Volcanic Rock/ Grab	Massive lava from interior floor of crater. Cooling cracks and incipent alteration along cracks.
J2-214-9-R1	Snowcap [Transit]	36002	8/08	17:44		2138	2337	1660	4	1	**2142**	**2338**	**1660**	**322**	**-**	Volcanic Rock/ Grab	Exterior of possibly volcanic bomb (sub-spherical vesicles; onion-skin cooling cracks). Slightly scoracious on exterior.
J2-214-10-R1	Snowcap	36140	8/08	18:42		2152	2419	1643	-2	0	**2150**	**2419**	**1644**	**030**	**1.3**	Volcanic Rock/ Grab	Hyaloclastite exposed on fractured and blocky flow. Cementing clasts is native S; locally abundant.
J2-214-10-R2	Snowcap	36185	8/08	19:05		2152	2422	1644	-3	0	**2149**	**2422**	**1644**	**69**	**1.7**	Volcanic Rock/ Grab	2nd piece. Hyaloclastite from same outcrop.
J2-214-11-R1	Snowcap	36231	8/08	19:25		2148	2419	1646	2	2	**2150**	**2421**	**1646**	**215**	**0.2**	Clastic rock/ Grab	Polymictic clastic rock (altered larger volcanic clasts and smaller sulfidic clasts). Clasts cemented by sulfide, sulfate and native sulfur?
J2-214-11-R2	Snowcap	36265	8/08	19:40		2148	2419	1646	2	2	**2150**	**2421**	**1646**	**215**	**0.2**	Volcanic Rock/ Grab	Massive lava w/ irregular, frothy, scoracious surface textures. Some cementation w/ S.
J2-214-12-N1, N2	Snowcap	36450	8/08	21:04		2206	2425	1636	0	-3	**2206**	**2422**	**1636**	**168**	**3.5**	NISKIN water sample.	Bottom water at Snowcap. T (ambient) 2.4 °C.
J2-214-13-R1	Snowcap	36489	8/08	21:22		2183	2402	1640	1	3	**2184**	**2405**	**1640**	**216**	**1.5**	Volcanic Rock/ Grab	Clastic rock OR strongly fractured massive volcanic rock. Orth native S wetting cracks.
J2-214-14-W1-IGT2	Tsukushi	36647	8/08	22:33		1841	2240	1660	-2	-3	**1839**	**2237**	**1660**	**244**	**0.2**	IGT water sample	Diffuse flow. From same Fe-oxide mound and crack as dive 211, station 2. T (max) 55 °C.
J2-214-14-W2-M2	Tsukushi	36693	8/08	22:50		1841	2240	1660	-2	-3	**1839**	**2237**	**1660**	**244**	**0.2**	MAJOR water sample	Replicate fluid sample. No T measurement. Pair to fluids 211-2 and 214-14.
J2-214-14-R1	Tsukushi	36715	8/08	22:57		1841	2240	1660	-2	-3	**1839**	**2237**	**1660**	**244**	**0.2**	Sediment/ Grab	Fe-oxide deposit from mound surrounding ~60 °C flow. Mn-oxide surface coating. PAIR to fluids 211-2 and 214-14.
J2-214-14-R2	Tsukushi	36715	8/08	23:01		1841	2240	1660	-2	-3	**1839**	**2237**	**1660**	**244**	**0.2**	Sediment/ Grab	2nd piece. Fe-oxide deposit.
J2-214-15-R1	Tsukushi	36794	8/08	23:21		1867	2234	1656	-2	0	**1865**	**2234**	**1656**	**68**	**1.6**	Relict Sulfide Chimney/ Grab	Relict spire from eastern collapsed chimney cluster at Tsukushi.
J2-215-1-R1	Roman Ruins	38052	8/9	17:29		2694	3172	1670	0	0	**2694**	**3172**	**1670**	**198**	**0.9**	Hydrothermal Talus/ Breccia/ Grab	Talus/sulfidic mass from surface of heavily coated (Fe-oxide; microbial S)
J2-215-2-R1	Roman Ruins [NE]	38393	8/9	20:37		3929	4028	1663	0	0	**3929**	**4028**	**1663**	**295**	**2.0**	Volcanic Rock/ Grab	Surficially altered (oxide stained?) volcanic rock from area of shimmering hydrothermal activity. Rich Fe-oxide surface coatings on mounds and ridges.
J2-216-1-R1	Fenway	39046	8/10	10:47		2462	2356	1709	-4	3	**2458**	**2359**	**1712**	**138**	**2.4**	Massive Anhydrite/ Grab	Massive anh protruding from beneath small active chimney complex.
J2-216-2-T1	Fenway	39092	8/10	10:59		2462	2356	1709	-2	-1	**2460**	**2355**	**1710**	**138**	**3.6**	Temperature Measurement	Jason T probe. 264 °C. Interior orifice of grey smoker from nr base of active edifice.
J2-216-2-R1	Fenway	39113	8/10	11:05		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	Active Sulfide Chimney/ Grab	Small exterior piece (single piece of chimney wall) of tip of gey smoker. PAIR to three fluids (216-2-W1,W2, W3)
J2-216-2-T2	Fenway	39124	8/10	11:09		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	Temperature Measurement	Jason T probe. 279 °C. Interior orifice of grey smoker after removing piece..

J2-216-2-W1-IGT7	Fenway	39144	8/10	11:15		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	IGT water sample	From grey smoker orifice. T (max) 283 °C. Pair to a sulfide sample.
J2-216-2-T3	Fenway	39161	8/10	11:19		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	Temperature Measurement	Jason T probe. 7 - 10 °C. Exterior surfaces.
J2-216-2-W2-IGT6	Fenway	39173	8/10	11:24		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	IGT water sample	Replicate fluid sample. T (max) 284 °C.
J2-216-2-W3-M2	Fenway	39225	8/10	11:43		2462	2355	1710	-2	0	**2460**	**2355**	**1710**	**078**	**3.4**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-216-3-T1	Fenway	39297	8/10	12:12	10	2464	2358	1709	-1	1	**2463**	**2359**	**1709**	**108**	**1.7**	Temperature Measurement	Jason T probe. 62 °C. Inserted into exterior surface of slope of diffuse flow beneath "Big Papi" sulfide complex.
J2-216-3-T2	Fenway	39317	8/10	12:17	10	2464	2358	1709	-1	1	**2463**	**2359**	**1709**	**108**	**1.7**	Temperature Measurement	Jason T probe. 83 °C. Inside of crack of diffuse flow from same slope.
J2-216-3-Mkr10	Fenway	39322	8/10	12:18	10	2464	2358	1709	-1	1	**2463**	**2359**	**1709**	**108**	**1.5**	Marker [Fenway]	Marker #10 from slope of diffuse flow between upper and lower terraces of Fenway active mound.
J2-216-4-T1	Fenway	39384	8/10	12:40		2469	2355	1710	0	-1	**2469**	**2354**	**1710**	**327**	**2.1**	Temperature Measurement	Jason T probe. 280 °C. Inserted into surface of sulfidic surface discharging black smoke directly from small fissures.
J2-216-4-T2	Fenway	39393	8/10	12:44		2469	2355	1710	0	-1	**2469**	**2354**	**1710**	**330**	**0.9**	Temperature Measurement	Replicate temperature measurement. T (max) 284 °C.
J2-216-4-R1	Fenway	39447	8/10	13:03		2469	2355	1710	4	-3	**2473**	**2352**	**1712**	**330**	**0.9**	Sediment/ Scoop	Scoop of sulfidic sediment from which black smoke fluids are discharging.
J2-216-5-W1-IGT4	Fenway	39549	8/10	13:38	10	2464	2358	1709	0	3	**2464**	**2361**	**1710**	**099**	**1.7**	IGT water sample	From crack discharging clear fluid; at marker 10 location on mound. T (max) 78 °C.
J2-216-5-W2-IGT3	Fenway	39598	8/10	13:55	10	2464	2358	1709	0	3	**2464**	**2361**	**1710**	**095**	**1.8**	IGT water sample	Replicate fluid sample. T (max) 80 °C.
J2-216-5-W3-M4	Fenway	39660	8/10	14:20	10	2464	2358	1709	0	3	**2464**	**2361**	**1710**	**111**	**1.1**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-216-5-R1	Fenway	39670	8/10	14:28	10	2464	2358	1709	-2	2	**2462**	**2360**	**1710**	**108**	**3.0**	Massive Anhydrite/ Grab	Massive Anh (possibly Ba?); w/ Ba or Gypsum rosettes on outer surface? Need confirmation.
J2-216-6-T1	Fenway	39720	8/10	14:40		2464	2355	1710	-1	-1	**2463**	**2354**	**1710**	**094**	**1.1**	Temperature Measurement	Jason T probe. 115 °C. Further T meas. from sediment of upper terrace slope.
J2-216-6-R1	Fenway	39731	8/10	14:45		2464	2355	1710	-1	-1	**2463**	**2354**	**1710**	**094**	**1.1**	Sediment/ Scoop	2nd scoop from slope of sulfide-sulfate rich sediment at base of upper terrace.
J2-216-7-R1	Fenway	39887	8/10	15:47		2475	2332	1723	0	-1	**2475**	**2331**	**1723**	**342**	**2.9**	Sulfide Mound Piece/ Grab	Altered and slightly oxidised sulfide talus from base of Fenway mound.
J2-216-8-R1	Fenway	40023	8/10	16:25		2475	2340	1716	1	0	**2476**	**2340**	**1716**	**300**	**6.3**	Sulfide Mound Piece/ Grab	Barite-Sulfide rich talus piece from base of blocky, old sulfide pile [top of scarp?]
J2-216-9-R1	Fenway	40157	8/10	17:17		2467	2348	1712	0	0	**2467**	**2348**	**1712**	**056**	**7.0**	Sulfide Mound Piece/ Grab	Altered and exposed relict sulfide mass from outcrop.
J2-216-10-R1	Fenway	40400	8/10	19:04		2486	2338	1726	0	-1	**2486**	**2337**	**1726**	**223**	**2.8**	Volcanic Rock/ Grab	Incipiently altered volcanic lava from basal Fe-oxide coated and sedimented slope.
J2-216-11-R1	Fenway	40474	8/10	19:33		2492	2356	1724	0	-1	**2492**	**2355**	**1725**	**331**	**2.3**	Volcanic Rock/ Grab	Incipiently altered volcanic lava from basal Fe-oxide coated and sedimented slope.
J2-216-11-R2	Fenway	40480	8/10	19:37		2492	2358	1723	1	0	**2493**	**2358**	**1724**	**331**	**2.3**	Volcanic Rock/ Grab	Piece of clastic stockwork. Clasts show gradation of alteration extent or type. Cemented w/ veined sulfides.
J2-216-11-T1	Fenway	40525	8/10	19:52		2490	2363	1722	0	0	**2490**	**2363**	**1720**	**358**	**2.0**	Temperature Measurement	Jason T probe. 24 °C. In Sediment from where volcanics sampled.
