Cruise Report

R/V Atlantis
AT18-09

THERMAL GRID 2011
CORK
HiSpeed Optical Comms

NSF Grant – OCE-1037840 Johnson and Tivey
NSF Grant – OCE-0926849 Tivey, Farr, Ware
NSF Grant – OCE-0942835 Farr, Ware, Bowen

Astoria to Astoria, Oregon
Aug 6th 2011 to Aug. 24th 2011

H. Paul Johnson, Maurice Tivey, Mike Hutnak, Norman Farr, Jonathan Ware and Shipboard Science, JASON-2 Technical Team

University of Washington
Seattle, WA 98195, USA
Woods Hole Oceanographic Institution
Woods Hole, MA 02543, USA

R/V Atlantis Cruise 18 Leg 9 (AT18-09)
Personnel List

Science Passengers – July 6th July 24th Astoria to Astoria, Oregon

1) Dr. H. Paul Johnson	University of Washington	johnson@ocean.washington	Chf. Scientist
2) Dr. Maurice Tivey	WHOI	mtivey@whoi.edu	Co-Chf. Sci.
3) Dr. Michael Hutnak	UC Santa Cruz		Scientist
4) Ms. Marie Salmi	University of Washington		GRA
5) Mr. Tor Bjorklund	University of Washington		Technician
6) Ms. Kira Homola	University of Washington		UG
7) Mr. Casey Hearn	University of Washington		UG
8) Ms. Megan Gambs	University of Washington		GRA
9) Ms. Ashley Wheeler	University of Washington		UG
10) Mr. Marcus Moore	University of Washington		UG
11) Mr. Will Fortin	University of Wyoming		GRA
12) Mr. Jonathan Ware	WHOI		Engineer
13) Mr. Cliff Pontbriand	WHOI		Engineer
14) Mr. Leo-Paul Pelletier	WHOI		Engineer
15) Mr. Norm Farr	WHOI		Engineer
16) Mr. Alberto Collasius	WHOI DSL		Jason Exp Ldr
17) Mr. Korey Verhein	WHOI DSL		Jason Engineer
18) Mr. Benjamin Tradd	WHOI DSL		Jason Pilot
19) Mr. James Varnum	WHOI DSL		Jason Pilot
20) Mr. Casey Agee	WHOI DSL		Jason Nav
21) Mr. Alexander Franks	WHOI DSL		Jason Engineer
22) Mr. Baxter Hutchinson	WHOI DSL		Jason Nav
23) Mr. Thomas Lanagan	WHOI DSL		Jason Engineer
24) Mr. Wayne Roberts	WHOI DSL		Jason Nav
25) Mr. James Pelowski	WHOI DSL		Jason Data
26) Mr. Kyle McDermott	WHOI Atlantis		SSSG Tech
27) Mr. David Sims	WHOI Atlantis		SSSG Tech

Ship's Crew

Allan Lunt	Captain	master@altantis.whoi.edu
Mitzi Crane	Chief Mate	
Craig Dickson	2nd Mate	
Any Biddle	3rd Mate	
James Brennan	Comm ET	
Wayne Bailey	Bosun	
Lance Wills	AB	
Ed Popowitz	AB	
Kevin Roth	AB	
Richard Barnes	OS	
Robert Arthur	OS	
Chris Morgan	Chf. Engineer	
Marcel Viera	1st Engineer	
Glenn Savage	2nd Engineer	
Jonathan Welsh	3rd Engineer	
Azeem Modak	Electrician	
Alex Taylor	Oiler	
Richard Stairs	Oiler	
Reece Standfill	Wiper	
Larry Jackson	Steward	
Brendon Todd	Cook	
Cecile Hall	Mess Attd	

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Acknowledgments

We thank Tito Collasius and the Jason team for their work in making the science program a success. We also thank RV Atlantis Captain Allan Lunt and the ships crew for their work in support of our science cruise. Finally, we wish to thank the National Science Foundation (NSF) for funding this work.

Executive Summary

This cruise was a multi-PI cruise (Johnson, Tivey and Farr) encompassing 3 separate projects. Johnson (Univ. of Washington) reports on the Thermal Grid portion of the cruise in a separate report. Tivey and Farr (Woods Hole Oceanographic Institution) had two related projects: 1) CORK borehole observatory optical communications link and 2) High-Speed Optical (HSO) communications. These were engineering research projects designed to test free-water transmission of underwater optical communications. The CORK operations visited Hole857D in Middle valley, on the northern Juan de Fuca Ridge (dive 585) and recovered an optical communications unit that had malfunctioned. Data was downloaded from the CORK. Nothing was deployed. The HSO operations consisted of three ROV dives (587, 588, 589) that visited Main endeavor vent field and a ridge flank area (Pockmark). Real-time video data was successfully transmitted via an optical link through the water between the ROV and the Medea vehicles. No instruments were permanently deployed.

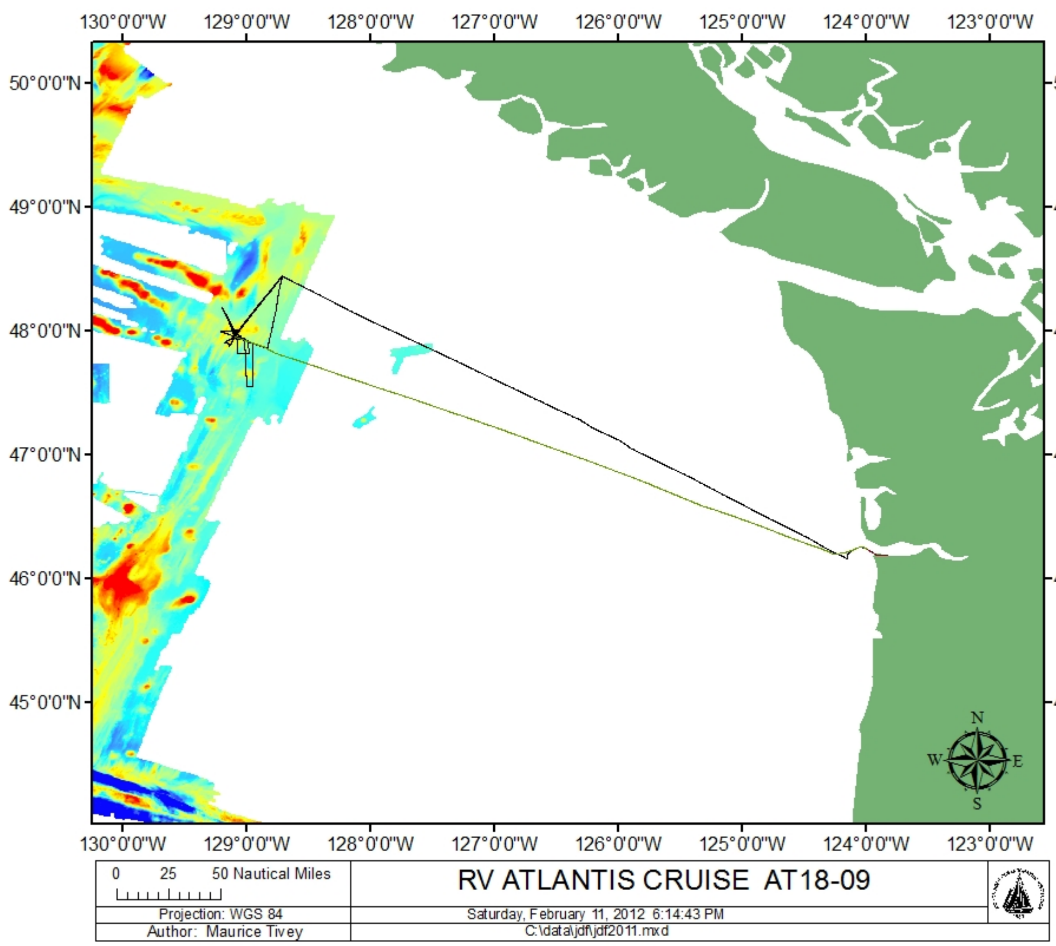

Figure 1. Map of RV Atlantis ship track from Astoria, Oregon to the CORK site and the Raven vent field site located on the Endeavour Ridge segment of the Juan de Fuca Ridge and subsequent return to Astoria.

CRUISE OBJECTIVES

The cruise was a combination of three different research programs and the operations were interleaved during the course of the Jason dive program.

Thermal Grid Experiment (Johnson, Hutnak, Tivey)
Approximately 10 dive days were assigned for the Thermal Grid experiment with lead PIs H. Paul Johnson, Maurice Tivey and Mike Hutnak to study the heat flux at the Raven hydrothermal vent field on the northern Endeavour Ridge of the Juan de Fuca midocean ridge spreading center in the northeast Pacific. The overall objective was to test the hypothesis that crustal fluid undergoes substantial horizontal sub-surface transit across the axial valley floor prior to discharge. A survey was designed to constrain the sub-surface structure of a high temperature vent system and to identify re-charge zones where seawater is entering into the crustal hydrothermal reservoir. The specific objectives of this project were to (1) deploy thermal blankets around the Raven vent field to measure the magnitude of thermal heat flux and to constrain patterns of hydrothermal circulation, (2) collect underway ROV Jason magnetic data to delineate the pattern of crustal magnetization and to relate that to subsurface alteration resulting from hydrothermal circulation (3) collect underway ROV Jason CTD data as a check on the variation in bottom water temperatures for thermal flux calculations, and (4) collect bathymetry data with the newly installed ship-based EM122 multibeam system including testing the full water column data mode.

CORK Optical Communications Project (Tivey, Farr, Ware)
The objective of this project was to install, test and operate an optical communication telemetry interface for a CORK observatory. This was the third year of the project and the second year of the field program. Approximately 3 dive days had been set aside for the CORK operations. The objective for 2011 was to recover an optical telemetry unit that had been installed at CORK 857D in Middle Valley on the northern Juan de Fuca Ridge. Prior to the instrument recovery, we planned to download the data that had been stored on the unit over the past year.

High-Speed Optical Communication Project (Farr, Ware, Bowen)
Approximately three dive days were allocated for testing a high speed optical communication link between Jason and Medea and Jason and a seafloor instrument. The objective was to test and demonstrate the transmission of real-time video data across the free-water optical link. The majority of the testing took place just south of the Raven vent field in the Main Endeavor vent Field (MEF) on the Endeavor Ridge.

BACKGROUND INFORMATION

Raven vent field

The Raven vent field is located on the 90 km long Endeavour Ridge segment of the intermediate-rate spreading Juan de Fuca Ridge system (Fig. 2). Endeavor Ridge features an elongate volcanic ridge with a central graben axial valley and hosts several major high temperature hydrothermal vent fields that are systematically spaced several kilometers apart (Delaney et al., 1992; 1997; Glickson et al., 2007; Kelley et al., 2012). These vent fields, from south to north, include Mothra, Main Endeavour vent Field (MEF), High Rise vent Field, Salty Dawg and Sasquatch (Kelley et al., 2012). While hydrothermal activity was initially thought to be limited to these five major vent fields (Wilcock and Delaney, 1996), it is now recognized that hydrothermal activity is more widely distributed with smaller and less active areas located between these major fluid emission sites (Johnson et al., 2002; Glickson et al., 2007; Clague et al., 2008; Jamieson et al., 2013; Kelley et al., 2012). The Raven hydrothermal vent field (Fig. 1) is an example of one of these small vent sites located ~400 meters north of MEF and ~1800 meters south of High Rise Field.

The Raven Field (Fig. 2, 3) was discovered in 2001 during an ROV survey of the near bottom geology and diffuse vent flux output (Johnson et al., 2002). The Raven Field is comprised of a central ~10 meter tall, largely inactive chimney complex directly adjacent to the western rift valley wall, with standing and toppled sulfide chimneys extending over to the western wall where active venting >200°C was located in 2001. Hydrothermal activity was found to extend along more than 100 meters south along this western wall (Johnson et al., 2002). In 2011, the area of >200°C venting had died down to low level diffuse activity, while active high temperature venting had shifted ~100 meters south along the rift valley wall (Hearn et al., 2013). Similar to the Main Endeavour Field, the Raven field lies within a region of reduced crustal magnetization (i.e., a magnetic burnhole) [Johnson et al., 2002; Tivey and Johnson, 2002; Tivey et al., 2014]. This association with the hydrothermal fluid emission site suggests the upper crust in these areas has been chemically and thermally altered by hydrothermal fluids [e.g. Tivey and Dyment, 2010]. The relatively isolated nature of the Raven vent field presented an opportunity to examine a vent field system that could be constrained by a single field program and potentially address universal questions regarding the geometry and extent of fluid recharge and discharge of hydrothermal systems.

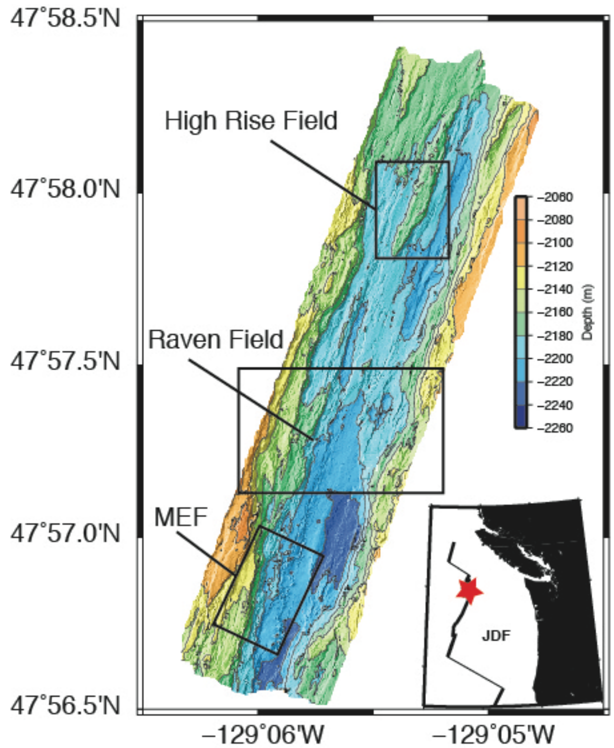

Figure 2. Location bathymetry map of Endeavour Ridge rift valley on the Juan De Fuca Ridge in the northeast Pacific showing the location of the Raven hydrothermal field just north of Main Endeavour Field (MEF) and south of High Rise vent field.

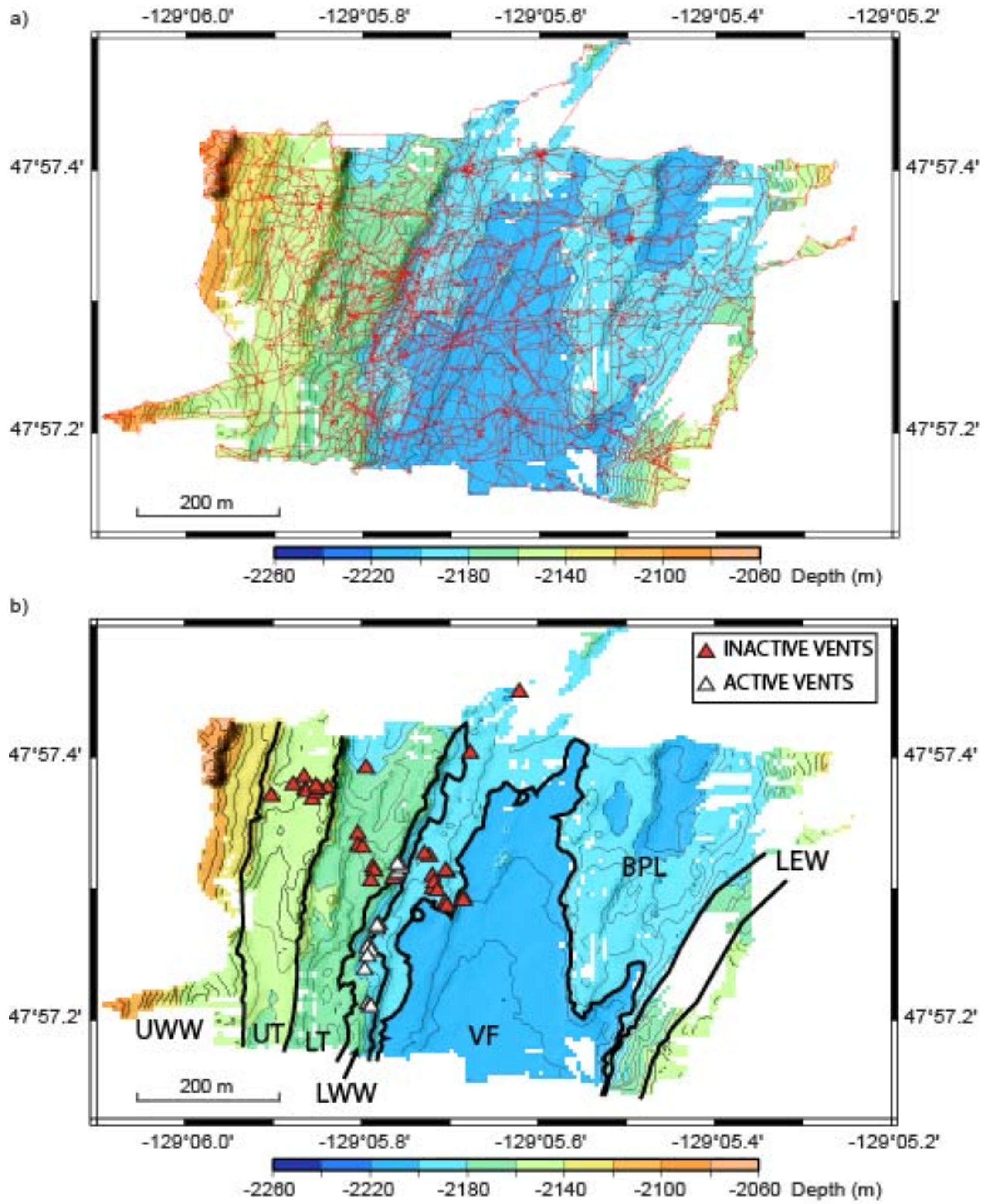

Figure 3. a) High resolution ROV Jason multibeam bathymetry map (SM2000 Johnson et al., 2002) of the Raven hydrothermal field area showing the Jason tracklines (red), which collected magnetic field and bathymetry data. Contour interval is 5 meters. b) Bathymetry map of the Raven vent field study area showing the location of the active (white triangles) and inactive (red triangles) hydrothermal vent sites and the major tectonic zones from west to east: Upper West Wall (UWW), Upper Terrace (UT), Lower Terrace (LT), Lower West Wall (LWW), Valley Floor (VF), Broken Pillow Lavas (BPL), Lower East Wall
(LEW). Contour interval is 5 meters.

METHODS

ROV Jason

ROV Jason (Fig. 4) is a ~30 HP scientific mission configured ROV with two full-function manipulators, a retractable sample basket capable of 200 lbs of samples, two swing arm baskets for additional payload, a CTD, a digital still camera, a three-axis vector magnetometer and multiple color high definition (HD) cameras. Jason is connected via a ~50m long neutrally buoyant tether to its fiber-optic cable junction vehicle, Medea (Fig. 5). Medea is the junction of the fiber-optic 0.680 cable from the ship. Jason was navigated using ultra-short baseline (USBL) and downlooking acoustic doppler velocity log (DVL). The DVL navigation provides a high data rate (typically 1Hz) position value but tends to drift. The USBL provides updates at a ~10 second rep rate and provides a position referenced to the ship's GPS unit. After the dive, the Jason USBL navigation is cleaned and edited and used as a set of fixed points to which the DVL navigation is fit. This re-navigated data was completed on board during the cruise by the Jason team. Table 1 notes the navigational net origins used during the cruise for the different dive sites.

Figure 4. ROV Jason being recovered on deck.

Other data collected by Jason include vector magnetic data, which is calibrated on each dive with a spin at mid-water depths (i.e. Tivey Twist). The north-seeking laser gyro system (Octans) on board the ROV provides an excellent vehicle attitude reference to calibrate the vector magnetometer against. Typical corrected noise levels of Jason magnetic calibrations were about +/-100 nT.

For the duration of the cruise Jason and Medea were outfitted with optical communication instrumentation (Fig. 5).

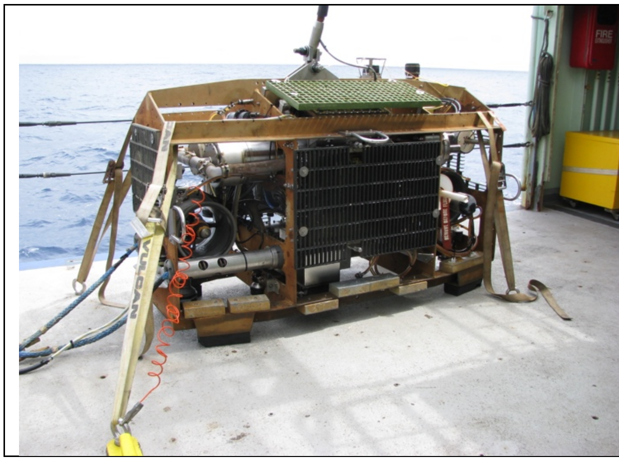

Figure 5. Medea vehicle that acts as the termination of the armored ship 0.680 cable and the junction box for the neutrally buoyant fiberoptic tether to the ROV Jason approximately 40 meters long. Medea carries cameras to look at the tether and down at Jason and also has a thruster to help maneuvering at depth.

Figure 6. Photo of optical communication device mounted on the rear of Jason for testing the free-water optical communication to Medea.

Thermal blankets

To measure the conductive heat flux in the axial rift valley around Raven vent field that features relatively thin to no sediment cover we undertook a dedicated survey using thermal blankets (Fig. 7.) developed at the University of Washington. A thermal blanket consists of a disk-shaped layer of open cell foam approximately 0.5 meter in diameter and 5 cm thick encased in a thin low permeability fabric shell as described in Johnson et al. [2010]. The thermal gradient within the blanket is measured using two Antares thermistors with a resolution of ± 0.001°C located on the top and bottom of the blanket mid-way across the diameter. Immediately after being placed on the seafloor, the bottom thermistor records an increase in temperature, which eventually reaches a stable value. The top thermistor records the time-dependent bottom water temperature directly above the blanket. Due to the small size, thermal blankets are easily manipulated using ROV Jason II, allowing for multiple station deployments for each instrument during a single dive.

Thermal blankets function as sensors by propagating the thermal gradient from the underlying rock into a material matrix of known thermal conductivity (λm, in units of W m-1K-1) over a fixed thickness (z), resulting in an internal thermal gradient from T_0 to T_1 therefore allowing for an estimation of heat flow, q (W m-2) using Fourier's Law:

$$q = \lambda_m \frac{T_1 - T_0}{z}$$

Figure 7. Photo of thermal blanket instrument. The instrument consists of a porous fabric covering a porous and pliable foam interior surrounded by a 17 inch diameter motorcycle inner tube filled with calcium chloride for weight with an additional lead weight ring. Two autonomous thermal sensors are mounted on each side of the blanket.

Figure 8. Thermal blankets loaded onto the front basket of Jason. It turns out that these need to be very securely down for launch and recovery.

Ship-based Science programs

EM122 Multibeam

In early 2011, the RV Atlantis was outfitted with a new Kongsberg EM122 (12 khz) multibeam system. The multibeam unit is a full ocean depth system, 1 degree by 1 degree resolution with 288 beams and 432 soundings per swath and a 6 times water depth swath width. The system also has the capability to display and record water column data. We used this feature throughout the cruise to image hydrothermal plumes in the water column above the vents sites on Endeavour Ridge.

The freely available MBsystem software package was used to process the data into data grids. Grids were made at 20 meter grid cell resolution. Summary maps of the outbound transit and study area are shown in Figures 8 and 9.

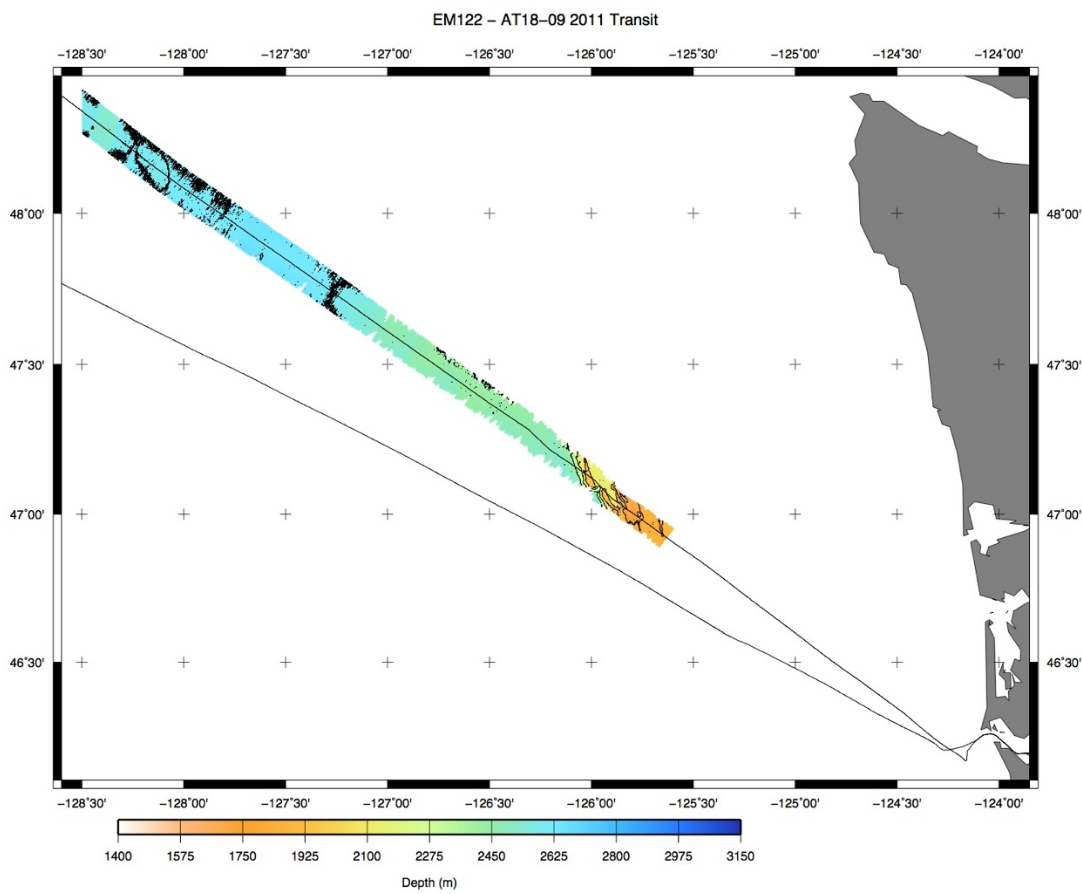

Figure 9. Map showing EM122 multibeam data collected during outbound transit for cruise AT18-09 leaving and returning to port of Astoria, Oregon.