J2-216-12-R1	Fenway	40679	8/10	20:53		2450	2366	1716	1	-1	**2451**	**2365**	**1716**	**224**	**0.2**	Massive Anhydrite/ Grab	Massive anhydrite (barite?) w/ disseminated sulfide; exposed on flanks of sedimented slope.
J2-216-13-R1	Fenway	40865	8/10	22:15		2460	2410	1704	0	1	**2460**	**2411**	**1705**	**001**	**1.3**	Volcanic Rock/ Grab	Somewhat altered volcanic lava w/ Mn-oxide coating. Lying on patch of sediment w/ rich microbial S.
J2-216-14-R1	Fenway	41017	8/10	23:11		2480	2360	1717	2	-1	**2482**	**2359**	**1717**	**273**	**1.2**	Massive Anhydrite/ Grab	Massive anhydrite (barite?) w/ disseminated sulfide; exposed on flanks of sedimented slope.

J2-216-15-R1	Fenway	41102	8/10	23:43		2464	2354	1705	0	1	**2464**	**2355**	**1705**	**214**	**5.4**	Active Sulfide Chimney/ Grab	Fragile, spindly black smoker spire from upper terrace [nr "Big Papi" smoker?]
J2-216-16-R1	Fenway	41128	8/10	23:52		2464	2354	1705	0	1	**2464**	**2355**	**1704**	**214**	**5.4**	Active Sulfide Chimney/ Grab	Cpy-rich multi-conduit black smoker chimney from close to 216-15-R1.
J2-217-1-T1	Suzette	41353	8/12	12:20		3329	4829	1520	0	-3	**3329**	**4826**	**1520**	**002**	**2.0**	Temperature Measurement	Jason T probe. 75 °C. Shimmering, diffuse flow from fissure in sedimented basement.
J2-217-2-T1	Suzette	41461	8/12	12:56		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	Temperature Measurement	Jason T probe. 302 °C. Grey smoker fluid venting out of Cpy-lined orifice.
J2-217-2-T2	Suzette	41466	8/12	12:59		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	Temperature Measurement	Jason T probe. 13 °C. On exterior wall of grey-smoker chimney.
J2-217-2-R1	Suzette	41477	8/12	13:02		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	Active Sulfide Chimney/ Grab	~ 1 cm thick, Cpy-lined open conduit smoker. PAIR to three fluids at station 2.
J2-217-2-W1-IGT8	Suzette	41519	8/12	13:21		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	IGT water sample	Fluid from Cpy-lined grey smoker chimney. T (max) 302 °C.
J2-217-2-W2-IGT5	Suzette	41540	8/12	13:30		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	IGT water sample	Replicate fluid sample/ T (max) 303 °C.
J2-217-2-W3-M2	Suzette	41562	8/12	13:38		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**059**	**4.2**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-217-2-R2	Suzette	41590	8/12	13:51		3323	4846	1504	0	-3	**3323**	**4844**	**1504**	**062**	**2.6**	Relict Sulfide Chimney/ Grab	Inactive sulfide chimney [stump] from base of large grey smoker complex.
J2-217-2-R3	Suzette	41668	8/12	14:23		3322	4847	1503	1	-4	**3323**	**4844**	**1504**	**126**	**5.1**	Active Sulfide Chimney/ Grab	Cpy-Py rich active chimney piece from the same structure as -2-R1 and _2-R2.
J2-217-3-R1	Suzette	41860	8/12	15:25		3277	4818	1502	-5	-3	**3272**	**4815**	**1503**	**040**	**1.9**	Active Sulfide Chimney/ Grab	[Probably] active, large multi-spired sulfide chimney piece from center of apex of active chimney complex.
J2-217-3-T1	Suzette	41908	8/12	15:42		3277	4818	1502	-5	-3	**3272**	**4815**	**1503**	**040**	**1.4**	Temperature Measurement	Jason T probe. 280°C. From orifice exposed by sampling of sulfide -3-R1.
J2-217-4-T1	Suzette	41993	8/12	16:09		3289	4808	1495	1	-2	**3290**	**4806**	**1495**	**303**	**8.4**	Temperature Measurement	Jason T probe. 290 °C. Large open conduit smoker from top of tall sulfide chimney. Prevalent biology (scaleworms; shrimp)
J2-217-4-T2	Suzette	42012	8/12	16:12		3289	4808	1495	1	-2	**3290**	**4806**	**1495**	**303**	**8.4**	Temperature Measurement	Jason T probe. 288 °C. Smaller grey smoker orifice from same chimney; adjacent to 217-4-T1.
J2-217-5-T1	Suzette	42084	8/12	16:40		3237	4837	1503	-1	1	**3236**	**4838**	**1504**	**203**	**1.9**	Temperature Measurement	Jason T probe. 76 °C. Shimmering flow from sediment at boundary to sulfide mound.
J2-217-6-R1	Suzette	42223	8/12	17:20		3188	4875	1490	-3	-8	**3185**	**4867**	**1489**	**018**	**1.3**	Volcanic Rock/ Grab	Altered volcanic lava exposed on Fe-oxide rich sediment.
J2-217-7-R1	Suzette	42432	8/12	18:14		3011	4928	1501	5	1	**3016**	**4929**	**1503**	**031**	**4.6**	Active Sulfide Chimney/ Volunteer	Volunteer sample from top of tall, active white diffuser-type spire.
J2-217-7-T1	Suzette	42642	8/12	18:24		3011	4928	1501	5	0	**3016**	**4928**	**1502**	**050**	**4.6**	Temperature Measurement	Jason T probe. 296 °C. Inserted ~15 cm into the main stack of diffuser spire; for -7-R1.
J2-217-8-T1	Suzette	42560	8/12	18:44		2996	4936	1489	-3	3	**2993**	**4939**	**1489**	**250**	**6.8**	Temperature Measurement	Jason T probe. 250 °C. Clear/Grey smoker fluid from fissure in sulfide complex. Lots of biological activity (*Ifremeria*).
J2-217-9-R1	Suzette	42686	8/12	19:24		2998	4957	1493	-6	-1	**2992**	**4956**	**1493**	**275**	**5.2**	Active Sulfide Chimney/ Grab	Small tip of Cpy-lined spire from clear smoker chimney orifice.
J2-217-10-T1	Suzette	42381	8/12	19:58		2994	4958	1488	0	-2	**2994**	**4956**	**1488**	**291**	**6.0**	Temperature Measurement	Jason T probe. 276 °C. Inserted ~ 6 cm into beehive, prior to crumbling.
J2-217-10-R1	Suzette	42940	8/12	20:40		2988	4959	1488	6	-3	**2994**	**4956**	**1488**	**265**	**6.3**	Active Sulfide Chimney/ Grab	Small tip of Cpy-lined spire from clear smoker chimney orifice; venting 275 °C fluids. PAIR to three fluids.
J2-217-10-W1-IGT1	Suzette	43015	8/12	20:59		2987	4960	1488	7	-4	**2994**	**4956**	**1488**	**269**	**7.6**	IGT water sample	Clear fluid from sampled orifice. T (steady) 274 °C.
J2-217-10-W2-IGT2	Suzette	43074	8/12	21:17		2987	4960	1488	7	-4	**2994**	**4956**	**1488**	**269**	**7.6**	IGT water sample	Replicate fluid sample. T (max) 272 °C.
J2-217-10-W3-M4	Suzette	43119	8/12	21:29		2983	4958	1488	11	-2	**2994**	**4956**	**1488**	**267**	**6.3**	MAJOR water sample	Replicate fluid sample. No T measurement.

J2-217-11-R1	Suzette	43204	8/12	21:56		3043	4975	1498	-1	-4	**3042**	**4971**	**1498**	**69**	**2.0**	Relict Sulfide Chimney/ Grab	Sulfide (unidentified mineralogy); altered and oxidezed surface. From sedimented outcrop.
J2-217-11-R2	Suzette	43235	8/12	22:06		3043	4975	1498	0	-2	**3043**	**4973**	**1497**	**69**	**2.0**	Sediment/ Grab	Partial, mixed volcanogenic clastic rock and indurated sulfide sand?
J2-217-12-R1	Suzette	43346	8/12	22:36		3068	4971	1496	1	-2	**3069**	**4969**	**1496**	**226**	**1.5**	Hydrothermal Talus/ Breccia/ Grab	Massive sulfide talus pieces. Coated in Fe-oxide and unidentified vibrant green ppt (Atacamite? Antlerite?). Minor Enargite and pyrite?
J2-217-13-T1	Suzette	43410	8/12	23:01	11	3046	4997	1487	0	1	**3046**	**4998**	**1487**	**151**	**1.7**	Temperature Measurement	Jason T probe. 220 °C. Tip of Py-rich active clear smoker tip inhabited by abundant snails.
J2-217-13-R1	Suzette	43467	8/12	23:17	11	3046	4997	1487	0	1	**3046**	**4998**	**1488**	**151**	**1.7**	Active Sulfide Chimney/ Grab	Friable pieces of Py-rich sulfide from tip of clear smoker.
J2-217-13-T2	Suzette	43480	8/12	23:21	11	3046	4997	1487	0	1	**3046**	**4998**	**1488**	**151**	**1.7**	Temperature Measurement	Jason T probe. 226 °C. Duplicate measurement in same orifice after removing sulfide sample.
J2-217-13-Mkr13	Suzette	43504	8/12	23:28	11	3047	4997	1487	0	3	**3047**	**5000**	**1488**	**158**	**2.0**	Marker [Suzette]	Marker #11. Benchmark of station 13. Marker is ~ 1m to E of sampled white chimney.
J2-218-1-T1	NE Paul	44156	8/13	13:11		4807	4582	1879	4	1	**4811**	**4583**	**1879**	**070**	**0.7**	Temperature Measurement	Jason T probe. 31 °C. From surface of sediment w/ patchy, thick microbial (Fe-) oxide precipitates.
J2-218-2-R1	NE Paul	44480	8/13	15:15		4875	4568	1880	-1	2	**4874**	**4570**	**1880**	**036**	**1.3**	Relict Sulfide Chimney/ Grab	Top of lone spire coated with thick Fe, Mn-oxide and patchy yellow, amorphous precipitates. Spire grown directly out of basement.
J2-218-3-T1	NE Paul	44545	8/13	!5:35		4864	4565	1880	-2	1	**4862**	**4566**	**1879**	**255**	**0.8**	Temperature Measurement	Jason T probe. 30.4 °C. Flow from fissure in basement inhabited by dense *Ifr*. and *Alv*. snail community.
J2-218-4-R1	NE Paul	44715	8/13	16:42		4897	4601	1875	-1	-5	**4896**	**4596**	**1875**	**083**	**0.9**	Volcanic Rock/ Grab	Ropey folded lava; fresh except for minor surficial staning with Mn-oxide.
J2-218-5-R1	NE Paul	44765	8/13	16:52		4901	4600	1875	0	0	**4901**	**4600**	**1875**	**197**	**1.7**	Volcanic Rock/ Grab	Black lava w/ taffy stretched surface appearance on exterior and smooth walled cavity on underside.
J2-218-6-N1,2	NE Paul	44842	8/13	17:19		4948	4398	1856	0	200	**4948**	**4598**	**1857**	**158**	**13.6**	NISKIN water sample	Bottom water from NE Pual region.