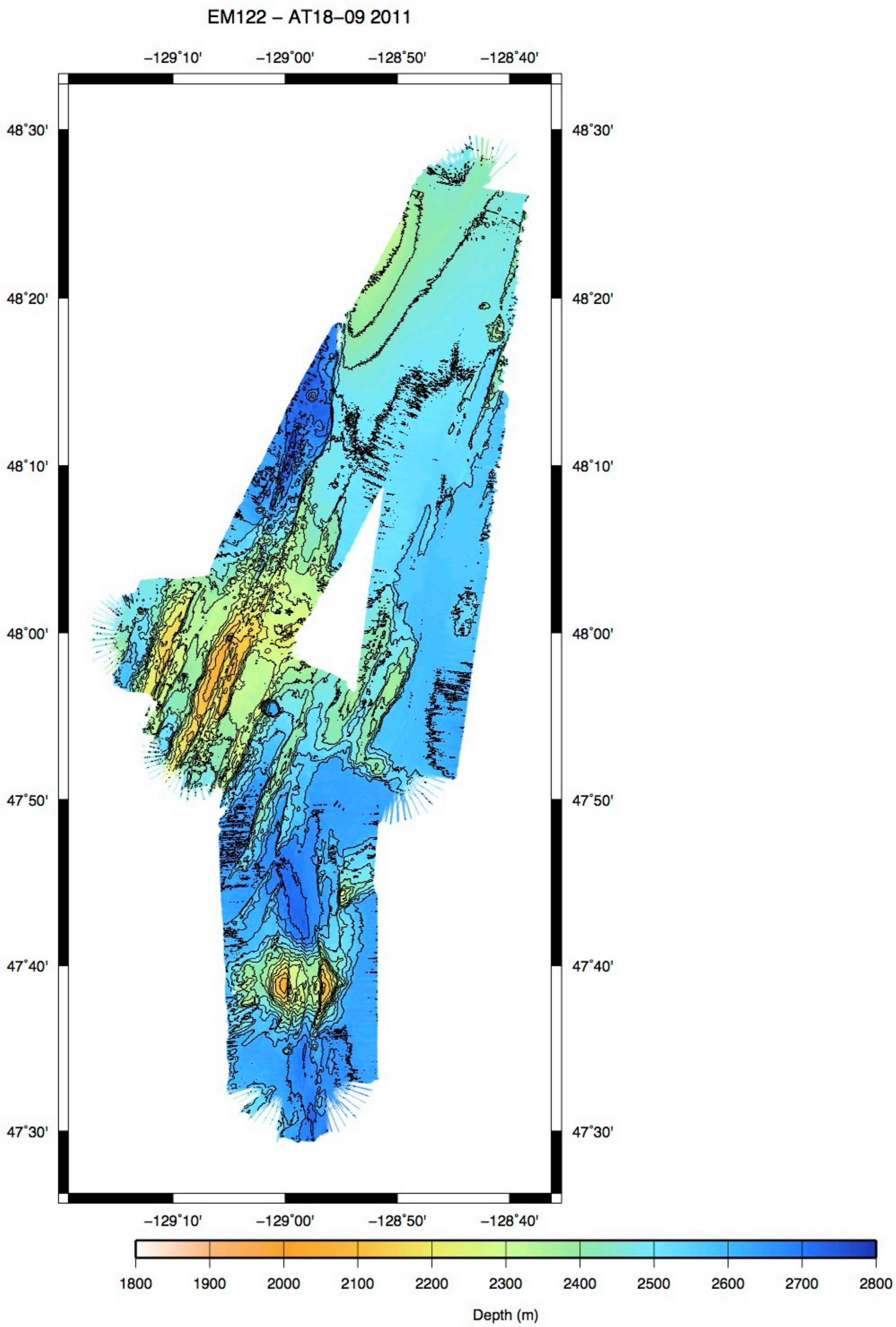

Figure 10. Summary map of EM122 multibeam data collected during the AT18-09 cruise over the Endeavour, Spilt Seamount and Middle Valley regions of the northern Juan de Fuca Ridge. Contour levels are 200 m interval.

CTD Data

The CTD program was run by the University of Washington science party except for the first two CTDs, which were for the optical communication tests at the CORK site using optical instruments mounted on a CTD frame (Fig. 11). A total of 12 CTD deployments were made on the cruise. The last two CTDs were tow-yos. Table 3 lists the CTD deployments and locations.

Figure 11. CTD rosette with the Niskin bottles removed and the optical communication hardware installed. The CTD instrument remained installed. The optical communications instrumentation used the SDSL communication protocol to allow for real-time comms with the optical system.

ADCP Data

The data were collected but not processed or used during the cruise for this science program.

Magnetic Drifter Experiment

During this cruise CoPI Tivey tested a magnetic surface drifter instrument for a small funded NSF program (NSF OCE0961163). The prototype magnetic surface drifter consists of a commercial Clearwater surface drifter typically used for physical oceanography experiments modified with a small Applied Physics System (model APS-1540) digital 3-axis fluxgate magnetometer. The drifter has a GPS transmitter and Iridium satellite communication interface. The drifter records 3-components of the Earth's magnetic field and GPS position data every 20 minutes, which are stored on board the drifter. The drifter then communicates every 4 hours with the iridium satellite network and sends the saved data to a server at Woods Hole Oceanographic Institution. The data is decoded and uploaded to a web accessible site. The magnetic drifter was deployed from the ship just east of the Endeavour on 47 deg. 55.986'N 129 deg. 2.626'W and was successfully recovered 6 days later 16.5 n. miles after being deployed west of the spreading axis.

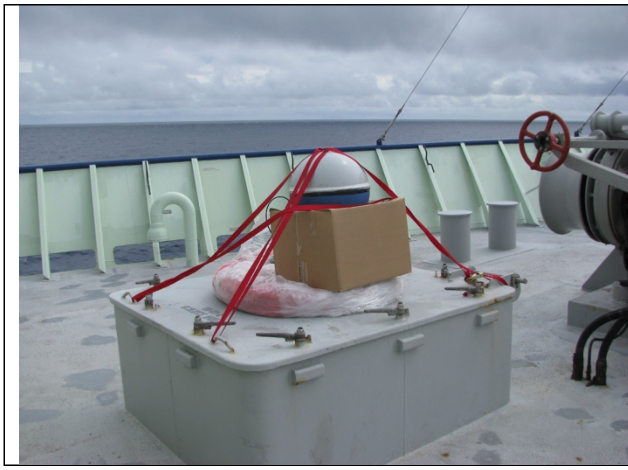

Figure 12. Magnetic drifter on forward deck testing satellite (Iridium) communications.

Figure 13. Magnetic drifter at sea prior to being recovered.

Figure 14. Drogue of Magnetic drifter being recovered.

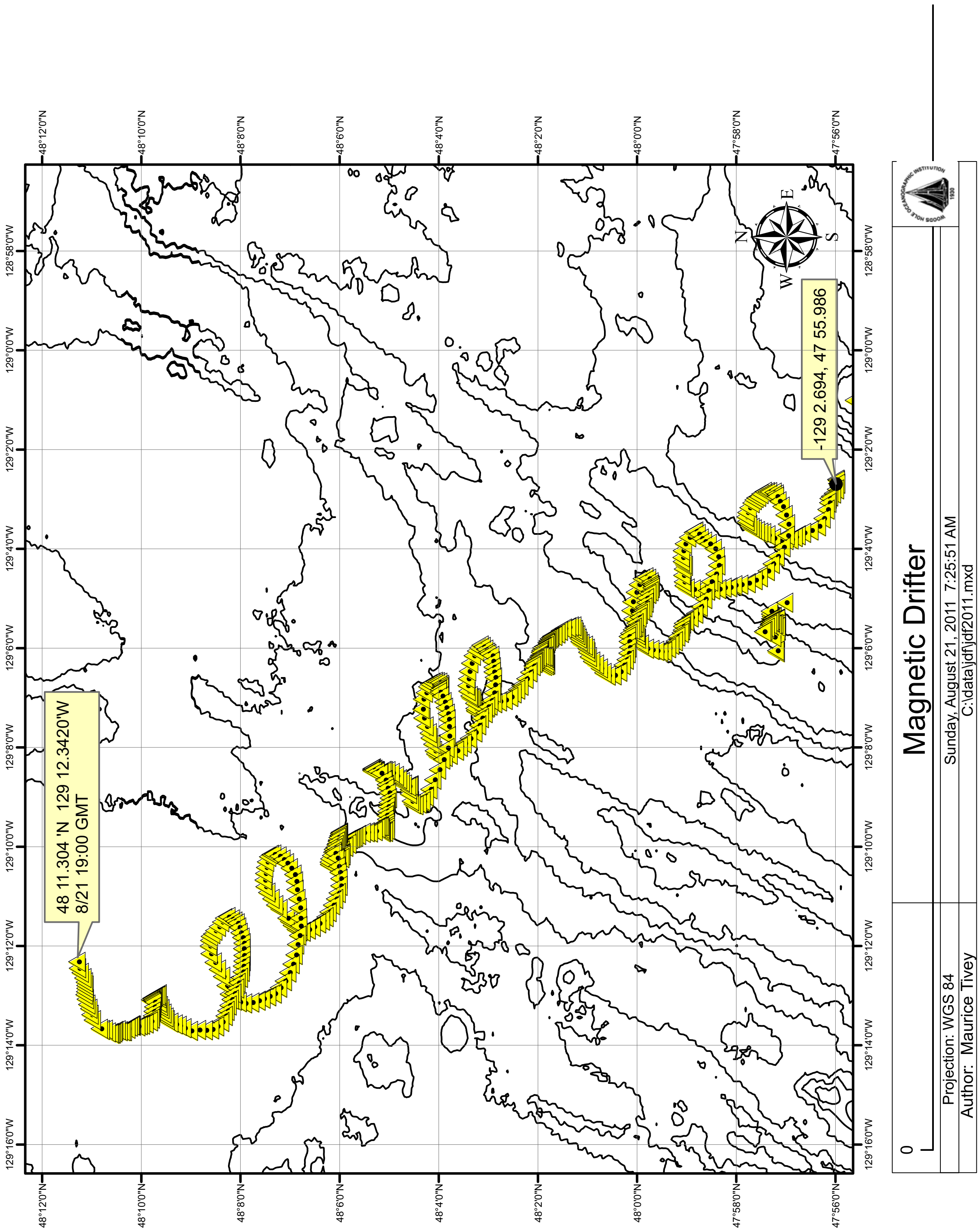

Figure 15. Map showing the track of the Magnetic drifter : deployment and recovery

INITIAL RESULTS

ROV Jason and tow vehicle Medea were launched a total of 9 times during this cruise (see detailed dive maps at the end of the report). The first dive (584) was an aborted at 100 m depth due to a ground fault. The following 8 dives were successful (Table 2). The dives were conducted at four different locations. The first location was the CORK Hole 857D site in Middle Valley on the northern Juan de Fuca Ridge spreading center. The second location was the Raven vent field on Endeavour Ridge. The third site was the “Pockmark“ site located on the flanks of the Endeavor ridge. The final location was Main Endeavour vent field just south of Raven on the Endeavor Ridge.

Photos from CORK Optical Communications instrument recovery from CORK 857D.

Figure 16. Photo of CORK 857D with optical communication sled plugged into the CORK electronics

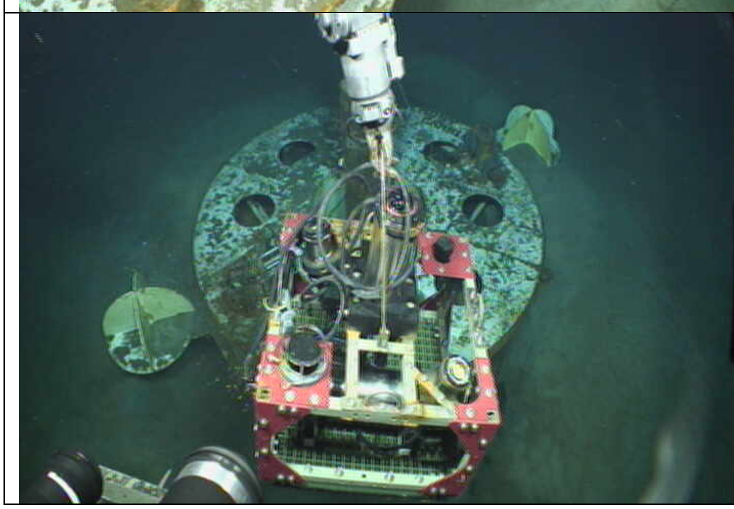

Figure 17. Recovery of the optical communication sled after unplugging from the CORK.

Figure 18. Photo of end cap on optical comms pressure housing showing corrosion around bulkhead connector

Figure 19. Photo showing a bubble in the emitter pressure housing indicating a leak.

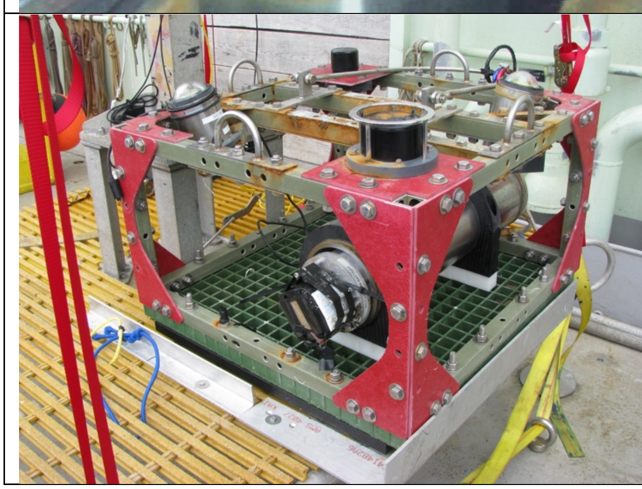

Figure 20. Photograph of the recovered CORK optical communication equipment. The instrument was deployed at Cork 857D for approximately 1 year. Note rusting on portions of the framing.

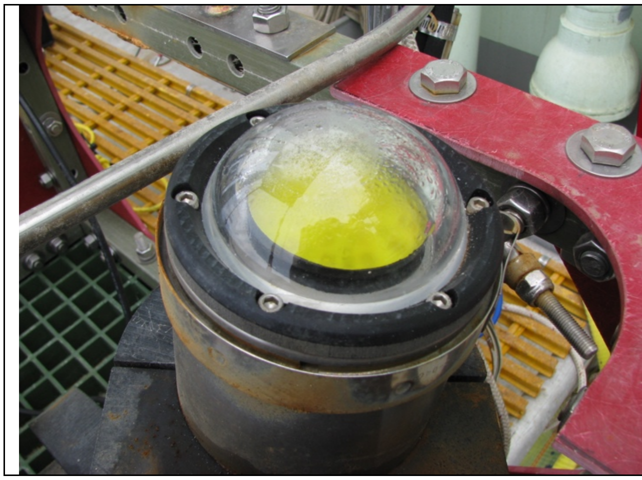

Figure 21. One of the optical emitters showing internal fluid on the inside of the glass dome indicating that the instrument had flooded.

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Table 1. Navigation net origin – AT18-09

UTM zone = 9

Net	Lat (N)	Long (W)	Lat (Dec. Degrees)	Long (Dec. Degrees)
Origin CORK 857D	**48° 25.00**	**128° 44.50**	**48.416667**	**128.741667**
Origin Raven	**47° 53.63400**	**129° 9.90000**	**47.893900**	**129.165000**

Table 2. JASON Dive Statistics – AT18-09

(Time in GMT, for reference Local time is GMT-7)

DIVE	Start/launch	On bottom	Off bottom	End/On deck	Area	Bottom Duration	Dive Duration
J2-584	8/8/2011 03:02	ABORTED	AT 100 m	8/8/2011 04:00	CORK 857D	N/A	N/A
J2-585	8/8/2011 15:08	8/8/2011 17:03	8/9/2011 06:07	8/9/2011 07:25	CORK 857D	13:04:00	16:17:00
J2-586	8/9/2011 20:47	8/9/2011 22:22	8/12/2011 16:39	8/12/2011 18:13	Raven	66:17:00	69:26:00
J2-587	8/14/2011 06:57	8/14/2011 08:29	8/16/2011 02:52	8/16/2011 04:18	Pock Mark	42:23:00	45:21:00
J2-588	8/16/2011 17:02	8/16/2011 18:44	8/17/2011 11:01	8/17/2011 12:22	MEF	16:17:00	19:20:00
J2-589	8/18/2011 03:06	8/18/2011 04:59	8/18/2011 14:05	8/18/2011 15:20	MEF	09:06:00	12:14:00
J2-590	8/19/2011 03:06	8/19/2011 04:41	8/21/2011 03:02	8/21/2011 04:08	Raven	46:21:00	49:02:00

J2-591	8/22/2011 17:05	8/22/2011 18:53	8/23/2011 21:19	8/23/2011 23:45	Raven	26:26:00	30:40:00
J2-592	8/24/2011 00:09	8/24/2011 01:20	8/24/2011 01:35	8/24/2011 02:49	Raven	00:15:00	02:40:00
TOTAL					Totals: (hrs)	220:15	245:00

Table 3. CTD Deployments – AT18-09

(Time in GMT, for reference Local time is GMT-7)

file name	Date/Time	lat degree	decimal minute	lon degree	decimal minute	annotations
at1809001	8/7/2011 15:08	48	26.51	-128	42.65	Cork
at1809002	8/7/2011 18:15	48	26.51	-128	42.65	Cork
at1809003	8/9/2011 16:59	47	55.5	-129	1	PockMark (PM)
at1809004	8/14/2011 02:49	47	55.9	-129	2.7	NW of PM
at1809005	8/16/2011 05:47	47	55.97	-129	0.33	NE of PM
at1809006	8/16/2011 08:42	47	56.4	-129	4.22	Transect west of PM 1
at1809007	8/16/2011 10:56	47	56.72	-129	5.2	Transect west of PM 2
at1809008	8/16/2011 13:07	47	57	-129	6	Transect west of PM 3
at1809009	8/18/2011 00:14	47	57.18	-129	5.59	Endeavor segment
at1809010	8/18/2011 23:58	47	58.42	-129	4.92	High Rise Field
at1809011	8/21/2011 06:34	47	58.64	-129	5.88	north west of High Rise Tow-Yo
at1809011a	8/21/2011 07:49	47	58.59	-129	5.67	north west of High Rise Tow-Yo
__________b	8/21/2011 08:18	47	58.51	-129	5.33	north west of High Rise Tow-Yo
__________c	8/21/2011 08:32	47	58.47	-129	5.16	north west of High Rise Tow-Yo
__________d	8/21/2011 08:57	47	58.42	-129	4.93	north west of High Rise Tow-Yo
__________e	8/21/2011 09:14	47	58.41	-129	4.92	north west of High Rise Tow-Yo
__________f	8/21/2011 09:22	47	58.41	-129	4.92	north west of High Rise Tow-Yo
at1809012	8/21/2011 10:21	47	58.41	-129	4.92	search for acoustically imaged plume and Plume search survey
at1809012a	8/21/2011	47	58.41	-129	4.92	search

	11:27					
__________b	8/21/2011 11:56	47	58.39	-129	4.92	search
__________c	8/21/2011 12:27	47	58.37	-129	4.95	search
__________d	8/21/2011 12:59	47	58.37	-129	4.95	search
__________e	8/21/2011 13:18	47	58.38	-129	4.99	search
__________f	8/21/2011 13:31	47	58.41	-129	4.95	search
__________g	8/21/2011 13:52	47	58.42	-129	4.94	search
__________h	8/21/2011 14:17	47	58.34	-129	4.93	search
__________i	8/21/2011 14:36	47	58.34	-129	4.89	search
__________j	8/21/2011 15:09	47	58.36	-129	4.94	search
__________k	8/21/2011 15:33	47	58.41	-129	4.93	search
__________l	8/21/2011 15:50	47	58.45	-129	4.88	search
__________m	8/21/2011 16:07	47	58.49	-129	4.9	search
__________n	8/21/2011 16:24	47	58.46	-129	4.94	search
__________o	8/21/2011 16:24	47	58.46	-129	4.94	search
__________p	8/21/2011 16:58	47	58.36	-129	4.99	search
__________q	8/21/2011 17:14	47	58.36	-129	4.92	search
__________r	8/21/2011 17:30	47	58.4	-129	4.88	search
__________s	8/21/2011 17:50	47	58.49	-129	4.78	search
__________t	8/21/2011 18:06	47	58.51	-129	4.86	search
__________u	8/21/2011 18:23	47	58.52	-129	4.93	search
__________v	8/21/2011 18:38	47	58.46	-129	5.01	search
__________w	8/21/2011 18:56	47	58.42	-129	5.06	search
__________x	8/21/2011 19:19	47	58.37	-129	4.98	search
__________y	8/21/2011 19:42	47	58.33	-129	4.89	search
__________z	8/21/2011 20:02	47	58.4	-129	4.83	search
__________aa	8/21/2011 20;21	47	58.44	-129	4.78	search

UNDERWAY LOG

Note: Local time: 7 hrs behind GMT

GMT	Local Time	Comments
15:13 jd=218 Aug 6	08:13	Departed Astoria In transit all day Start running the multibeam system once we hit 1000 m deep water.
13:00 jd=219	06:00	Arrive on station at CORK 857D site 48 deg 26.5086565'N 128 deg 42.6528842'W (Note: location is corrected position from 2010 Alvin location and not the published location in the ODP volume)
15:12	08:12	CTD#1 – AT1809001 48 deg 26.51'N -128 42.65'W At CORK 857D site using the optical comms gear mounted on the CTD frame. No success in waking up CORK – something is wrong. Stop the ship's multibeam in case of interference – no difference.
16:28		Decide to bring CTD back up on deck
17:12		CTD at 50 m and then on deck. Replace Benthos acoustic modem on the CTD with the older model modem we had mounted on Jason. Redeploy CTD
18:14		CTD#2 - AT1809002 48 deg 26.51'N -128 42.65'W Redeploy CTD at CORK 857D site again Log file Obs7508071521.csv
19:08		Try acoustic modem commands again to Lander on CORK. Still no response. Something is wrong with lander. Bring CTD back up
GMT	Local	Comments

	Time	
20:00		CTD back on deck Just heard we have a problem with the ship's bow thruster Also Jason has a problem with Kraft manipulator. This will delay going in Jason. Originally scheduled to go in at 2 pm after discussion with Tito but bow thruster still has continuing issues.
03:02 08/08 Jd 220	20:02	START JASON DIVE 584 Launched slightly offset from CORK 857D site at a heat flow station PGC86-2c 48 deg 26.26.5398'N 128 deg 42.6900'W We have optical comms gear on board including high o/p rcvr and emitter on basket plus 2 thermal blankets and heat flow probe.
		At 100 m depth we have ground fault on both heat flow probe and optical comms gear. Will need to abort dive and recover Jason and fix ground fault problems.
04:00	21:00	END JASON Dive 584 Jason back on deck Tito (Expd Ldr) says we cannot launch again until next morning at 08:00 am local. We will do a multibeam survey in the meantime.
04:00	20:00	Begin multibeam survey Transit down to start position and then survey at 6 kts. 47 deg 51.500'N 128 deg 50.00'W 47 deg 59.833'N 129 deg 13.00'W 48 deg 00.5'N 129 deg 3.5'W 47 deg 54.0'N 129 deg 7.5'W 47 deg 33.83'N 128 deg 58.0'W 47 deg 51.5'N 128 deg 58.0'N
	07:00	Completed portion of multibeam survey
GMT	Local	Comments

	Time	
15:15 08/08	08:15	Launch JASON START JASON Dive 585 Launch target is at CORK 857D site PGC86-2c heatflow target: 48 deg 26.5398'N 128 deg 42.6900'W No grounds faults on optical gear or other science gear so continue on down.
		Deployed two thermal blankets, N and L at landing site. Near target PGC86-2c
		Transited over to CORK 857D to inspect the Optical Lander. Sitting in front of the Lander on the CORK. i) Lander did not respond to any acoustic commands ii) One emitter has a bubble in it iii) A connector of the main 'lander' housing has obvious corrosion. Not sure if it means the housing, that has batteries in it, is flooded. iv) We will need to recover by elevator to minimize risk of explosion to both Jason and deck.
		Decide carry out other optical tests of the Jason-medea optical video transmission Turn off Jason lights Turn off Medea lights Turn on Jason optical modem lights Turn on medea optical modem lights Begin transmitting live video using the optical modem between Jason and medea. Carry out a series of tests of optical video transmission system
		Come back to CORK Unplug the Optical lander ODI connector from the CORK and plug it into a dummy ODI.
		Plug Jason ODI into the CORK
GMT	Local	Comments

	Time	
		Begin process to download the CORK data Following instructions: Use the HP mini computer booted into linux Run Konsole cd AT18_09 mlterm –l 11p857d_1.log >menu Started download File: 11p857d.raw but the download baud rate was 19200 and so the download was going to take 17 hrs. Killed download (using esc). Try and reset download baud rate to 230400 On menu Hit I for info: reports 235368 sectors of 1000944 used. On menu Hit G to get settings - save to file 'settings' Edited 'settings' file to set download rate to 230400. Hit W to write 'settings' to CORK Hit I again for info Hit D for download File: 11p857d-1.raw Download time is only 1 hr 37 mins Finished downloading 235368 sectors downloaded. Did NOT reset/check clock or time offset on CORK Did NOT clear memory on CORK We will be back to the CORK and could repeat download and then clear memory. Disconnect Unplug ODI
		Setup to pick up lander and carry over to elevator Place lander on elevator. Go back to thermal blanket sites and do a heat flow probe station.
GMT	Local	Comments

	Time	
		Finished the heat flow probe station. Had a major power failure (locally). Jason and Medea and dead in the water. We are able to reboot and come back up. Recover heat flow probe and then the blankets. Had another power loss – Troubleshooting found a knicked power cable in the van jetway. Power is restored and we head over to elevator to release it.
06:00 08/09	23:00	Jason released elevator with CORK Optical Lander
06:06	23:06	Jason dropped weights and is on the way up.
07:00	00:00	Jason on deck END of JASON DIVE 585 Elevator still coming up
08:00	01:00	Elevator with CORK lander is on surface. We suspect it has flooded housings including the battery housing. We will track it for two hours before bringing on deck.
10:00	03:00	Bring Elevator on deck safely. Can see emitter housings have flooded. Unscrew a connector on battery housing and water seeps out, not under pressure.
11:00	04:00	Begin transit south to begin a short multibeam survey over the Endeavour ridge axis. 1 47 51.50'N -128 58.00'W 2 47 33.50'N -128 58.00'W 3 47 33.50'N -129 01.00'W 4 47 58.00'N -129 01.00'W 5 48 00.50'N -129 03.50'W 6 47 54.00'N -129 07.50'W Only do the last waypoints due to time constraints wp5 to wp 6.
GMT	Local	Comments