J2-218-7-R1	NE Paul	44995	8/13	18:33		5031	4573	1868	0	0	**5031**	**4573**	**1868**	**191**	**4.0**	Volcanic Rock/ Grab	Crudely triangular, prismatic massive lava w/ hackly surface texture from crater pit.
J2-218-8-T1,2	NE Paul	45150	8/13	19:40		4800	4585	1879	0	0	**4800**	**4585**	**1879**	**349**	**1.5**	Temperature Measurement	Jason T probe. 30 °C within shimmering flow; 35 °C from within oxide sediment from mound w/ flow.
J2-218-8-W1-IGT3	NE Paul	45180	8/13	10:56		4800	4585	1879	0	0	**4800**	**4585**	**1879**	**349**	**1.5**	IGT water sample	Diffuse flow (from fissure) within oxide mound. T (steady) 33 °C.
J2-218-8-W2-IGT4	NE Paul	45190	8/13	20:07		4800	4585	1879	0	0	**4800**	**4585**	**1879**	**349**	**1.5**	IGT water sample	Replicate fluid sample. 35 °C.
J2-218-8-W3-M4	NE Paul	45210	8/13	20:18		4800	4585	1879	0	0	**4800**	**4585**	**1879**	**349**	**1.5**	MAJORS water sample	Replicate fluid sample. No T measuremrnt.
J2-218-8-R1	NE Paul	45225	8/13	20:48		4800	4585	1879	0	0	**4800**	**4585**	**1879**	**349**	**1.5**	Sediment/ Scoop	Cohesive, primarily clay-like sediment material w/ minor oxide material from sediment surface.
J2-218-9-R1	NE Paul	45363	8/13	23:38		5544	5459	1915	1	-1	**5545**	**5458**	**1915**	**054**	**0.7**	Volcanic Rock/ Grab	Incipiently altered volcanic fragment w/ minor Mn-oxide surficial staining.
J2-219-1-R1	Suzette	45859	8/14	9:43		2527	4808	1607	-7	-7	**2520**	**4801**	**1607**	**179**	**1.9**	Relict Sulfide [Flange]/ Grab	Highly degraded sulfide-sulfate knob from cap rock/ pavement in proximity to multiple fissures. Abundant microbial mats.
J2-219-1-R2	Suzette	45898	8/14	9:52		2527	4808	1607	-7	-7	**2520**	**4801**	**1607**	**179**	**1.9**	Relict Sulfide Flange/ Grab	2nd piece. Flange-like piece from edge of pavement feature.
J2-219-1-R3	Suzette	45945	8/14	10:12		2527	4808	1607	-8	-6	**2519**	**4802**	**1607**	**179**	**1.9**	Sediment/ Scoop	Clay-rich sediment collected w/ push core. To be sampled for organic content (Seewald, WHOI).
J2-219-2-R1	Suzette	46210	8/14	11:40		2729	4725	1552	-1	0	**2728**	**4725**	**1552**	**112**	**5.0**	No Recovery	Active, friable beehive structure that disint-ergrated in transit to surface.
J2-219-2-T1	Suzette	46230	8/14	11:45		2729	4725	1552	-1	0	**2728**	**4725**	**1552**	**112**	**5.0**	Temperature Measurement	Jason T probe. 283 °C. Inserted into clear smoker orifice sampled for beehive sulfide.
J2-219-2-T2	Suzette	46243	8/14	11:50		2729	4725	1552	-1	0	**2728**	**4725**	**1552**	**112**	**5.0**	Temperature Measurement	Jason T probe. 16 °C. Exterior wall at base of beehive structure.

J2-219-2-W1-IGT7	Suzette	46262	8/14	11:56		2729	4725	1552	-1	0	2728	4725	1552	112	5.0	IGT water sample	Clear focused flow from (former) beehive edifice. 282 (max) °C.
J2-219-2-W2-IGT6	Suzette	46277	8/14	12:03		2729	4725	1552	0	0	2729	4725	1552	112	5.0	IGT water sample	Replicate fluid sample. T (max) 290 °C.
J2-219-2-W3-M2	Suzette	46302	8/14	12:25		2729	4725	1552	0	0	2729	4725	1552	112	5.0	MAJOR water sample	Sample did not fire.
J2-219-2-R2	Suzette	46374	8/14	12:40		2729	4725	1552	0	0	2729	4725	1552	112	5.0	Active Sulfide Chimney/ Grab	~ 5 cm thick exterior Cpy, Py rich wall from top if large active grey smoker chimney.
J2-219-2-Mkr12	Suzette	46405	8/14	12:46		2729	4725	1552	0	0	2729	4725	1552	112	5.0	Marker [Suzette]	Marker #12 placed atop large chimney sampled for active spire -2-R1.
J2-219-2-R3	Suzette	46458	8/14	13:02		2729	4727	1555	0	0	2729	4727	1555	090	2,7	Relict Sulfide Chimney/ Grab	Top ~ 30 cm of large relict sulfide spire. Small Cpy(Py?)-lined comduits in Zn-Fe solid matrix. Chimney is next to Marker 12.
J2-219-3-T1	Suzette	46526	8/14	13:28		2736	4727	1550	0	-1	2736	4726	1550	152	4.5	Temperature Measurement	Jason T probe. 281 °C. Flow from "Cathedrale"; multi-spired active chimney complex venting clear/ grey smoker fluids.
J2-219-3-T2	Suzette	46534	8/14	13:31		2736	4727	1550	0	-1	2736	4726	1550	152	4.5	Temperature Measurement	Jason T probe. 294 °C. From orifice adjacent to 3-T1.
J2-219-3-R1	Suzette		8/14	13:59		2737	4725	1550	-1	1	2736	4726	1551	134	5.1	Active Sulfide Chimney/ Grab	Cpy-lined open conduit smoker; 294 °C fluid venting.
J2-219-3-T3	Suzette		8/14	14:07		2737	4725	1550	-1	1	2736	4726	1550	134	5.1	Temperature Measurement	Jason T probe. 280 °C. Re-inserted into orifice after sample removed.
J2-219-4-R1	Suzette		8/14	14:39		2837	4721	1543	-1	1	2836	4722	1543	132	5.1	Hydrothermal Talus/ Breccia/ Grab	Massive Py w/ minor Anh/ From exposed sulfide outcrop nr. base of sedimented slope.
J2-219-5-R1	Suzette		8/14	15:38		2920	4774	1516	-3	1	2917	4775	1516	106	3.5	Hydrothermal Talus/ Breccia/ Grab	Massive Cpy w/ surficial oxidation to peacock ore minerals. From massive sulfide exposed outcrop.
J2-219-5-R2	Suzette		8/14	15:43		2920	4774	1516	-3	1	2917	4775	1517	106	3.5	Hydrothermal Talus/ Breccia/ Grab	2nd piece. Massive Cpy. Cap to massive sulfide sample 5-R1.
J2-219-6-R1	Suzette		8/14	18:06		3102	4996	1521	-5	-4	3097	4992	1521	047	0.3	No Recovery	Push core of sediment that did not endure recovery! No sample.
J2-219-7-T1,T2	Suzette		8/14	18:29		3148	5012	1509	-5	2	3143	5014	1509	142	3.2	Temperature Measurement	Jason T probe. 132 °C. Clear, focused flow from nr. base of copri-form beehive spire.
J2-219-8-T1	Suzette	47519	8/14	18:52		3150	5030	1506	-1	-3	3149	5027	1506	016	3.9	Temperature Measurement	Jason T probe. 194 °C. Flow from under flange growing out from side of bulbous sulfide mound.
J2-219-9-T1	Suzette	47700	8/14	19:49		3148	5047	1510	0	0	3148	5047	1509	250	2.4	Temperature Measurement	Jason T probe. 233 °C. From orifice exposed by breaking [Cpy-lined?] chimney conduit. Sulfide piece crumbled.
J2-219-10-R1	Suzette	47869	8/14	20:36		3118	5046	1505	-1	1	3117	5047	1505	293	3.1	Active Sulfide Chimney/ Grab	Porous, friable Fe(+Cu-?)-rich spire encased in white, microbial S. Sample crumbled to several pieces. PAIR to two fluids.
J2-219-10-W1-IGT8	Suzette	47971	8/14	20:59		3118	5046	1505	-1	1	3117	5047	1505	293	3.1	IGT water sample	Clear, focused flow to pair to solid. T (max) 229 °C.
J2-219-10-W1-IGT5	Suzette	48001	8/14	21:07		3118	5046	1505	-1	1	3117	5047	1505	293	3.1	IGT water sample	Replicate fluid sample. T (max) 227 °C.
J2-219-11-R1	Suzette	48312	8/14	22:54		3195	4940	1509	0	0	3195	4940	1509	234	0.5	Volcanic Rock/ Grab	Relatively fresh volcanic rock; phenocrysts; from crust of large, broken pillow flow.
J2-219-12-T1	Suzette	48389	8/14	23:16		3226	4916	1500	2	1	3228	4917	1500	239	1.0	Temperature Measurement	Jason T probe. 80 °C. Flow emanating from underneath cracked "pavement" w/ abundant microbial matting.
J2-219-12-T2	Suzette	48405	8/14	23:25		3226	4916	1500	2	1	3228	4917	1500	239	1.0	Temperature Measurement	Jason T probe. 125 °C. Flow from ~ 20 cm lateral to 12-T1.
J2-219-12-R1	Suzette	48440	8/14	23:30		3226	4916	1500	2	1	3228	4917	1500	239	1.0	Relict Sulfide Chimney/ Grab	Small relict knob grown up from top surface of cracked pavement.
J2-220-1-N1	Desmos	48737	8/15	10:00		2045	2269	2078	0	0	2045	2269	2078	353	3.3	NISKIN water sample	Fired at bottom, within depression at SE quadrant of Onsen vent field.
J2-220-2-R1	Desmos	48868	8/15	10:53		1800	2455	1995	1	-3	1801	2452	1995	342	3.3	Volcanic Rock/ Grab	Aphyric, ~ 10 % vesicular, fresh, glassy lava from lightly sedimented pillow outcrop

J2-220-3-R1	Desmos	49179	8/15	12:35		1430	2723	1914	3	0	**1433**	**2723**	**1917**	**272**	**0.8**	Volcanic Rock/ Grab	Pervasively bleached; advanced argillic alteration, hard but brittle. Sulfur veining and filling of vesicles obvious. From hyaloclastite outcrop.
J2-220-4-T1	Desmos	49390	8/15	13:43		1363	2786	1907	4	0	**1367**	**2786**	**1911**	**183**	**1.8**	Temperature Measurement	Jason T probe. 83 - 112 (max) °C. Thick, turbid white smoker fluid from fissure in sulfur-rich basement.
J2-220-4-T2	Desmos	49466	8/15	14:08		1364	2787	1909	0	1	**1364**	**2788**	**1909**	**233**	**1.0**	Temperature Measurement	Jason T probe. 112 °C. From second fissure in same suite of outcrops.
J2-220-5-T1	Desmos	49541	8/15	14:35		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**218**	**2.2**	Temperature Measurement	Jason T probe. 117 °C. White, smokey fluid from more focused flow (underneath) forming flange-
J2-220-5-T2	Desmos	49561	8/15	14:37		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**218**	**2.2**	Temperature Measurement	Jason T probe. 94 °C. From upper surface of [over-flowing] ledge.
J2-220-5-W1-IGT1	Desmos	49577	8/15	15:00		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**245**	**2.2**	IGT water sample.	Thick, smokey white fluid discharging pervasively across pavement flange structure. T (max) 113 °C
J2-220-5-W2-IGT2	Desmos	49603	8/15	15:16		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**245**	**2.2**	IGT water sample.	Replicate fluid sample. 117 °C. Relicabrated from 129°C.
J2-220-5-W3-M4	Desmos	49635	8/15	15:32		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**245**	**2.2**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-220-5-R1	Desmos	49703	8/15	15:45		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**245**	**2.2.**	Volcanic Rock/ Grab	Mostly fresh volcanic lava w/ some surficial alteration. Cracks and cavities filled w/ abundant
J2-220-5-R2	Desmos	49727	8/15	16:00		1361	2790	1908	0	0	**1361**	**2790**	**1908**	**256**	**2.2**	Sulfur/ Scoop	Predominantly native/ elemental sulfur scooped from surface of flow.
J2-220-6-T1	Desmos	49785	8/15	16:16		1355	2794	1908	2	1	**1357**	**2795**	**1908**	**251**	**2.8**	Temperature Measurement	Jason T probe. 72 °C. From clear, shimmering flow out of porous [bacterial] elemental sulfur and Fe-oxide rich surficial
J2-220-6-R1	Desmos	49846	8/15	16:20		1355	2794	1908	2	0	**1357**	**2794**	**1908**	**252**	**2.6**	Volcanic Rock/ Grab	From surface w/ T measurement. Relatively fresh w/ stainings and encrustations of whitish-yellow S and rusty Fe-oxide.
J2-220-7-R1	Desmos	50002	8/15	17:36		1437	3025	1894	1	-2	**1438**	**3023**	**1894**	**341**	**3.6**	Volcanic Rock/ Grab	Slightly stained and altered volcanic lava from rubbly, broken flow. Sulfur present in light-grey altered areas - early argillic?
J2-220-8-R1	Desmos	50150	8/15	18:20		1478	3054	1862	3	-4	**1481**	**3050**	**1863**	**322**	**7.7**	Volcanic Rock/ Grab	Lava with argillaceous alteration (light-grey - to - cream); soft and friable. Py + ba(?) disseminated within matrix.
J2-220-9-R1	Desmos	50176	8/15	18:31		1483	3049	1892	-1	-2	**1482**	**3047**	**1892**	**010**	**3.5**	Volcanic Rock/ Grab	Pervasively altered (brown interior; light-brown/ cream exterior), brittle and hard rock. Base of [fault] w/ small talus pile.
J2-220-10-R1	Desmos	50409	8/15	20:07		1449	2814	1914	-23	8	**1426**	**2822**	**1915**	**006**	**1.3**	Volcanic Rock/ Grab	Fresh, glassy lava w/ irregularly folded and stretch upper surface. Rich Fe-oxide coatings orginally on surface.
J2-220-11-R1	Desmos	50524	8/15	20:54		1368	2791	1918	0	1	**1368**	**2792**	**1918**	**234**	**2.7**	Volcanic Rock/ Grab	Altered (bleached) volcanic lava. Micro-vesicular; white to pale-grey. Mostly soft. Disseminated, trace black, opaque grains. Sulfur along internal fractures. Lava dome?
J2-220-12-R1	Desmos	50637	8/15	21:27		1360	2776	1905	0	3	**1360**	**2779**	**1905**	**335**	**2.3**	Sulfur/ Grab	Very friable native sulfur. Several distinct and interesting textures. From highly fissured volcanic
J2-220-12-R2	Desmos	50660	8/15	21:51		1360	2776	1905	-2	2	**1358**	**2778**	**1905**	**268**	**2.5**	Sulfur-cemented clastic rock/ Grab	Mixed sulfur and (glassy) broken volcanics from a sharp faulted ridge S of the Onsen field.
J2-220-13-R1	Desmos	50776	8/15	22:27		1346	2778	1900	2	0	**1348**	**2778**	**1901**	**260**	**0.7**	Volcanic Rock/ Grab	Surficially stained (FeOx), incipiently altered volcanic pillow from edge of vertical wall.
J2-220-14-R1	Desmos	50880	8/15	22:53		1371	2732	1903	1	-1	**1372**	**2731**	**1903**	**259**	**4.0**	Volcanic Rock/ Grab	Aphyric, vesicular lava from field of altered hyaloclastite. Sooty, sulfur-sulfate that is very soft and rubs off.
J2-220-14-R2	Desmos	50912	8/15	22:57		1371	2732	1903	1	-1	**1372**	**2731**	**1903**	**259**	**4.0**	Volcanic Rock/ Grab	Massive, hyaloclastitic lava from talus field. Incipient alteration on surfaces.

J2-220-14-R3	Desmos	50932	8/15	22:59		1371	2732	1903	1	-1	**1372**	**2731**	**1903**	**259**	**4.0**	Volcanic Rock/ Grab	Aphanitic, vesicular (~ 40 % porosity) rock; also from rugged, broken hyaloclastitc field.
J2-220-15-W1-IGT4	Desmos	51028	8/15	23:42		1356	2785	1908	1	1	**1357**	**2786**	**1908**	**254**	**2.3**	IGT water sample.	Diffuse, clear flow from Fe-oxide rich broken lavas w/ bacterial sulfur in intersitices. T (max) 70 °C.
J2-220-15-W2-IGT3	Desmos	51053	8/15	23:50		1356	2785	1908	1	1	**1357**	**2786**	**1908**	**254**	**2.3**	IGT water sample.	Replicate fluid sample. T (max) 69 °C.
J2-220-15-W3-M2	Desmos	51072	8/15	23:57		1356	2785	1908	1	2	**1357**	**2787**	**1908**	**254**	**2.3**	MAJOR water sample	Replicate fluid sample. No T measurement.
J2-221-1-T1	North Su	51714	8/16	12:33		3756	3552	1263	0	0	**3756**	**3552**	**1263**	**087**	**1.1**	Temperature Measurement	Jason T probe. 272 °C. Cloudy, white smoker type fluid emanating from sediments with molten sulfur
J2-221-1-T2	North Su	51746	8/16	12:45		3756	3552	1263	0	0	**3756**	**3552**	**1263**	**087**	**1.1**	Temperature Measurement	Jason T probe. 284 °C. Same location Cloudy, white fluid from sediments.
J2-221-2-T1	North Su	51808	8/16	13:05		3749	3573	1267	0	1	**3749**	**3574**	**1257**	**090**	**2.3**	Temperature Measurement	Jason T probe. 20 °C. White smoke from collapsed roof of pillow. FeOx and microbial mat staining on upper surfaces.
J2-221-3-T1	North Su	51880	8/16	13:26		3719	3581	1253	5	8	**3724**	**3589**	**1253**	**49**	**3.4**	Temperature Measurement	Jason T probe. 46 °C. From fissure, microbial mat, at base of blocky scarp (fallen talus, rubble?)
J2-221-3-W1-IGT8	North Su	51905	8/16	13:30		3719	3581	1253	5	8	**3724**	**3589**	**1253**	**050**	**3.4**	IGT water sample	Clear fluid from crack in blocky scarp. T (max) 47 °C.
J2-221-3-W2-IGT7	North Su	51927	8/16	13:37		3719	3581	1253	5	8	**3724**	**3589**	**1253**	**050**	**3.4**	IGT water sample	Replicate fluid sample. T variable between 36 and 48 °C.
J2-221-3-W3-M4	North Su	51961	8/16	13:51		3719	3581	1253	5	8	**3724**	**3589**	**1253**	**050**	**3.4**	MAJOR water sample	Replicate fluid samples. No T data. No good tell-tale flow evident.
J2-221-4-R1	North Su	52072	8/16	14:33		3744	3558	1261	-1	-3	**3743**	**3555**	**1261**	**034**	**4.4**	Clastic Rock/ Grab	Polymictic breccia from base of volcanic slump; S slope. Abundant white smoker activity up slope.
J2-221-4-R2	North Su	52087	8/16	14:34		3744	3558	1261	-1	-3	**3743**	**3555**	**1261**	**034**	**4.4**	Clastic Rock/ Grab	Brecciated volcanic rock from same outcrop. Trace Py disseminated?
J2-221-5-R1	North Su	52156	8/16	14:41		3751	3553	1257	0	0	**3751**	**3553**	**1259**	**065**	**1.6**	Clastic Rock/ Grab	Polymictic clastic rock w/ trace dissem. sulfur and py? From area of intense acidic, cloudy flow.
J2-221-5-W1-IGT6	North Su	52181	8/16	14:57		3751	3553	1257	0	0	**3751**	**3553**	**1259**	**053**	**1.4**	IGT water sample	Vigorous white smoker fluid from rubbly volcanic terrain. T (max) 206 °C.
J2-221-5-W2-IGT5	North Su	52244	8/16	15:15		3751	3553	1257	0	0	**3751**	**3553**	**1259**	**053**	**2.1**	IGT water sample	Replicate fluid sample. T (max) 215 °C.
J2-221-5-W3-M2	North Su	52263	8/16	15:23		3751	3553	1257	0	0	**3751**	**3553**	**1259**	**053**	**1.5**	MAJOR water sample	Replicate fluid sample. No T data.
J2-221-6-R1	North Su	52408	8/16	16:25		3770	3621	1202	-2	-2	**3768**	**3619**	**1203**	**047**	**7.4**	Clastic Rock/ Grab	Monomictic breccia w/ porphyritic (plg+ cpx) clasts and sulfur/sulfide + clay matrix. From steep faced wall.
J2-221-7-R1	North Su	52516	8/16	17:08		3757	3657	1192	0	0	**3757**	**3657**	**1192**	**105**	**8.7**	Clastic Rock/ Grab	Hyaloclastite, friable, several pieces. From edge of volcanic flow. Sulfur matrix. No sulfide.
J2-221-8-R1	North Su	52620	8/16	17:42		3795	3653	1164	3	0	**3798**	**3653**	**1164**	**053**	**4.6**	Volcanic Rock/ Grab	Glassy, porphyritic lava coated w/ well-developed Fe-oxide staining and ocherous matter.
J2-221-9-T1	North Su	52710	8/16	18:03		3818	3692	1161	-15	-30	**3803**	**3662**	**1161**	**295**	**2.3**	Temperature Measurement	Jason T probe. 302 °C. Small black smoker chimlet from active, larger complex.
J2-221-9-R1	North Su	52727	8/16	18:26		3818	3692	1161	-18	-28	**3800**	**3664**	**1161**	**289**	**2.5**	Inactive Sulfide Chimney/ Grab	Wide, multi-conduit inactive cpy-lined chimney. In complex of several small active black smokers.