	Time	
	08:00	CTD at1809003 47. 55.50'N -129 1.00'W This was done in the flank "pockmark" area Found possible temperature anomaly in caldera.
20:00 08/09	13:00	Launch JASON DIVE 586 At Raven site !3 thermal blankets are loaded on Jason : 6 in swing arms and 7 on front basket. As Jason is launching the 7 basket blankets slip off and float away!!! WE have LOST 7 of 13 blankets. We recover Jason back on deck. Decide to continue on with the program.
20:47	13:47	Launch JASON a second time DIVE 586 Going down.
22:22		Approaching bottom – will deploy the first 6 blankets and then a geology survey and then an optical comms test of Jason-Medea video, followed by a near-bottom magnetics survey over the Raven central area.
06:06 08/10 Jd 222	23:06	Start of Jason mag survey
12:00	05:00	End of Jason mag survey
		Redeploy blankets for second batch of measurements
		Find 4 of the lost blankets
		Find 2 more of the lost blankets
		Found final lost blanket – now have all 13.
		Continue blanket deployments
		Start second mag survey
		End second survey
		Recover all blankets
		Jason surfacing
18:13 08/13		Jason on deck End of JASON DIVE 586
GMT	Local	Comments

	Time	
02:38 08/14	17:38	Launch elevator at Pockmark dive site with 8 blankets 47 deg. 55.98721'N 129 2.69639'W
		Deploy Tivey magnetic drifter at same location as elevator 47 55.986'N -129 2.694'W,
		Carry out a CTD just outside of the Pockmark Location: CTD at1809004 47 55.90'N 129 2.70'W
07:00	00:00	Launch Jason and Medea START JASON DIVE 587 POCKMARK area. 47 deg. 55.98721'N 129 2.69639'W Thermal blankets, heat flow probe and magnetometer survey along with optical lander tests
		Jason on bottom
08:46		Deploy Optical lander (disco ball) near the elevator and do initial sanity tests 47 deg. 55.9938'N 129 2.6831'W
10:00		Test video from lander to Jason over optical link Can see Jason in video!
10:15		Put optical lander to sleep and go and deploy the blankets
		Finish thermal blanket deployments and return to elevator
20:13 08/14		Begin optical tests at the lander. Range tests with 5 different colored light sources, cyan, blue, green, white and violet.
11:07 08/15		Finish up optical testing. Go and recover thermal blankets
02:30 08/16		Recover lander
02:48		Release elevator
04:19 08/16		End of JASON DIVE 587
GMT	Local	Comments

	Time	
		Ship operations : 4 CTDs AT1809005 47 deg 55.97'N 129 0.33'W AT1809006 47 deg 56.40'N 129 4.22'W AT1809007 47 deg 56.72'N 129 5.20'W AT1809008 47 deg 57.00'N 129 6.00'W
16:43 8/16		Launch elevator for Jason dive with just weights on it Just to south east of Jason launch site. Elevator drifted towards the south east by about 100 m
17:02 08/16	10:02	Launch Jason at Main Endeavour Field START JASON Dive 588 47 deg 56.8333'N 129 5.8333'W Objectives are to test different light geometries: Toroid, focused and lambertian Do realtime Jason video transmission between lander and Jason. The focused beam emitter is not encoding data (it is just putting out light) so it is on limited use.
18:44 08/16	11:44	Jason on bottom
19:37 08/16		Deploy lander 47 56.827620'N / 129 5.813180' W and go to elevator to pickup weights
20:53 08/16		Back to lander and start doing range tests of the different types of emitters
GMT	Local	Comments

	Time	
		Finished range tests. Now go over to vent areas to look for a smoky environment to test range and attenuation plus a place to do video transmission. We are carrying the lander and the weights – vehicle pitch is 24 degrees. Head first to S&M and the Milli-Q but not much luck in terms of vigorous activity. Move over to Peanut, Sully. Again not much luck, some black smoke but no place to set down lander – terrain too rough. Decide to head north to Grotto/Dante/Lobo area Fly over at 25 m altitude. Find the Butterfield RAS instrument with floats
		Try looking for smokers and find both Dante and Grotto have good black smokers but are ais too rough to deploy. We deploy lander near a small vent (TP) and illuminate vent with the lander. We carry out live video transmission from the lander to Jason on an optical link displaying Jason in the video!
		After video tests we try and do a range test with smoke in the way. We put Jason to the west of the Lobo vent structure and send optical comms data back to the lander.
11:00 08/17	04:00	Optical tests are complete. We recover the lander onto the basket. We will end the dive here and leave the elevator down for now. Jason is on the way up
12:23 08/17	05:23	Jason on deck END of JASON DIVE 588

GMT	Local Time	Comments
		Ship operations – do an EM122 survey of Endeavour Ridge axis to try and image hydrothermal plumes with the water imager function. Line1 47 53.0'N 129 08.3'W to 48 00.5'N 129 03.5'W line2 – High Rise 47 59.04'N 129 06.24'W to 47 57.48'N 129 02.64'W line3 – Main Endeavour 47 56.28'N 129 03.48'Wto 47 57.84'N 129 07.08'W line4 – Mothra 47 56.28'N 129 08.10'W to 47 54.72'N 129 04.50'W Run the lines at 2kts
		CTD AT1809009 47 57.18'N 129 05.59'W
03:04 8/18	20:04	Launch Jason at MEF for second Optical comms testing. START JASON DIVE 589 Launch location (at weights where we left them yesterday) 47 deg. 56.9703'N 129 deg. 05.8763'W Dive arrived back at the weights and we set up the lander at the same spot at MEF adjacent to vents TP and Dante. We then resumed optical comms testing of live video connection from the lander to Jason imaging Jason adjacent to the vents.
12:31		Finished optical testing

		Pick up the lander
GMT	Local Time	Comments
12:38		Head over to the elevator
14:01		Release the elevator
14:05		Jason is coming up
15:21		Jason on deck END of JASON DIVE 589
		With ship go off and do a 3.5 Khz survey: 47 deg 57.00 N 129 03.5 W to 47 deg 55. 5 128 59.5'W at 4 knots. Then transit at transit speed to next EM122 and 3.5 kHz line at: 47 deg 49.0 N and 129 04.0 to 47 deg 49.0 and 128 deg 52.0 at 4 knots. Survey High Rise Vents with EM122
23:00 08/18	16:00	Launch elevator with all 13 of the thermal blankets at Raven field: 47 deg 30.0'N 129 deg 05.65 Elevator drifted to the northwest.
		CTD cast ??? (coordinates 47 deg 58.4220'N 129 deg 04.9380'W)
03:03 08/19	20:00	Launch Jason START JASON DIVE 590 47 deg 30.0'N 129 deg 05.65
04:46 08/19		Jason on bottom, elevator is in sight – location of elevator: 47 57.394620 N 129 5.687214 W Start blanket unloading. Store several blankets on the seafloor to help with cooling off. Remaining blankets are loaded onto Jason and begin deployment

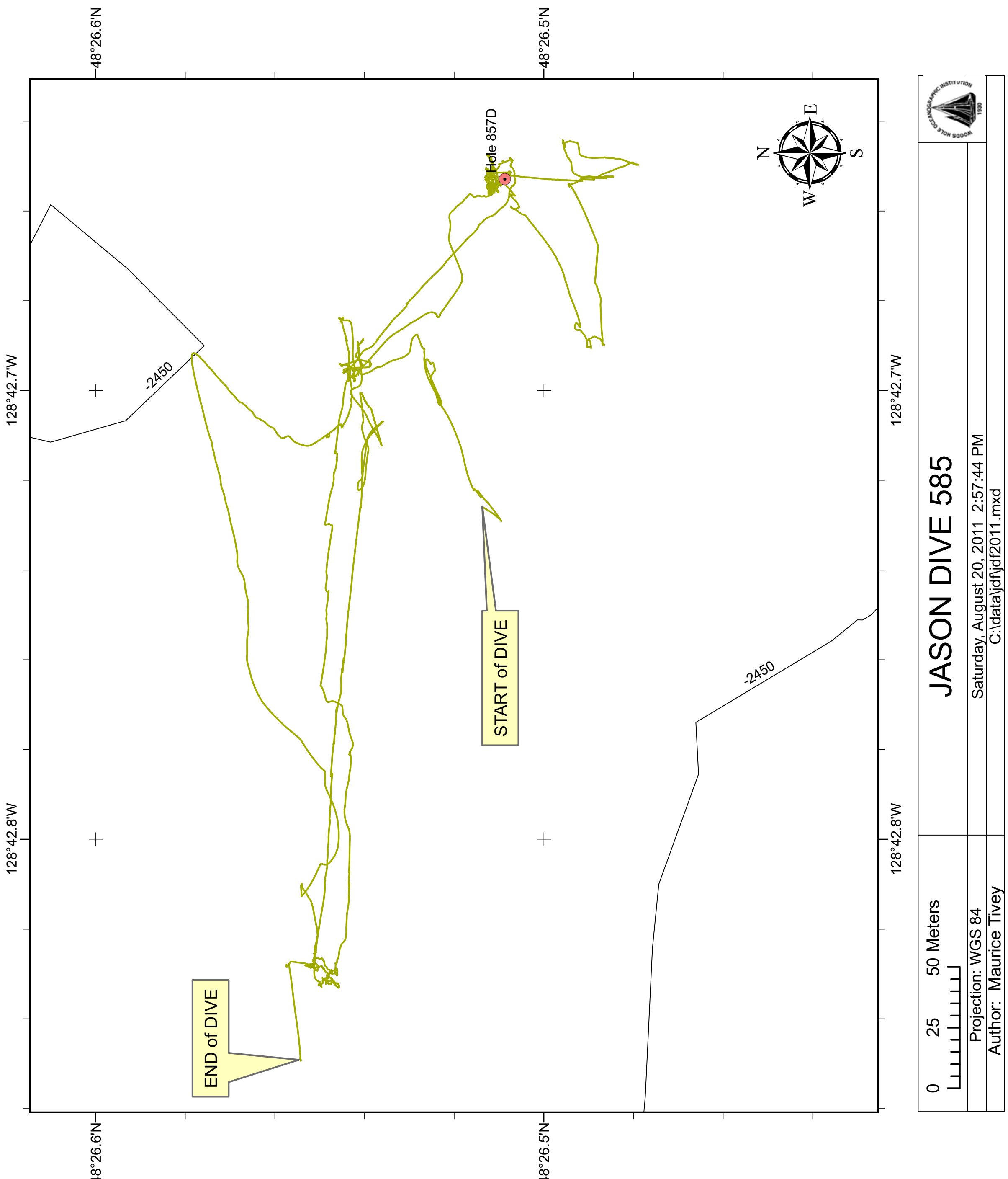
GMT	Local Time	Comments
		Because of an approaching squall the Exp. Ldr requests that Jason be recovered prior to the end of the science mission. Jason has been having thruster problems. Squall is expected to hit late Sat night early Sunday and then dissipate quickly.
03:02		Jason off bottom and coming up. We will leave the blankets and elevator down. We plan to come back after the storm has passed later on Sunday
04:09 08/21		Jason on deck END JASON DIVE 590
		Ship operations CTD and EM survey… EM122 line at 1kt from: 47 58.200'N-129 04.975'W to 47 58.600'N -129 04.717'W Then head down to: 47 58.416'N -129 04.596'W and hold position in DP and do a spin in place over 30 minutes (12 degrees per minute). Then to: 47 58.200'N -129 04.000'W at cruising speed where we will lower the CTD tow-yo and head to: 47 58.416'N -129 04.920'W at 1kt. At this location we will spend some time locating the hydrothermal plume we are seeing in the EM122. Time permitting we would like to continue the tow-yo to 47 58.644'N -129 05.874'W