J2-221-9-R2	North Su	52905	8/16	18:36		3818	3692	1161	-17	-27	**3801**	**3665**	**1161**	**083**	**3.8**	Active Sulfide Chimney/ Grab	Mostly sealed (recently inactive?) , cpy-lined chimney from same complex. More vigorous BS activity after sampling.
J2-221-9-T2	North Su	52944	8/16	18:42		3818	3692	1161	-17	-27	**3801**	**3665**	**1161**	**083**	**3.8**	Temperature Measurement	Jason T probe. 286 °C. From exposed orifice after sampling 211-9-R2.

J2-221-10-R1	North Su	53050	8/16	19:08		3804	3692	1154	4	0	**3808**	**3692**	**1154**	**238**	**1.4**	Inactive Sulfide Flange/ Grab	Sulfidic (or possible volcanic??) origin. Crust or flange from sedimented (S and Fe-oxide) slope beneath chimneys.
J2-221-11-R1	North Su	53200	8/16	19:48		3804	3698	1158	1	0	**3805**	**3698**	**1158**	**201**	**0.9**	Sediment/ Scoop	Scoop to determine the nature of the sediment piles. Sulfide?
J2-221-12-R1	North Su	53309	8/16	19:58		3801	3691	1154	1	0	**3802**	**3691**	**1154**	**227**	**1.1**	Clastic Rock/ Grab	Coarse-grained sandy, laminated and cross-bedded mineralised sediment structure?? Formed ledge overhang w/ flow from under.
J2-221-12-T1	North Su	53359	8/16	20:08		3801	3691	1154	1	0	**3802**	**3691**	**1154**	**227**	**1.1**	Temperature Measurement	Jason T probe. 68 °C. Flow from underneath laminated overhang.
J2-221-13-T1	North Su	53498	8/16	20:55		3876	3606	1217	0	0	**3876**	**3606**	**1217**	**357**	**1.2**	Temperature Measurement	Jason T probe. 71 °C. From cloudy flow emanating out of crusty surface (chimney?) formations.
J2-221-13-R1	North Su	53502	8/16	20:59		3876	3606	1217	0	0	**3876**	**3606**	**1217**	**357**	**1.2**	Sulfur/ Grab	Native S w/ botryoidal lime-green sulfur on exterior. From crust of 70 °C flow.
J2-221-13-R2	North Su	53555	8/16	21:16		3876	3606	1217	0	0	**3876**	**3606**	**1217**	**357**	**1.4**	Clastic Rock/ Grab	Altered, breccia containing (plg) clasts in minor sulfide matrix, but likely mostly volcanic. Minor sulfur in voids.
J2-221-14-R1	North Su	53625	8/16	21:33		3836	3614	1208	0	-1	**3836**	**3613**	**1208**	**360**	**2.1**	Clastic Rock/ Grab	Highly altered rubbly piece from S slope on FeOx and bact. Mat-rich sediment. Volcanic breccia-tpe sample.
J2-221-15-R1	North Su	54019	8/16	23:33		3750	3551	1260	-5	-4	**3745**	**3547**	**1262**	**085**	**1.5**	Volcanic Rock/ Grab	Massive lava pillow, plg-crysts (1 - 4 mm). Mostly fresh; superficial staining.
J2-221-16-R1	North Su	54047	8/16	23:40		3748	3553	1260	-2	-2	**3746**	**3551**	**1260**	**083**	**1.6**	Volcanic Rock/ Grab	Plg-cpx phyric, vesicular lava. 15 - 20 % phenocrysts. From mostly fresh rubbly lava flow.
J2-221-16-R2	North Su	54047	8/16	23:40		3748	3553	1260	-2	-2	**3746**	**3551**	**1260**	**083**	**1.6**	Volcanic Rock/ Grab	2nd piece from same outcrop. Sparse-plg phenocrysts. Possibly surface of flow w/ ropey outer surface.
J2-222-1-R1	Rogers Ruins	54563	8/17	10:54	8	2663	3428	1710	0	1	**2663**	**3429**	**1710**	**148**	**4.5**	Active Sulfide Chimney/ Grab	Base of tall Zn-rich active tall (> 1 m), thin spire. Pipe-llike structure. Complex of several active spires. PAIR to three fluids.
J2-222-1-T1	Rogers Ruins	54649	8/17	11:08	8	2663	3428	1710	0	1	**2663**	**3429**	**1710**	**174**	**3.2**	Temperature Measurement	Jason T probe. 268 °C. From exposed stump of sampled chimney.
J2-222-1-W1-IGT4	Rogers Ruins	54671	8/17	11:13	8	2663	3428	1710	0	1	**2663**	**3429**	**1710**	**174**	**3.2**	IGT water sample	From orifice exposed from sampling chimney. T (max) 130 °C. Pair to solid sample.
J2-222-1-W2-IGT3	Rogers Ruins	54697	8/17	11:22	8	2663	3428	1710	0	1	**2663**	**3429**	**1710**	**174**	**3.2**	IGT water sample	Replicate fluid sample. T (max) 274 °C.
J2-222-1-W3-M2	Rogers Ruins	54718	8/17	11:28	8	2663	3428	1710	0	1	**2663**	**3429**	**1710**	**174**	**3.2**	MAJOR water sample	Replicate fluid sample. No T data.
J2-222-1-R2	Rogers Ruins	54783	8/17	11:40	8	2663	3428	1710	-1	1	**2662**	**3429**	**1711**	**178**	**3.1**	Inactive Sulfide Chimney/ Grab	Relict, thin spire; in same complex. Next to active sample. Base piece taken.
J2-222-2-R1	Rogers Ruins	54870	8/17	12:04		2632	3379	1714	1	0	**2633**	**3379**	**1714**	**237**	**2.3**	Volcanic Rock'/ Grab	Glassy rubble flow, from large steep flow front of coulee.
J2-222-3-T1	Roman Ruins	54964	8/17	12:42	20	2699	3295	1702	-1	-1	**2698**	**3294**	**1702**	**056**	**1.2**	Temperature Measurement	Jason T probe. 88 °C. Clear fluid venting from oxide mound
J2-222-3-Mkr20	Roman Ruins	54992	8/17	12:50	20	2698	3295	1701	0	0	**2698**	**3295**	**1702**	**056**	**2.6**	Marker [Roman Ruins]	Marker #20 on top of rubbly volcanic mound/ ridge coated w/ Fe-oxide.
J2-222-4-R1	Roman Ruins	55350	8/17	14:50	18	2763	3261	1680	1	2	**2764**	**3263**	**1680**	**202**	**2.7**	Active Sulfide Chimney/ Grab	Tip of active, black smoker Cpy-lined chimney from periphyery of (> 12 m) massive sulfide edifice. PAIR to fluid.
J2-222-4-W1-IGT2	Roman Ruins	55391	8/17	15:05	18	2763	3261	1680	1	2	**2764**	**3263**	**1681**	**202**	**2.7**	IGT water sample	To pair to solid sample. T (max) 339 °C.
J2-222-4-W2-IGT1	Roman Ruins	55431	8/17	15:13	18	2763	3261	1680	1	2	**2764**	**3263**	**1681**	**202**	**2.7**	IGT water sample	Replicate fluid sample. T (max) 341 °C
J2-222-4-W3-M4	Roman Ruins	55460	8/17	15:22	18	2763	3261	1680	1	2	**2764**	**3263**	**1681**	**202**	**2.7**	MAJOR water sample	Replicate fluid sample. No T data.

J2-222-4-R2	Roman Ruins	55492	8/17	15:30	18	2763	3261	1680	1	3	**2764**	**3264**	**1679**	**202**	**2.7**	Inactive Sulfide Chimney/ Grab	Inactive chimney spire; cpy-rich. From same complex; next to active sample.
J2-222-5-R1	Roman Ruins	55680	8/17	16:37		2719	3273	1695	0	0	**2719**	**3273**	**1695**	**137**	**3.5**	Oxide Crust/ Grab	TWO pieces of Fe-Mn-oxide rich crust from rugged and ropey surface lava flows and relict sulfide chimneys? One piece given to Nautilus
J2-222-6-R1	Roman Ruins	55730	8/17	16:58		2727	3228	1682	0	2	**2727**	**3230**	**1683**	**176**	**3.0**	Volcanic Rock'/ Grab	Aphyric, aphanitic lava w/ crumbly and botryoidal Fe-Mn-oxide coatings from side of steep scarp face.
J2-222-7-R1	Roman Ruins	55831	8/17	17:18		2750	3211	1678	0	1	**2750**	**3212**	**1678**	**200**	**1.8**	Active Sulfide Flange/ Grab	Outer ~ 5 cm edge of active flange w/ porous, open dendritic lamellae. No temp.
J2-222-8-R1	Roman Ruins	55983	8/17	18:15		2734	3185	1678	0	7	**2734**	**3192**	**1678**	**005**	**3.1**	Inactive Sulfide Chimney/ Grab	Thin, perfect pipe-like sealed conuit spire. Former Copy-lined conduit < 1 cm wide; filled w/ Wtz. ZnS exterior layer.
J2-222-8-R2	Roman Ruins	56049	8/17	18:36		2734	3185	1677	0	7	**2734**	**3192**	**1677**	**008**	**4.4**	Active Sulfide Chimney/ Grab	Lightly, active, grey smoker Cpy-lined small spire from outer base of larger complex.
J2-222-8-T1	Roman Ruins	56060	8/17	18:40		2734	3185	1677	0	7	**2734**	**3192**	**1677**	**008**	**4.4**	Temperature Measurement	Jason T probe. 254 °C. From orifice exposed on left hand side of vacated space.
J2-222-8-T2	Roman Ruins	56070	8/17	18:44		2734	3185	1677	0	7	**2734**	**3192**	**1677**	**008**	**4.4**	Temperature Measurement	Jason T probe. 288 °C. From orifice exposed on right hand side or vacated space.
J2-222-9-R1	Roman Ruins	56127	8/17	19:03		2725	3182	1678	4	-5	**2729**	**3177**	**1678**	**228**	**0.8**	Volcanic Rock'/ Grab	Aphyric, aphanitic lava w/ few stretched vesicles. Sub-part displays pervasive clay (greenish) alteration.
J2-222-9-R2	Roman Ruins	56134	8/17	19:05		2725	3182	1678	4	-4	**2729**	**3178**	**1678**	**228**	**0.8**	Volcanic Rock'/ Grab	2nd piece. Same outcrop of rubbly, and fallen lava flows.
J2-222-10-N1,N2	Roman Ruins [SW]	56303	8/17	20:14		2503	3330	1711	1	1	**2504**	**3331**	**1709**	**229**	**6.0**	NISKIN water sample	In bottom water; volcanic terrain. Removed from vigorous hydrothermal activity.
J2-222-11-R1	Roman Ruins [SW]	56453	8/17	21:18		2488	3096	1671	-2	-1	**2486**	**3095**	**1671**	**054**	**2.7**	Volcanic Rock'/ Grab	Mostly fresh, volcanics from ropey, rugged small flow ridge.
J2-222-12-R1	Roman Ruins [SW]	56696	8/17	23:00		2374	2894	1651	0	-2	**2374**	**2892**	**1651**	**338**	**2.5**	Volcanic Rock'/ Grab	Fresh, aphyric lava block from top of volcanic knoll.
J2-223-1-R1	North Su	56972	8/18	10:35		3802	3665	1157	0	0	**3802**	**3665**	**1157**	**110**	**7.7**	Active Sulfide Chimney/ Grab	Top of parasitic spire grown from side of larger (10 m) edifice. Cpy-lined. PAIR to three fluids.
J2-223-1-T1	North Su	57051	8/18	10:50		3802	3665	1157	0	0	**3802**	**3665**	**1157**	**110**	**7.7**	Temperature Measurement	Jason T probe. 288 °C. From central orifie of remaining spire (sampled piece)
J2-223-1-W1-IGT8	North Su	57074	8/18	10:56		3802	3665	1157	0	0	**3802**	**3665**	**1157**	**110**	**7.7**	IGT water sample	Black smoker fluid from basal piece of sampled spire. T (max) 299 °C.
J2-223-1-W2-IGT7	North Su	58092	8/18	11:04		3802	3665	1157	0	0	**3802**	**3665**	**1157**	**110**	**7.7**	IGT water sample	Replicate fluid sample. T (max) 300 °C.
J2-223-1-W3-M2	North Su	57116	8/18	11:13		3802	3665	1157	0	0	**3802**	**3665**	**1157**	**110**	**7.7**	MAJOR water sample	Replicate fluid sample. No T data. Good tell-tale discharge through sampler.
J2-223-2-T1	North Su	57267	8/18	11:56		3798	3693	1156	0	1	**3798**	**3694**	**1156**	**176**	**2.0**	Temperature Measurement	Jason T probe. 90 °C. Clear fluid venting from fissure at base of large flange structure. Should have sampled from here.
J2-223-2-T2	North Su	57283	8/18	12:00		3798	3693	1156	0	1	**3798**	**3694**	**1156**	**176**	**1.5**	Temperature Measurement	Jason T probe. 54 °C. Inserted into white mat coated sediment ~5 cm away from hole.
J2-223-3-R1	North Su	57414	8/18	12:37		3850	3705	1170	0	1	**3850**	**3706**	**1170**	**173**	**1.9**	Volcanic Rock/ Grab	Volcanic rock from rubble, at base of blocky, steep sided lava flow (possibly a dike?)
J2-223-4-T1	North Su	57511	8/18	13:08		3853	3771	1200	-3	3	**3850**	**3774**	**1200**	**123**	**2.3**	Temperature Measurement	Jason T probe. 32 °C. Diffuse flow from large snail populus at crest of small volcanic ridge (a slump feature?)
J2-223-4-T2	North Su	57550	8/18	13:24		3859	3773	1202	2	-1	**3861**	**3772**	**1202**	**192**	**2.2**	Temperature Measurement	Jason T probe. 23 °C. From fissure/crack in volcanic substratum; colonized by juvenile snails.
J2-223-5-R1	North Su	57694	8/18	14:20		3893	3667	1198	1	0	**3894**	**3667**	**1198**	**285**	**5.3**	Volcanic Rock/ Grab	Exterior of lava flow from prominent ecsarpment/ faulted mound.
J2-223-6-T1	North Su	57855	8/18	15:12		3845	3672	1166	-1	-2	**3844**	**3670**	**1165**	**005**	**8.4**	Temperature Measurement	Jason T probe. 59 °C. From fissure in upper surface of large volcanic mound coated w/ extensive Fe-oxide and [bacterial] sulfur.

J2-223-6-R1	North Su	57875	8/18	15:15		3845	3672	1166	-1	-1	**3844**	**3671**	**1166**	**004**	**8.1**	Clastic Rock/ Grab	Altered breccia w/ voclanic clasts and native sulfur veins; from exposed side of mound below fissures.
J2-223-7-R1	North Su	57939	8/18	15:41		3818	3688	1159	1	1	**3819**	**3689**	**1159**	**253**	**4.2**	Clastic Rock/ Grab	Dominantly volcanic clasts; matrix is poorly preserved but possibly barite and black sulfur. Some barite rosettes visible. Top of elongate volcanic mound.
J2-223-8-R1	North Su	58030	8/18	16:02		3796	3709	1162	0	0	**3796**	**3709**	**1162**	**041**	**0.9**	Clastic Rock/ Grab	Sulfur/oxide crust from unconsolidated debris flow at base of low-lying ridge.
J2-223-9-R1	North Su	58140	8/18	16:50		3812	3764	1190	-3	-4	**3809**	**3760**	**1190**	**106**	**8.7**	Sulfur / Grab	Friable, ropey flow of native sulfur. Colors metallic grey to yellow-green. Side of large elongate volcanic mound.
J2-223-9-R2	North Su	58173	8/18	16:59		3812	3764	1190	-3	-4	**3809**	**3760**	**1190**	**106**	**8.3**	Volcanic Rock/ Grab	Plg-cpx-phyric volcanic rock; moderatley vesicular Patchy, thin deposits of Py along cracks/veins and vesicle walls.
J2-223-10-R1	North Su	58259	8/18	17:25		3858	3771	1198	-2	1	**3856**	**3772**	**1198**	**228**	**1.9**	Volcanic Rock/ Grab	Three pieces, volcanic talus from slope of area of ~ 30 °C fluid flow. Encrusted in juvenile snails.
J2-223-11-T1	North Su	58358	8/18	18:01		3791	3782	1206	2	1	**3793**	**3783**	**1206**	**228**	**2.0**	Temperature Measurement	Jason T probe. 102 °C. Clear fluid from small crack hosting locally abundant bacterial mats. On thin crust volcanic pavement on rubbly basement.
J2-223-11-T2	North Su	58384	8/18	18:09		3791	3782	1206	2	1	**3793**	**3783**	**1206**	**228**	**2.0**	Temperature Measurement	Jason T probe. 125 °C. Adjacent crack; same environment.
J2-223-11-W1-IGT5	North Su	58448	8/18	18:45		3791	3782	1204	-2	-1	**3789**	**3781**	**1204**	**206**	**2.3**	IGT water sample	Flow enamating from thicker, friable white sediment. Smoke black to grey in color. T (max) 241 °C.
J2-223-11-W2-IGT6	North Su	58606	8/18	19:26		3791	3782	1204	-2	-1	**3789**	**3781**	**1204**	**206**	**2.3**	IGT water sample	Fluid from a similar low porosity zone in sediments. Not the eaxct same flow. T (steady) 203 °C.
J2-223-11-R1	North Su	58735	8/18	19:34		3791	3782	1204	-2	-1	**3789**	**3781**	**1204**	**206**	**2.3**	Clastic Rock or Cust/ Grab	Mixed sulfide-sulfate-oxide crust ~ 2 cm thick overlying diffuse, high temperature flows.
J2-223-11-R2	North Su	58771	8/18	19:44		3791	3782	1204	-2	-1	**3789**	**3781**	**1205**	**206**	**2.3**	Sediment / Scoop	Larger scoop of the overlying sediment. Collecting sediment and crust.
J2-223-12-T1	North Su	58847	8/18	20:10		3778	3784	1209	-1	2	**3777**	**3786**	**1209**	**100**	**3.8**	Temperature Measurement	Jason T probe. 89 °C. Extensive clear flows from fissures in sediments and volcanic flow fronts and ledges.
J2-223-12-R1	North Su	58946	8/18	20:38		3778	3784	1209	0	0	**3778**	**3784**	**1209**	**100**	**3.8**	Active Sulfide Flange/ Grab	Mixed , major Py, minor clastic (?) frag held in Pyritic matrix from leading edge of altered volcanic ledge (small fissure scarp)
J2-223-12-R2	North Su	58961	8/18	20:40		3778	3784	1209	0	0	**3778**	**3784**	**1209**	**100**	**3.8**	Volcanic Rock/ Grab	Altered volcanic lava with dense sulfide (Py?) vein network. Sulfides sometimes in preserved vesicles.
J2-223-13-R1	North Su	59011	8/18	21:02		3751	3790	1225	0	-4	**3751**	**3786**	**1225**	**106**	**2.0**	Active Sulfide Chimney/ Grab	Sulfide (ZnS) flange and protruding chimney meshed together from another fissure area of active flow.
J2-223-13-T1	North Su	59050	8/18	21:13		3751	3790	1225	-1	-4	**3750**	**3786**	**1225**	**106**	**2.0**	Temperature Measurement	Jason T probe. 212 °C. From next to 223-13-R1, but not necessarily associated w/ it.
J2-223-14-T1	North Su	59149	8/18	21:43		3768	3766	1207	-2	1	**3766**	**3767**	**1207**	**133**	**2.1**	Temperature Measurement	Jason T probe. 89 - 102 °C. Cracks in rubbly volcanic flow hosting Fe-oxide stainings and bacterial mats. Base of fissure?
J2-223-14-R1	North Su	59160	8/18	21:49		3768	3766	1207	-1	0	**3767**	**3766**	**1207**	**133**	**2.1**	Volcanic Rock/ Grab	Vesicular, mostly fresh volcanic lava w/ outer Fe-oxide and white microbial stainings.
J2-223-15-T1	North Su	59317	8/18	22:35		3747	3700	1182	-1	1	**3746**	**3701**	**1182**	**134**	**3.3**	Temperature Measurement	Jason T probe. 315 °C. Vigorously venting black smoker orifice. Flashing; phase separated?
J2-223-15-W1-M4	North Su	59338	8/18	22:44		3747	3700	1182	-1	1	**3746**	**3701**	**1182**	**134**	**3.3**	MAJOR water sample	From the black smoker orifice. No T data; Good tell-tale flow from sampler.

J2-223-15-R1	North Su	59360	8/18	22:54		3747	3700	1182	-1	1	**3746**	**3701**	**1182**	**134**	**3.3**	Active Sulfide Chimney/ Grab	Multiple piece of thin, friable Zn-Pb-rich sulfide (thin wall or flange crust?) that fell into basket whilst sampling fluids.
J2-223-15-R2	North Su	59383	8/18	22:57		3747	3700	1182	-1	1	**3746**	**3701**	**1182**	**134**	**3.3**	Active Sulfide Chimney/ Grab	Friable, thin walled, multiple conduit Zn-Pb rich sulfde wall from side of large sulfide edifice.
J2-223-16-R1	North Su	50508	8/18	23:58		3736	3651	1207	0	-1	**3736**	**3650**	**1208**	**056**	**4.8**	Volcanic Rock/ Grab	Piece of large talus rubble. Mostly fresh interior; but with Fe-oxide staining and whispy microbial oragnic matter coating surface.
J2-224-1-R1	South Su	59852	8/19	10:08		4131	2853	1352	14	8	**4145**	**2861**	**1357**	**188**	**5.2**	Volcanic Rock/ Grab	Highly altered, bleached, soft volcanic rock from rugged outcrop. Locally abundant microbial (?) mats
J2-224-2-R1	South Su	60210	8/19	12:52		4115	2830	1340	-9	-9	**4106**	**2821**	**1340**	**192**	**1.9**	Volcanic Rock/ Grab	Bleached rock, from steep sided volcanic outcrop or slope. Suspected advanced argillic alteration
J2-224-3-R1	South Su	60585	8/19	15:19		4016	2690	1348	-2	1	**4014**	**2691**	**1349**	**125**	**3.1**	Volcanic Rock/ Grab	Volcanic outcrop. Piece collected from exposed surface. Has significant brecciation, mineralization and Fe-oxide surface staining.