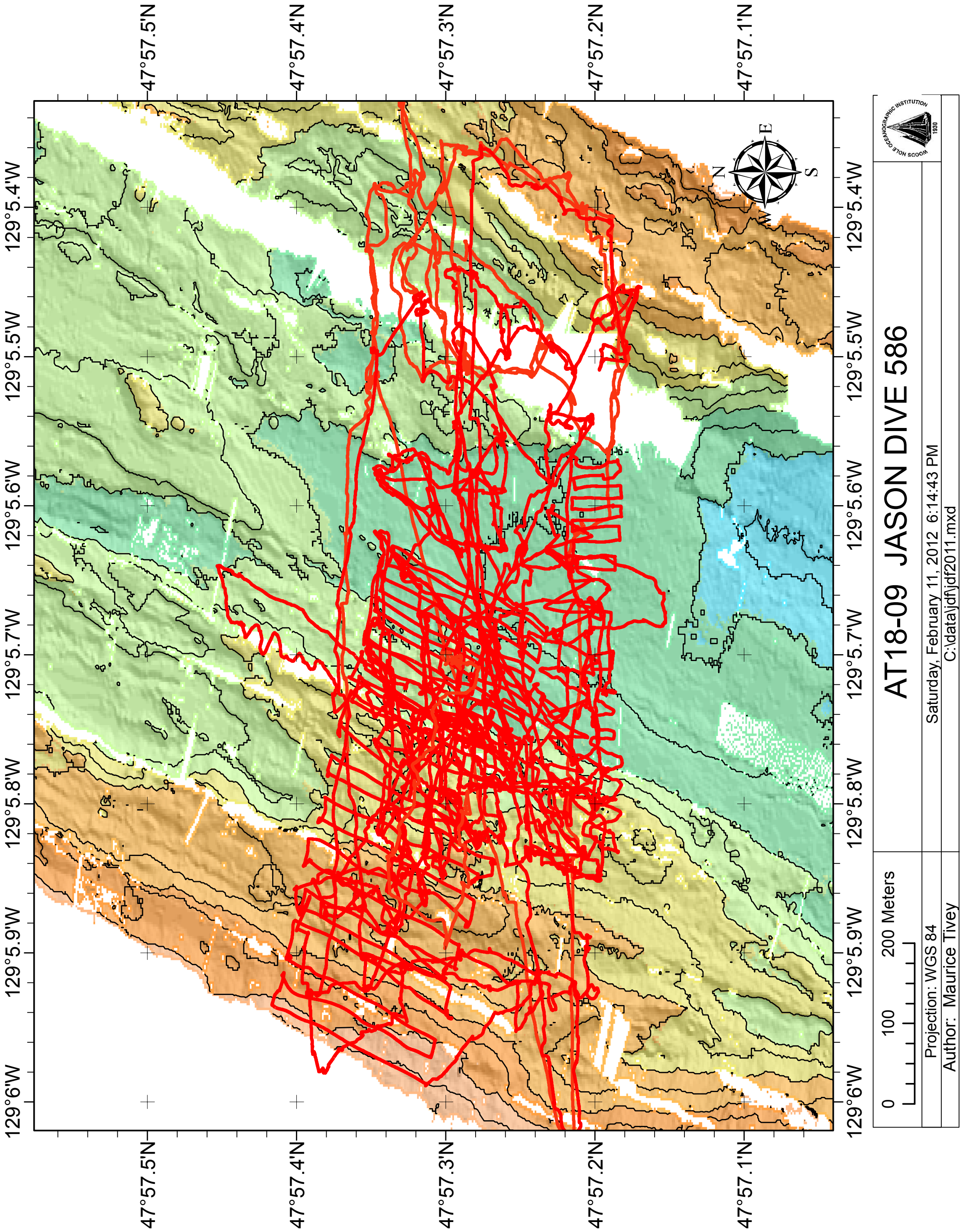
GMT	Local Time	Comments
23:30 8/21		Maggie drifter successfully recovered 48 11.256'N 129 12.006'W
		We then transit back to Raven dive site ready for dive the following morning – no other science operations.
17:05 8/22		Launch Jason at Raven site where weights were left. START JASON DIVE 591 47 57.414'N 129 5.602'W
18:53 8/22		Jason on bottom
19:16 8/22		Deploy optical lander 47 57.411767'N 129 5.597293'W depth 2194 m
19:22		Go and pick up weights nearby,then fly to elevator to pick up more weights.
19:47		At elevator to pick up more weights
19:57		Go and pick up 9 blankets starting with L-16
21:17 8/22		Now head to the western flank of the ridge to deploy in a line out to old crust.
14:41 8/22		Start deploying the blankets starting with O18
02:50		Finish blanket deployment and head back to lander site. We will first go and 'scope out" the high temperature chimneys for potential video tests using optical coms. First site is not that exciting move south Shimmering site 2
04:24		At shimmering site 2 – original 199C vent structure was destroyed but bi bushes of tube worms present and shimmering water. We do some Jason video here with the optical comms.
05:29 8/23		Head back to optical lander for optical tests
07:12		Go and get blanket K to use as a prop for Jason-Medea optical lander video.

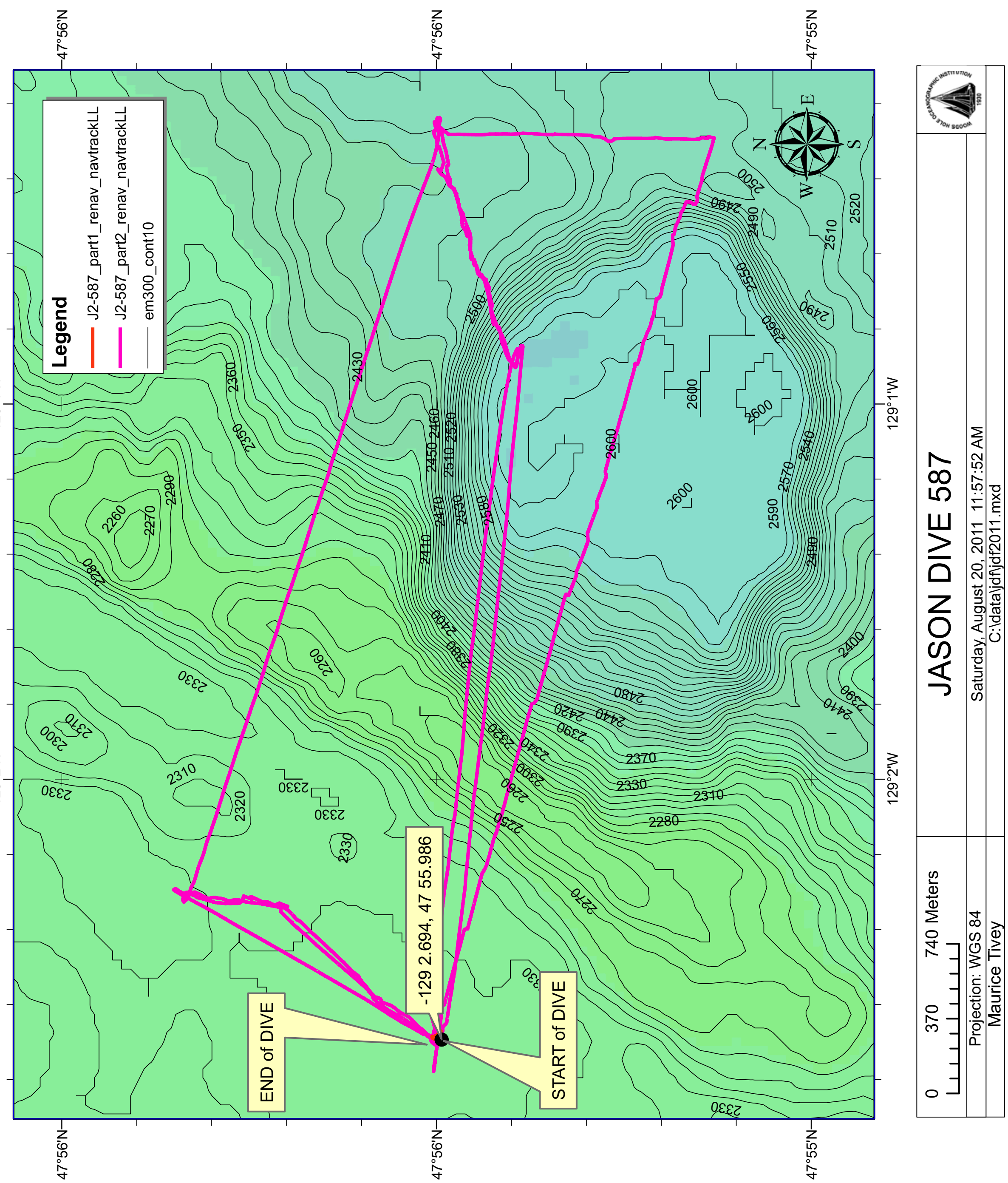
09:58 8/23		Finish optical comms tests
GMT	Local Time	Comments
10:06		Collect blankets in valley and return to elevator to off-load
12:27		Going to the west to pick up the blankets on the western flank hill.
16:41 8/23		Last blanket is recovered from west ridge transect (N16) Returning to the elevator at warp speed
18:29		Jason at elevator. All blankets are loaded onto the elevator.
19:06		Tried to release elevator but even though we pulled the pin the elevator did not move. It looks like the elevator is too heavy. We start to remove blankets. One blanket (Q) is dropped out first, but then we stack the blankets on Jason's basket. After 5 blankets are removed the elevator will still not float. We remove another four blankets. We put them in the side-arms. The elevator looks buoyant at this point. We decide however to remove all the blankets and put them on Jason. We put the other four in the port side-arm. We then let the elevator go and it rockets up at 50m/min.
20:26		We lose the stacked blankets on the front basket as they tip off and have to recover them again.
20:52		We are still missing that first blanket (Q) and begin to look for it. Finally, we find it and recover and stack on basket with a weight on the top and manipulator to hold in place.
21:19 8/23		Jason coming up with all the blankets
21:25		Elevator at the surface
23:45 8/23		Jason on deck. Blankets successfully recovered. END of JASON DIVE 591
00:09 8/24		Launch Jason at optical lander site START JASON DIVE 592

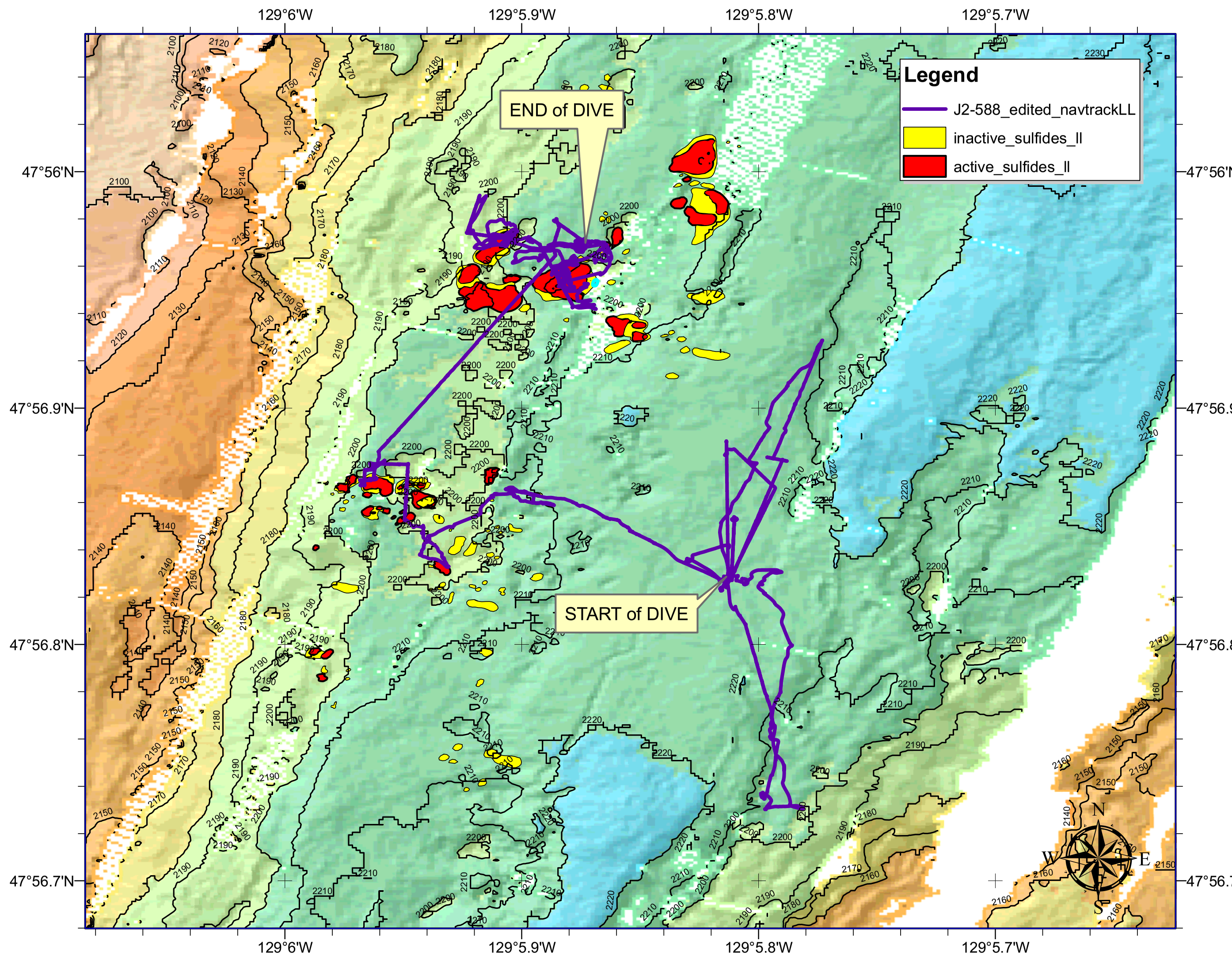
01:20		Jason on bottom. Lander in sight
01:28		Pick up optical lander and put on basket.
GMT	Local Time	Comments
01:35 8/24		Weights away. Jason is off bottom and heading for the surface
		Trouble with boom bring Medea on deck. Will recover Jason first and then crane medea on
02:49		Jason on deck END JASON DIVE 592
02:52 8/24		Medea on deck.
03:00 8/24		Start heading for Astoria. End of science operations.
18:00		In transit to Astoria
23:00 8/24	16:00	Columbia River Pilot
8/24	18:00	At dock, Astoria END OF CRUISE