J2-224-4-T1	South Su	60776	8/19	16:14		4108	2712	1317	4	-3	**4112**	**2709**	**1317**	**059**	**0.9**	Temperature Measurement	Jason T probe. 17 °C. Diffuse flow from Summit of gently-sloping, sedimented ridge. Patchy, abundant bacterial mats; mussels and shrimp on exposed volcanics.
J2-224-4-T2	South Su	60835	8/19	16:36		4140	2695	1315	-28	14	**4112**	**2709**	**1317**	**058**	**1.6**	Temperature Measurement	Jason T probe. 25 °C. Second measurement of diffuse flow from same general area.
J2-224-5-R1	South Su	60923	8/19	17:10		4245	2676	1308	5	6	**4250**	**2682**	**1309**	**214**	**2.6**	Relict Sulfide Chimney/ Grab	Degraded ~ 1 m tall sulfide chimmey from field of multiple slender, small inactive spires.
J2-224-5-R2	South Su	60955	8/19	17:21		4245	2676	1308	5	2	**4250**	**2678**	**1309**	**227**	**2.9**	Inactive Sulfide Chimney' Grab	Zn-rich tip of inactive spire. From small complex adjacent to relict spire -5-R1.
J2-224-6-R1	South Su	61001	8/19	17:35		4259	2681	1307	-2	0	**4257**	**2681**	**1307**	**185**	**3.1**	Active Sulfide Chimney/ Grab	Large spire from active complex. Single central porous conduit w/ Zn-rich (+enargite? tennantite?) sulfide. Lamellae reminiscent of beehive textures. Broken. PAIR to three fluids.
J2-224-6-T1	South Su	61041	8/19	17:39		4259	2681	1307	-2	0	**4257**	**2681**	**1309**	**182**	**3.1**	Temperature Measurement	Jason T probe. 267 °C. From exposed conduit from base of broken spire.
J2-224-6-W1-IGT4	South Su	61130	8/19	18:05		4259	2681	1307	-2	0	**4257**	**2681**	**1308**	**175**	**3.7**	IGT water sample	From open conduit orifice, exposed after sampling. T (max) 265 °C. Dropped to 225 °C during sampling.
J2-224-6-W2-IGT3	South Su	61165	8/19	18:15		4259	2681	1307	-2	0	**4257**	**2681**	**1308**	**186**	**3.7**	IGT water sample	Replicate fluid sample. T (max) 271 °C.
J2-224-6-W3-M2	South Su	61182	8/19	18:28		4259	2681	1307	-2	0	**4257**	**2681**	**1308**	**229**	**3.7**	MAJOR water sample	Replicate fluid sample. No T data.
J2-224-7-T1-T4	South Su	61230	8/19	18:45		4257	2767	1309	2	-89	**4259**	**2678**	**1309**	**321**	**2.2**	Temperature Measurement	Jason T probe. Measurements from around flange on side of sulfide scarp. 11 - 25 °C around flange; 241 °C in flange pool
J2-224-7-R1	South Su	61250	8/19	18:52		4257	2767	1309	2	-89	**4259**	**2678**	**1309**	**321**	**2.2**	Active Sulfide Flange/ Grab	Zn-rich bud protruding from top of active flange.
J2-224-7-R2	South Su	61288	8/19	19:05		4257	2767	1309	2	-89	**4259**	**2678**	**1309**	**321**	**2.2**	Active Sulfide Flange/ Grab	Zn-rich, ~ 3 cm thick outer edge of active flange
J2-224-7-T5	South Su	61297	8/19	19:10		4257	2767	1309	2	-89	**4259**	**2678**	**1309**	**321**	**2.2**	Temperature Measurement	Jason T probe. 293 °C. Clear-grey fluid from beneath flange after sampling.
J2-224-8-T1	South Su	61360	8/19	19:27		4270	2682	1308	1	-3	**4271**	**2680**	**1307**	**040**	**3.6**	Temperature Measurement	Jason T probe. 284 °C. Thin-walled, open conduit grey smoker
J2-224-8-R1	South Su	61376	8/19	19:33		4270	2682	1308	1	-3	**4271**	**2680**	**1307**	**040**	**3.6**	Active Sulfide Chimney/ Grab	Extremely friable, thin walled (cpy/py?) smoker w/ interior porous abundant black, acicular anh.
J2-224-9-R1	South Su	61547	8/19	20:43		4335	2792	1330	-2	-3	**4333**	**2789**	**1330**	**187**	**1.5**	Volcanic Rock/ Grab	Altered volcanic rock from exposed "pinnacle" on slope of dominantly volcanic ridge.
J2-224-10-N1	South Su	61635	8/19	21:21		4265	2776	1364	100	2	**4365**	**2778**	**1364**	**206**	**2.7**	NISKIN water sample	Niskin bottle fired from above ropey, broken, mostly flat lava flows.
J2-224-10-R1	South Su	61647	8/19	21:25		4335	2776	1364	33	4	**4368**	**2780**	**1365**	**222**	**1.7**	Volcanic Rock/ Grab	Fresh, vesicular lava from broken flows.

J2-224-11-T1	South Su	61911	8/19	23:03		4298	2640	1329	0	-4	**4297.8**	**2636**	**1329**	**016**	**4.2**	Temperature Measurement	Jason T probe. 279 °C. Open conduit w/ clear flow. Porous, v. friable white diffuser type spire. Not sampled.
J2-224-12-R1	South Su	61934	8/19	23:13		4300	2642	1327	0	-4	**4300**	**2639**	**1327**	**341**	**3.2**	Active Sulfide Chimney/ Grab	Base of active beehive chimney. No beehive structure preserved; only basal piece. Large friable Fe-Zn sulfide. PAIR to three fluids.
J2-224-12-W1-IGT1	South Su	61997	8/19	23:25		4300	2642	1327	0	-4	**4300**	**2639**	**1327**	**341**	**3.2**	IGT water sample	Black smoker fluid, venting vigorously from exposed open conduit. T (max) 288 °C
J2-224-12-T1	South Su	62010	8/19	23:29		4300	2642	1327	0	-4	**4300**	**2639**	**1327**	**341**	**3.2**	Temperature Measurement	Jason T probe. 11 °C. From exterior wall of remaining stump. Not a good measure of the samples chimney.
J2-224-12-W2-IGT2	South Su	62025	8/19	23:34		4300	2642	1327	0	-4	**4300**	**2639**	**1327**	**341**	**3.2**	IGT water sample	Replicate fluid sample from black smoker. T (max) 287 °C.
J2-224-12-W3-M4	South Su	62057	8/19	23:45		4300	2642	1327	0	-4	**4300**	**2639**	**1327**	**341**	**3.2**	MAJOR water sample	Replicate fluid sample. No T data. Good tell-tale sign of flow through sampler.
J2-226-1-R1	Suzette	62450	8/21	08:38		3312	4864	1517	5	-2	**3317**	**4862**	**1521**	**235**	**1.0**	Hydrothermal Talus/ Breccia/ Grab	Cpy-rich talus block; minor external weathering. Exposed on sediment slope, away from proximal hydrothermal activity. Sampled previously?
J2-226-2-T1	Suzette	63100	8/21	13:08	9	3243	4910	1500	4	-1	**3247**	**4909**	**1500**	**259**	**1.3**	Temperature Measurement	Jason T probe. 147 °C. Clear flow from "turtle" pavement; flow from under edge of sulfide pavement.
J2-226-2-T2	Suzette	63110	8/21	13:16	9	3243	4910	1500	4	-1	**3247**	**4909**	**1500**	**259**	**1.3**	Temperature Measurement	Jason T probe. 153 °C. Same flow from adjacent sulfide flange.
J2-226-2-W1-IGT6	Suzette	63159	8/21	13:36	9	3243	4910	1500	4	-1	**3247**	**4909**	**1500**	**259**	**1.3**	IGT Water sample	Sample of clear flow from outcrop. T (max) 157 °C; but was variable (down to 60 °C) during sampling.
J2-226-2-W2-IGT5	Suzette	63190	8/21	13:48	9	3243	4910	1500	4	-1	**3247**	**4909**	**1500**	**259**	**1.3**	IGT Water sample	Replicate fluid sample. T increased from 189 to 249 °C during sampling.
J2-226-2-W3-M2	Suzette	63220	8/21	14:00	9	3243	4910	1500	4	-1	**3247**	**4909**	**1500**	**259**	**1.3**	MAJOR water sample	Replicate fluid sample. No T data.
J2-226-2-Mkr9	Suzette	63244	8/21	14:06	9	3235	4911	1500	12	-2	**3247**	**4909**	**1500**	**215**	**1.3**	Marker [Suzette]	Marker #9 placed at the "turtle back" cracked pavement at N. Suzette.
J2-226-2-R1	Suzette	63272	8/21	14:16	9	3244	4911	1500	3	-2	**3247**	**4909**	**1500**	**259**	**1.3**	Active Sulfide Flange/ Grab	Fe-oxide and microbial suilfur stained ZnS flange from edge of pavement and ~ 30 cm away from shimmering flows.
J2-226-3-R1	Suzette	63420	8/21	15:12		3018	4939	1505	-5	4	**3013**	**4943**	**1506**	**211**	**2.6**	Sediment / Grab	Heavily cemented sand(+sulfide?) from surface, cracked blocks.
J2-226-4-T1	Suzette	63840	8/21	17:38		2673	4751	1569	26	-8	**2699**	**4743**	**1570**	**302**	**1.0**	Temperature Measurement	Jason T probe. 210 °C (max). Clear/grey smoker fluid diffusing from cracks in layered (flange) sulfide mound.
J2-226-4-R1	Suzette	63976	8/21	18:00		2673	4751	1569	23	-3	**2696**	**4748**	**1571**	**131**	**1.4**	Active Sulfide Chimney/ Grab	White "diffuser-type" spire venting fluids from sides and summit of spire. Broke into several pieces (c.f, 4-R2 and 4-R3). Zn-rich w/ Fe-oxide and sulfur staining.
J2-226-4-W1-IGT7	Suzette	63950	8/21	18:24		2673	4751	1569	23	-3	**2696**	**4748**	**1570**	**131**	**1.4**	IGT Water sample	Exposed orifice from remaining stump of spire collected as 4-R1, R2 and R3. T (max) 226 °C.
J2-226-4-W2-IGT8	Suzette	63994	8/21	18:43		2673	4751	1569	23	-3	**2696**	**4748**	**1570**	**131**	**1.4**	IGT Water sample	Replicate fluid sample. T (max) 225 °C.
J2-226-4-W3-M4	Suzette	64030	8/21	18:55		2673	4751	1569	23	-3	**2696**	**4748**	**1570**	**132**	**1.4**	MAJOR water sample	Replicate fluid sample. No T data.
J2-226-4-R2	Suzette	64045	8/21	19:05		2673	4751	1569	23	-3	**2696**	**4748**	**1570**	**131**	**1.4**	Active Sulfide Chimney/ Grab	Pick of broken pieces from spire sampled from top of layered/flange-like sulfide mound. Same as 4-R1. Possibly basal piece.
J2-226-4-R3	Suzette	64050	8/21	19:05		2673	4751	1569	23	-3	**2696**	**4748**	**1570**	**132**	**1.4**	Active Sulfide Chimney/ Grab	Pick of broken pieces from spire sampled from top of layered/flange-like sulfide mound. Same as 4-R1. Possibly tip piece.
J2-226-4-R4	Suzette	64062	8/21	19:10		2673	4751	1569	21	-1	**2694**	**4750**	**1570**	**139**	**1.5**	Active Sulfide Flange/ Grab	Ba-Zn-rich flange w/ large dendrite textures from basal, periphery of mound.
J2-226-5-R1	Suzette	64159	8/21	19:51		2524	4809	1607	34	-27	**2558**	**4782**	**1607**	**225**	**1.0**	Relict Sulfide Flange/ Grab	Largely cemented (Silica, barite?), relict sulfide flange. Some interior (dendritic) textures preserved. Also from pavement-type edifice.

J2-226-6-R1	Suzette	64205	8/21	20:10		2523	4806	1608	33	-28	**2556**	**4778**	**1606**	**257**	**1.1**	Relict Sulfide Flange/ Grab	Less degraded sulfide flange piece; somewhat similar to -6-R1. From another low-lying surface mound w/ flange.
J2-226-7-R1	Suzette	64285	8/21	20:33		2519	4801	1609	28	-25	**2547**	**4776**	**1609**	**094**	**3.3**	Inactive Sulfide Mound/ Grab	Mixed (cpy, ZnS, tennantite?) sulfide block from outer hanging ledge of irregularly shpaed sulfide mound.
J2-226-8-R1	Suzette	64429	8/21	21:28		2775	4588	1591	1	6	**2776**	**4594**	**1591**	**011**	**1.5**	Hydrothermal Talus/ Breccia/ Grab	Zn-(+ minor Cu) massive sulfide talus piece w/ exterior Fe-oxide and Atacamite staining; from block, rubble (partly sed.) slope.
J2-226-8-R2	Suzette	64444	8/21	21:33		2775	4588	1591	0	6	**2775**	**4594**	**1591**	**010**	**1.6**	Volcanic Rock/ Grab	Mostly fresh, vesicular volcanic rock from same slope as 8-R1.
J2-227-1-R1	South Su [West]	64939	8/22	10:35		3600	2010	1549	2	-3	**3602**	**2007**	**1549**	**018**	**1,2**	Volcanic Rock/ Grab	Fresh, surficially stained volcanic talus from faulted scarp
J2-227-1-R2	South Su [West]	65020	8/22	10:40		3600	2010	1549	3	-2	**3603**	**2008**	**1549**	**018**	**1,2**	Sediment/ Grab	Muddy sediment from faulted scarp w/ abundant volcanic clasts.
J2-227-2-R1	South Su [West]	65206	8/22	12:25	15	3243	2356	1642	-4	-8	**3239**	**2348**	**1641**	**094**	**0.9**	Volcanic Rock/ Grab	Small piece of bleached volcanic rock. Altered exterior; fresh interior.
J2-227-2-R2	South Su [West]	65265	8/22	12:30	15	3243	2356	1642	-4	-8	**3239**	**2348**	**1641**	**159**	**1.9**	Volcanic Rock/ Grab	Fresh volcanic lava from incipiently sedimented rubbly lava flow.
J2-227-2-R3	South Su [West]	65285	8/22	12:33	15	3243	2356	1642	-3	-8	**3240**	**2348**	**1642**	**158**	**1.7**	Volcanic Rock/ Grab	Small piece of bleached volcanic rock from rubbly outcrop.
J2-227-2-Mkr15	South Su [West]	65293	8/22	12:37	15	3243	2356	1632	-3	-8	**3240**	**2348**	**1642**	**159**	**1.5**	Marker [Surprise; W of Su]	Marker #15 placed at exposed, broken volcanic talus and rubble.
J2-227-3-T1	South Su [West]	65790	8/22	15:57		4262	2521	1369	0	-2	**4262**	**2519**	**1369**	**350**	**2.1**	Temperature Measurement	Jason T probe. 45 °C. From crack in crusty sediment. Some (sulfidic?) rugged outcrops in proximity.
J2-227-4-R1	South Su	65830	8/22	16:15		4219	2531	1365	2	-2	**4221**	**2529**	**1365**	**329**	**3.3**	Volcanic Rock/ Grab	Fresh volcanic lava from rugged and fissured prominent volcanic mound. Mussels in cracks.
J2-227-5-R1	South Su	65864	8/22	16:24		4218	2543	1363	0	-1	**4218**	**2542**	**1363**	**022**	**2.3**	Volcanic Rock/ Grab	Fresh volcanic lava from exposed, flat outcrop above sediment.
J2-227-5-R2	South Su	65864	8/22	16:24		4218	2543	1363	0	-1	**4218**	**2542**	**1363**	**022**	**2.3**	Clastic Rock/ Grab	Native sulfur-cemented crust with volcanic clasts; from beneath sample 5-R1.
J2-227-6-R1	South Su	65951	8/22	16:49		4276	2563	1366	1	-1	**4277**	**2562**	**1366**	**302**	**3.2**	Sulfur/Oxide Crust/ Grab	Native sulfur and Fe-oxide rich "crust" (highly altered?) from collapsed, broken volcanic flows.
J2-227-6-R2	South Su	65970	8/22	16:52		4276	2563	1366	1	-1	**4277**	**2562**	**1366**	**302**	**3.2**	Sulfur/Oxide Crust/ Grab	2nd piece. Similar mineralogy/composition from same outcrop.
J2-227-7-R1	North Su	66184	8/22	19:04		3751	3697	1190	0	0	**3751**	**3697**	**1190**	**063**	**4.4**	Active Sulfide Chimney/ Grab	Py(+Cpy) lined, thin platey, chimney wall from 300 °C black smoker; mid-section, periphery of large edifice.
J2-227-7-R2	North Su	66200	8/22	19:06		3751	3697	1190	0	0	**3751**	**3697**	**1190**	**063**	**4.4**	Massive Anhydrite/ Grab	Massive Anh sampled from base of edifice, above volanic pillows.
J2-227-8-W1-IGT4	North Su	66264	8/22	19:27		3752	3698	1183	0	0	**3752**	**3698**	**1183**	**112**	**7.0**	IGT water sample	Black smoker fluid; phase separated. Opposite side of edifice to station #7. T (max) 325 ℃.
J2-227-8-W2-IGT3	North Su	66325	8/22	19:46		3752	3698	1183	0	0	**3752**	**3698**	**1183**	**112**	**7.0**	IGT water sample	Replicate fluid sample. T (steady) 325 °C.
J2-227-8-W3-M4	North Su	66351	8/22	19:54		3752	3698	1183	0	0	**3752**	**3698**	**1183**	**112**	**7.0**	MAJOR water sample	Replicate fluid sample. No T data. Good tell-tale flow prior to sampling.
J2-227-8-R1	North Su	66410	8/22	20:17		3752	3698	1183	0	0	**3752**	**3698**	**1184**	**112**	**7.0**	Active Sulfide Chimney/ Scoop	Scoop of the extremely friable black smoker orifice from 324 °C vent.
J2-227-9-R1	North Su	66490	8/22	20:31		3758	3686	1186	-1	0	**3757**	**3686**	**1185**	**106**	**5.5**	Relict Sulfide Chimney/ Grab	Inactive, Zn-rich sulfide tip from larger conical spire. Beehive textures. From just E of 324 °C vent.
J2-227-10-R1	North Su	66600	8/22	21:01		3807	3686	1153	-6	-1	**3801**	**3685**	**1154**	**141**	**3.5**	Active Sulfide Chimney/ Grab	Two pieces. Tip and bulk of spire at Py-rich, "diffuser"-type spires.
J2-227-10-W1-IGT2	North Su	66703	8/22	21:22		3807	3686	1153	-6	-1	**3801**	**3685**	**1155**	**141**	**3.5**	IGT water sample	Fluid collected from orifice at base of the sampled chimney. T (max) 299 °C.
J2-227-10-W2-IGT1	North Su	66730	8/22	21:29		3807	3686	1153	-6	-1	**3801**	**3685**	**1154**	**141**	**3.5**	IGT water sample	Replcate fluid sample. T (max) 296 °C.
J2-227-10-W3-M2	North Su	66777	8/22	21:40		3807	3686	1153	-6	-1	**3801**	**3685**	**1154**	**141**	**3.5**	MAJOR water sample	Replicate fluid sample. Trigger depressed and no good tell-tale, but bottle fired.

J2-227-10-R2	North Su	66832	8/22	21:52		3805	3685	1153	-2	1	**3803**	**3686**	**1154**	**104**	**2.4**	Relict Sulfide Chimney/ Grab	Relict, Cpy-Py-lined sealed conduit smoker from base of the sulfide complex.
J2-227-11-R1	North Su	66888	8/22	22:04		3822	3691	1159	1	-1	**3823**	**3690**	**1159**	**283**	**1.5**	Volcanic Rock/ Grab	Mostly fresh, surifically stained vesicular rock from interior of summit mound.
J2-227-12-R1	North Su	66990	8/22	22:42		3765	3692	1185	0	1	**3765**	**3693**	**1183**	**156**	**3.3**	Volcanic Rock/ Grab	Volcanic talus piece - relatively fresh - from base of black smoker complex
J2-227-13-R1	North Su	67179	8/22	23:47		3865	3509	1229	1	2	**3866**	**3511**	**1229**	**201**	**2.1**	Volcanic Rock/ Grab	Small clast from sediment-hosted ridge on SE flank of Su mound.
J2-227-13-N1	North Su	67199	8/22	23:51		3865	3509	1229	2	3	**3867**	**3512**	**1229**	**199**	**3.7**	NISKIN water sample	Fired at bottom. Station #13. Prior to leaving bottom.
J2-228-1-R1	Umbo	68250	8/28	20:12		6523	6006	1818	0	0	**6523**	**6006**	**1818**	**258**	**0.9**	Volcanic Rock/ Grab	Fresh, plg-olv phyric, vesicular lava from summit of Umbo mound.
J2-228-2-R1	Umbo	68560	8/28	23:08		8063	5492	2100	0	0	**8063**	**5492**	**2100**	**312**	**3.0**	Volcanic Rock/ Grab	Concentrically-layered mostly fresh lava from top of fault wall; lots of talus rubble.
J2-228-3-W1-M4	Umbo	68662	8/28	23:40		8197	5385	2100	0	0	**8197**	**5385**	**2100**	**121**	**4.2**	MAJOR water sample	Bottom water. ~4 m off seafloor. Eastern extent of Umbo mound. No hydrothermal activity (anywhere).