JASON DIVE MAPS

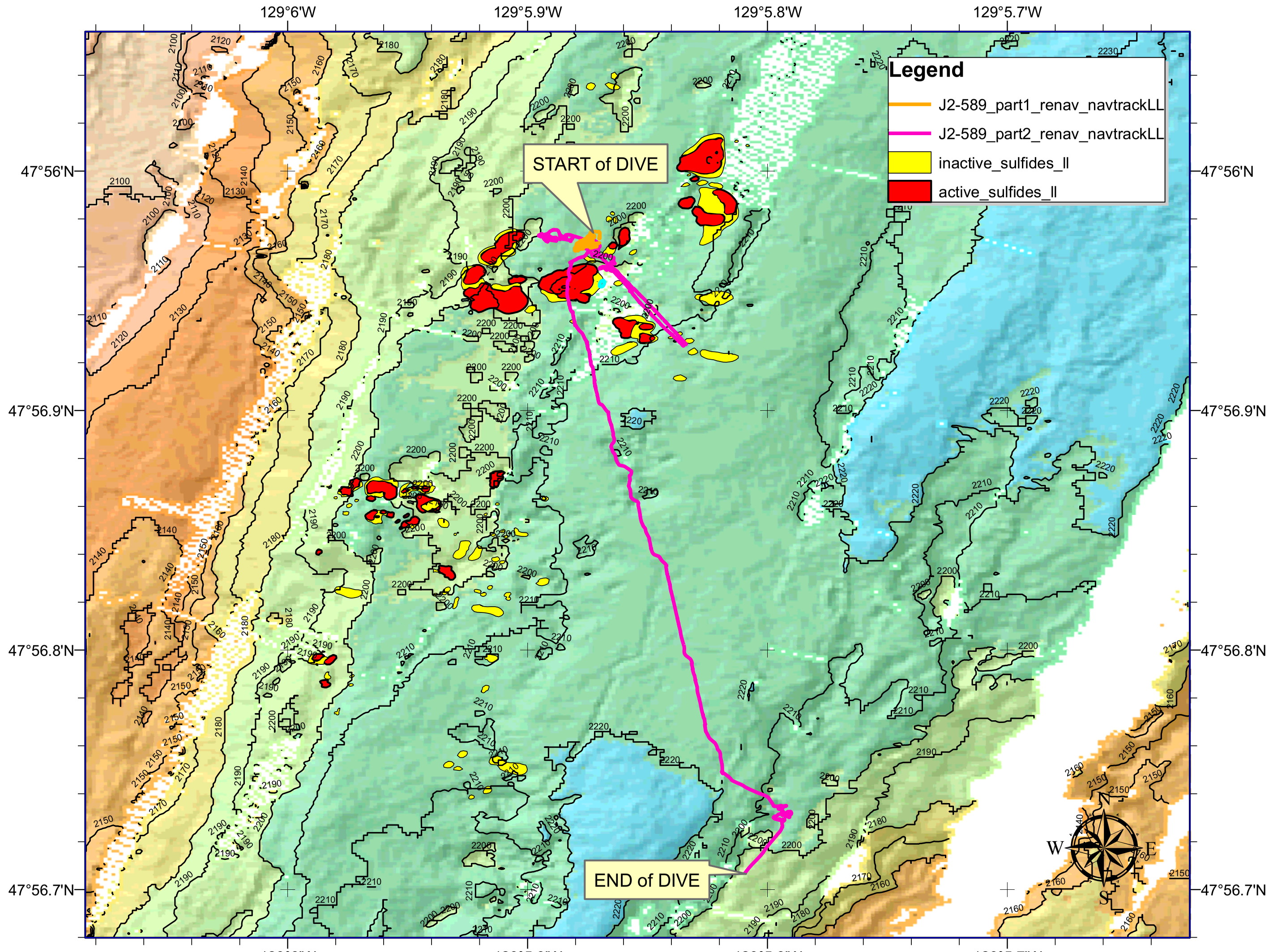



AT18-09 JASON DIVE 586
Saturday, February 11, 2012 6:14:43 PM
C:\data\jdf\jdf2011.mxd
Projection: WGS 84
Author: Maurice Tivey
0 100 200 Meters
47°57.5'N
47°57.4'N
47°57.3'N
47°57.2'N
47°57.1'N
129°6'W
129°5.9'W
129°5.8'W
129°5.7'W
129°5.6'W
129°5.5'W
129°5.4'W
N
E
S
W

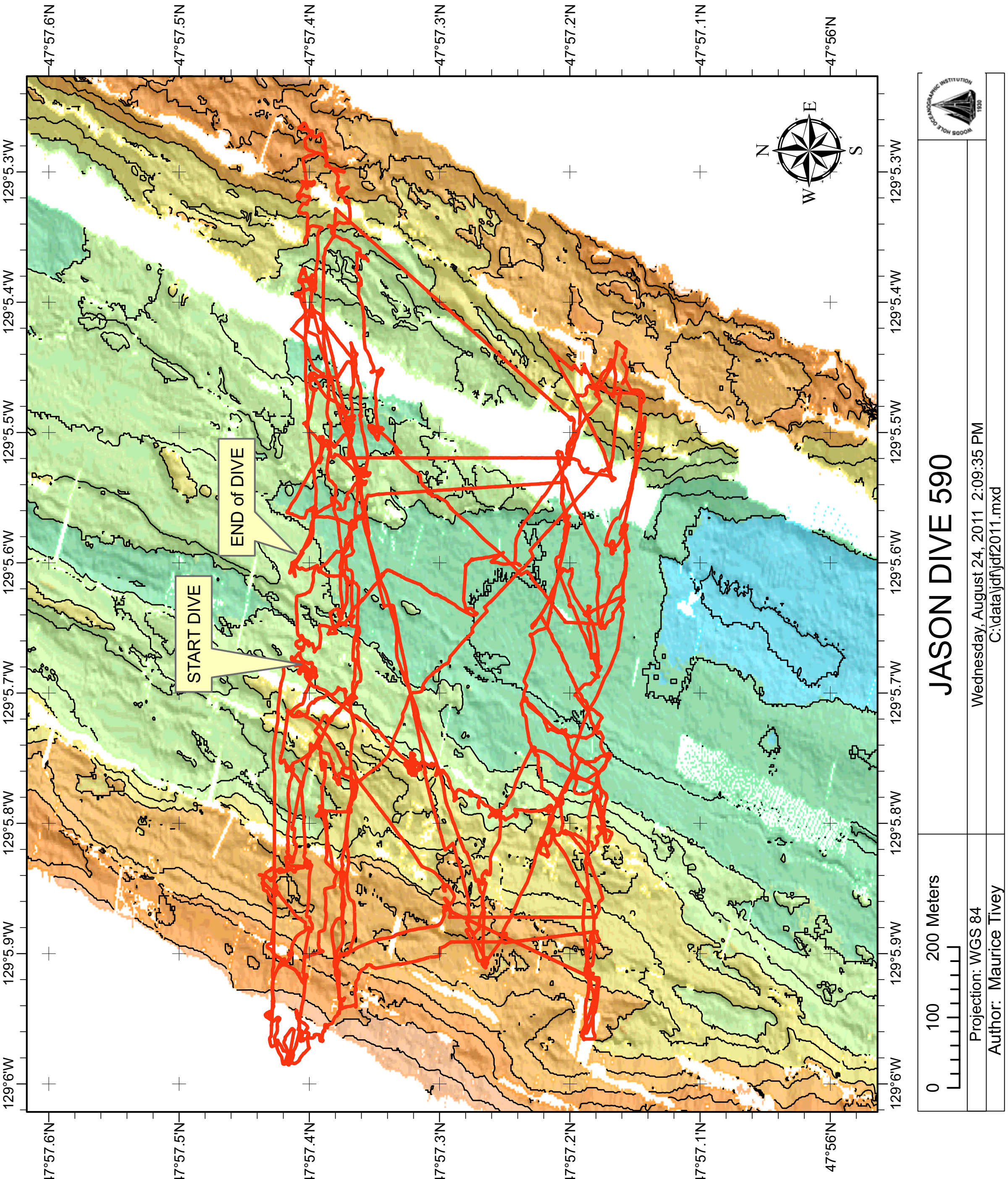

JASON DIVE 587
Legend
J2-587_part1_renav_navtrackLL
J2-587_part2_renav_navtrackLL
em300_cont10
START of DIVE
END of DIVE
-129 2.694, 47 55.986
47°56'N
47°55'N
129°1'W
129°2'W
0 370 740 Meters
Projection: WGS 84
Maurice Tivey
Saturday, August 20, 2011 11:57:52 AM
C:\data\jdf\jdf2011.mxd
N
E
S
W

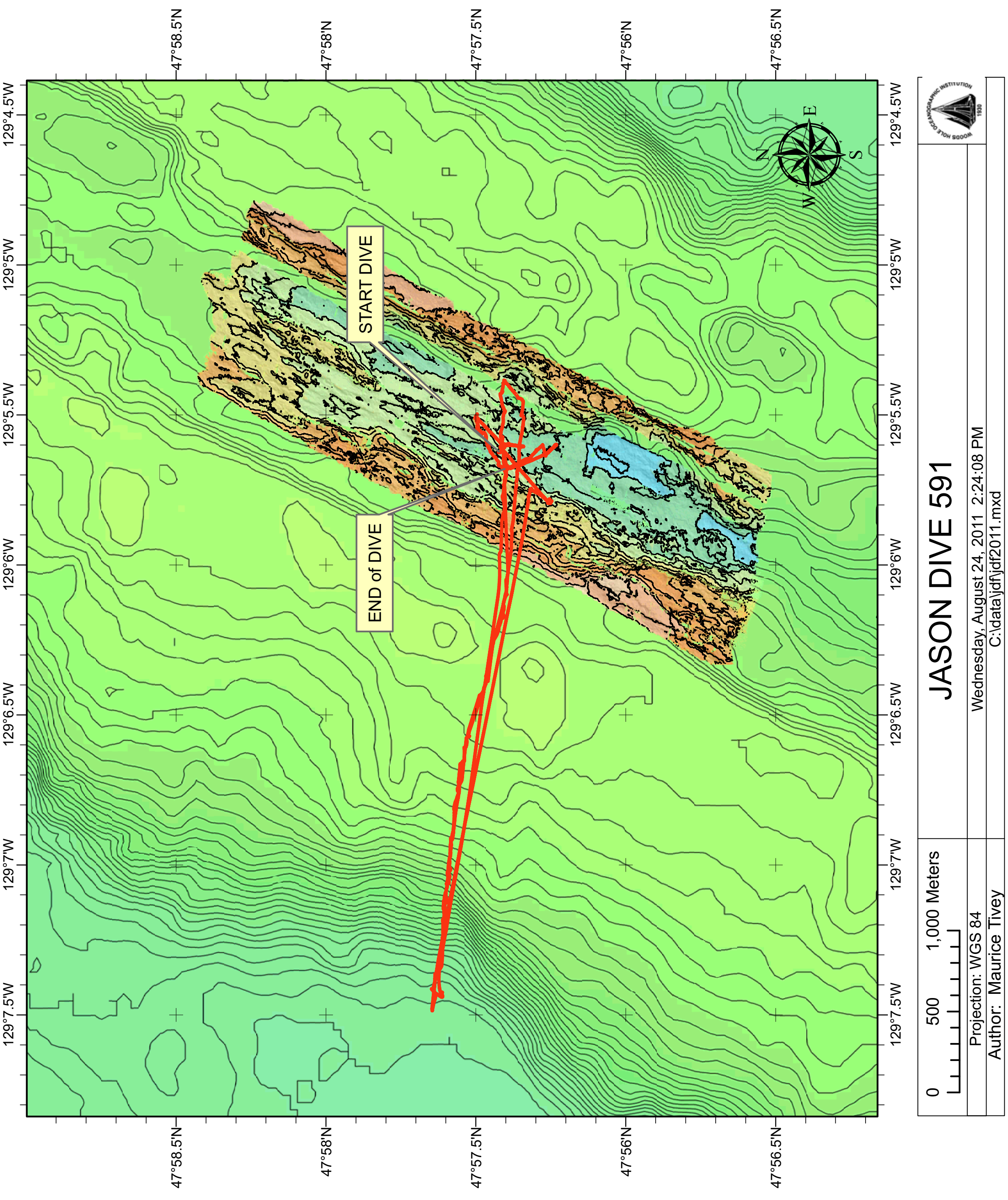


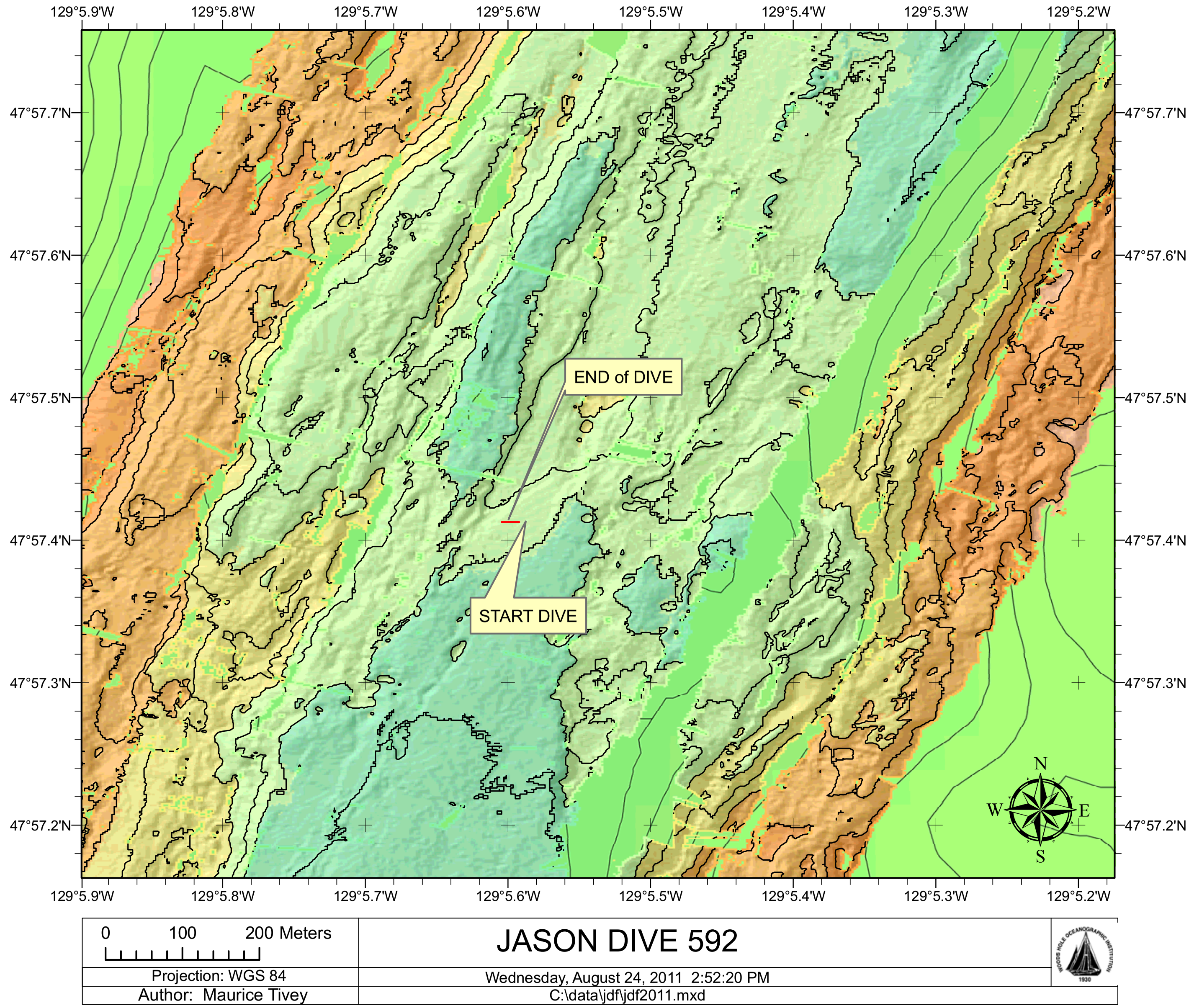
0 60 120 Meters	JASON DIVE 588
Projection: WGS 84	Saturday, August 20, 2011 11:42:19 AM
Maurice Tivey	C:\data\jdf\jdf2011.mxd

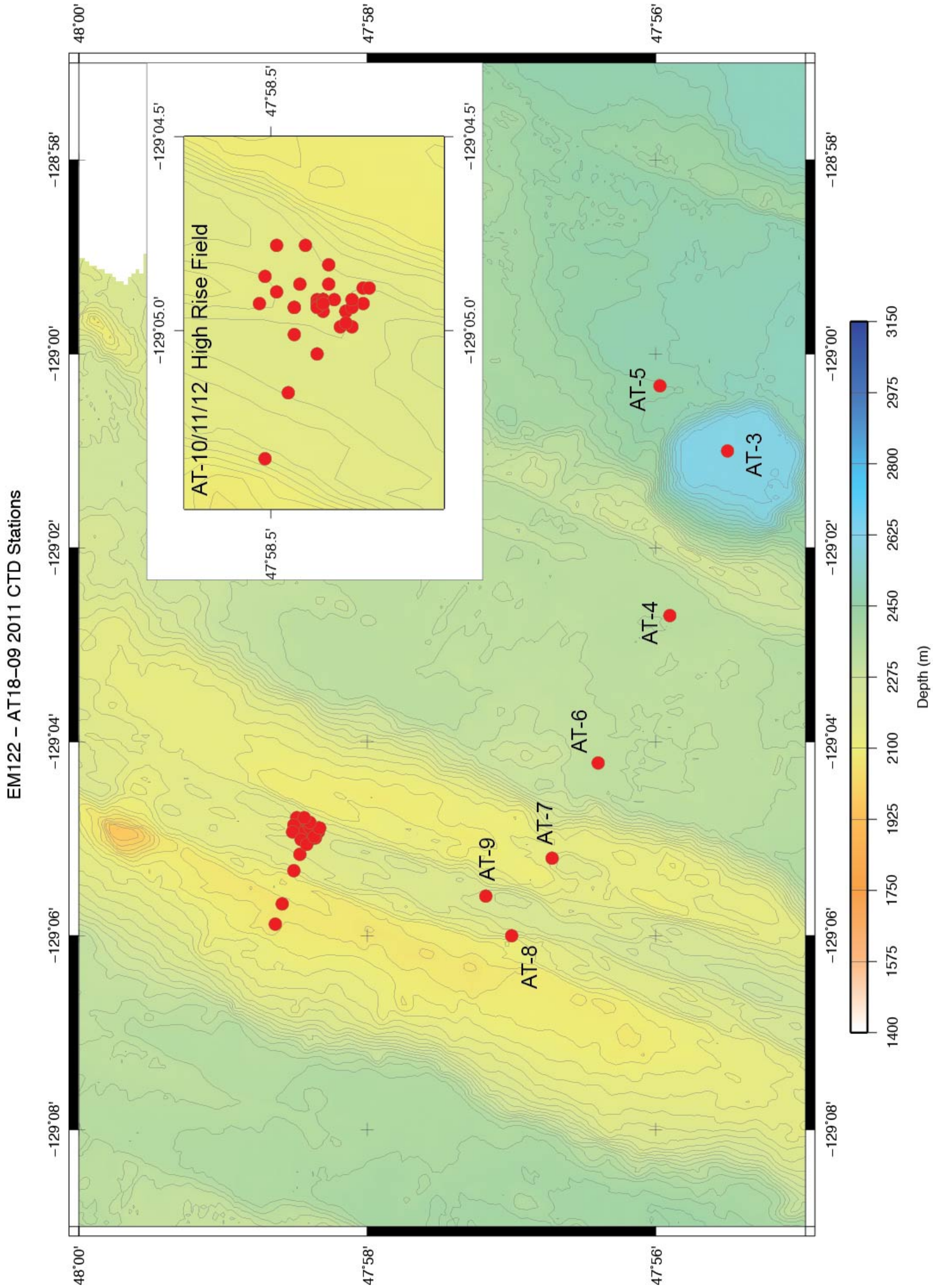


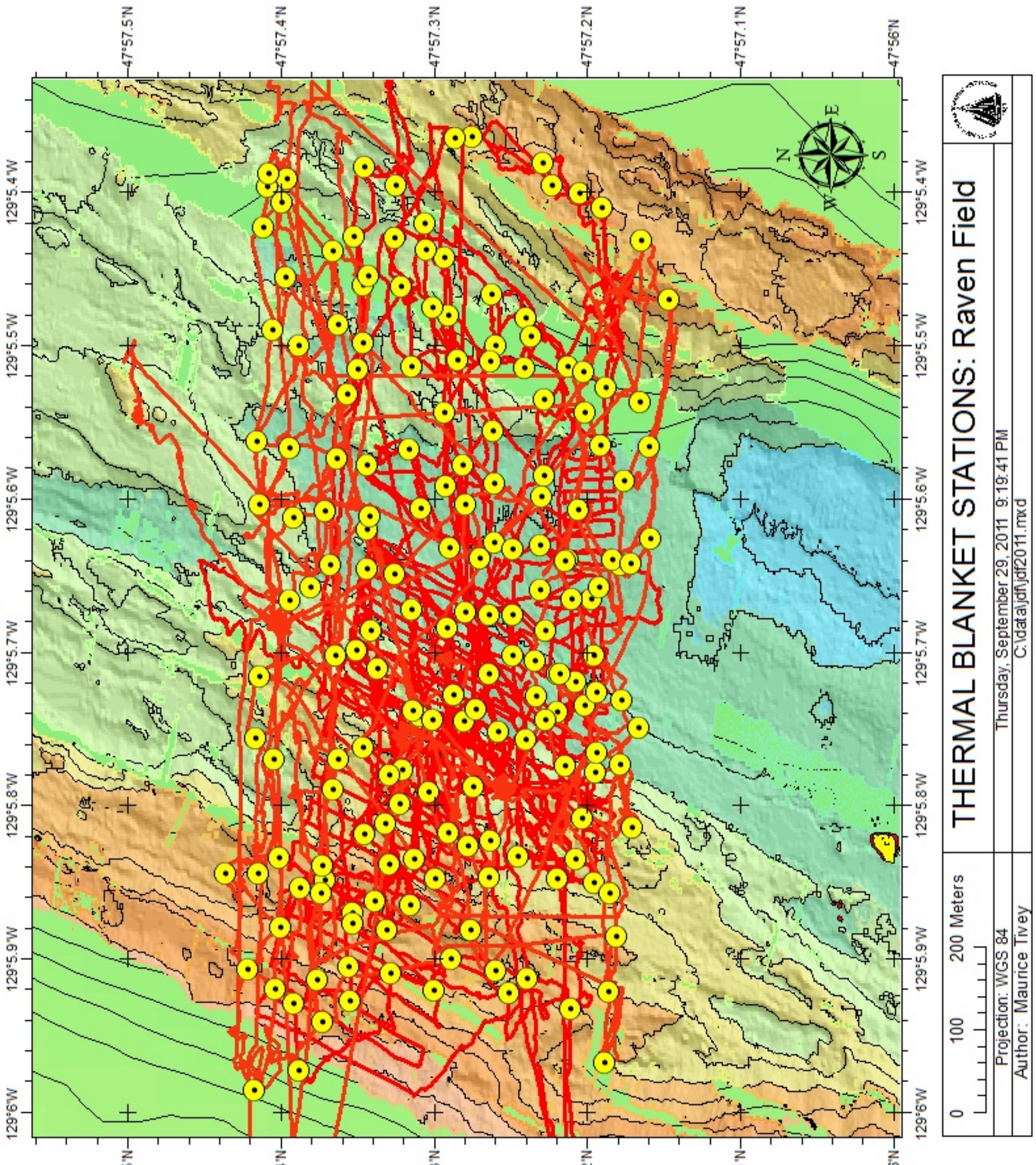
0 60 120 Meters	JASON DIVE 589
Projection: WGS 84	Saturday, August 20, 2011 11:10:37 AM
Maurice Tivey	C:\data\jdf\jdf2011.mxd


JASON DIVE 590
Wednesday, August 24, 2011 2:09:35 PM
C:\data\jdf\jdf2011.mxd
Projection: WGS 84
Author: Maurice Tivey
0 100 200 Meters
START DIVE
END of DIVE
N
E
S
W
129°6'W
129°5.9'W
129°5.8'W
129°5.7'W
129°5.6'W
129°5.5'W
129°5.4'W
129°5.3'W
47°57.6'N
47°57.5'N
47°57.4'N
47°57.3'N
47°57.2'N
47°57.1'N
47°56'N


JASON DIVE 591
Wednesday, August 24, 2011 2:24:08 PM
C:\data\jdf\jdf2011.mxd
Projection: WGS 84
Author: Maurice Tivey
0 500 1,000 Meters
START DIVE
END of DIVE
47°58.5'N
47°58'N
47°57.5'N
47°56'N
47°56.5'N
129°4.5'W
129°5'W
129°5.5'W
129°6'W
129°6.5'W
129°7'W
129°7.5'W
N
E
S
W


129°5.9'W
129°5.8'W
129°5.7'W
129°5.6'W
129°5.5'W
129°5.4'W
129°5.3'W
129°5.2'W
47°57.7'N
47°57.6'N
47°57.5'N
47°57.4'N
47°57.3'N
47°57.2'N
END of DIVE
START DIVE
N
W
E
S
0
100
200 Meters
Projection: WGS 84
Author: Maurice Tivey
JASON DIVE 592
Wednesday, August 24, 2011 2:52:20 PM
C:\data\jdf\jdf2011.mxd


EM122 – AT18–09 2011 CTD Stations
AT-10/11/12 High Rise Field
AT-3
AT-4
AT-5
AT-6
AT-7
AT-8
AT-9
48°00'
47°58'
47°56'
47°58.5'
−129°08'
−129°06'
−129°04'
−129°02'
−129°00'
−128°58'
−129°05.0'
−129°04.5'
Depth (m)
1400
1575
1750
1925
2100
2275
2450
2625
2800
2975
3150


THERMAL BLANKET STATIONS: Raven Field
Thursday, September 29, 2011 9:19:41 PM
C:\data\jdf\jdf2011.mxd
Projection: WGS 84
Author: Maurice Tivey
0 100 200 Meters
N
E
S
W
47°57.5'N
47°57.4'N
47°57.3'N
47°57.2'N
47°57.1'N
47°56'N
129°6'W
129°5.9'W
129°5.8'W
129°5.7'W
129°5.6'W
129°5.5'W
129°5.4'W