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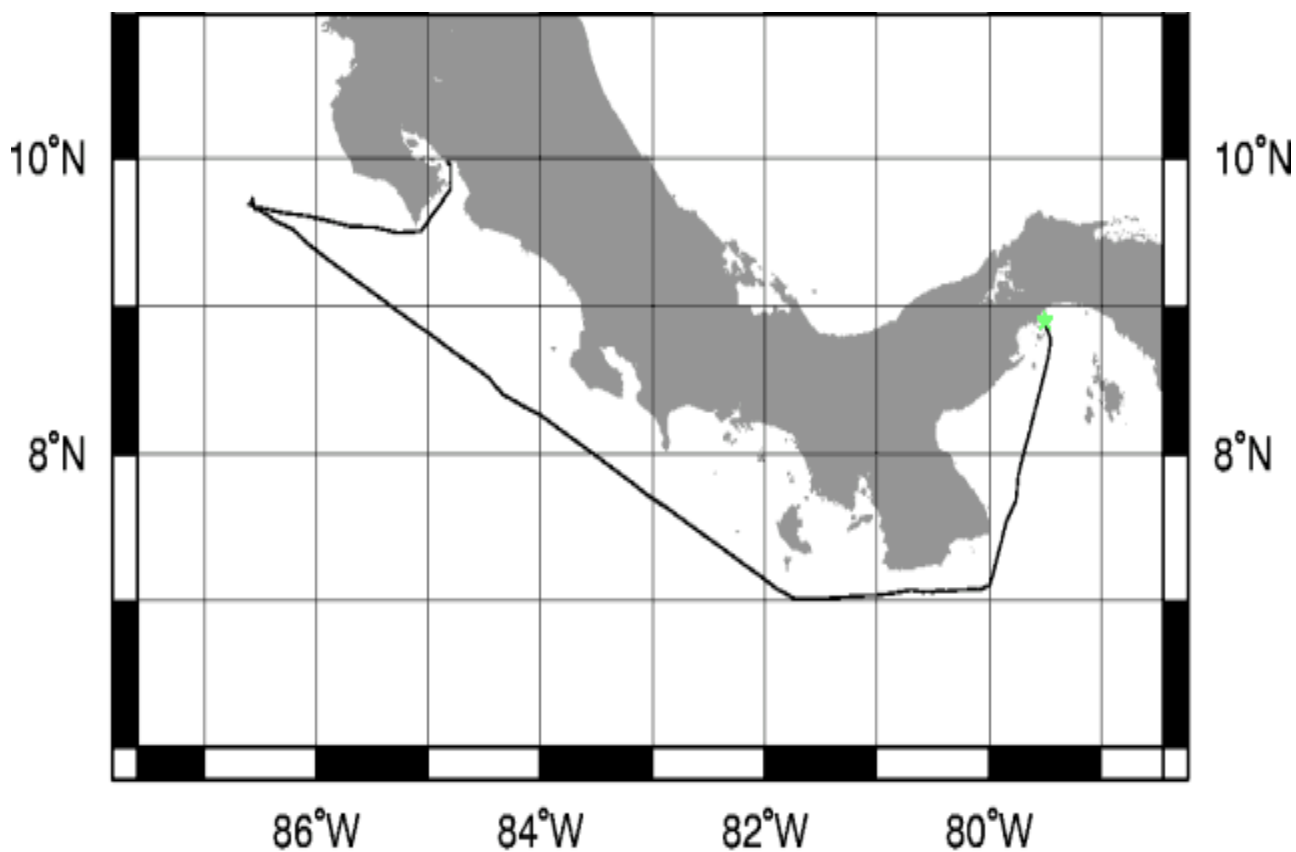
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R/V Maurice Ewing Data Reduction Summary

EW–0212 Puntarenas, Costa Rica – Balboa, Panama

Date	Julian Date	Time	Port
November 17, 2002	321	00:48:00UTC	Puntarenas, Costa Rica
November 20, 2002	324	11:46:02UTC	Balboa, Panama



GMT 2002 Nov 21 01:10:09 TO DATE

Project Summary

DESCRIPTION

Understanding the processes involved in the thermal, and chemical aging of oceanic crust in off ridge–axis locations has long been of great interest to the general ocean geological/geophysical communities. There is now substantial and growing evidence from heat flow and coring investigations that the oceanic plate off Costa Rica is highly hydrologically active and that this activity is responsible for one of the most anomalously cold thermal environments encountered in the oceanic environment. Recent work has additionally identified limited regions above certain topographic highs with extremely high heat flows. Pore water profiles derived from cores above these thinly sedimented basement highs are suggestive of up–ward flow on the order of ~ 1 cm/y. These highs may be the principal regions of out–flow from the basement in this region and, thus, can potentially be used to constrain the general level of hydrologic activity. The Chemical and Aqueous Transport (CAT) meters we deployed during this cruise are highly sensitive to both in–flow and out–flow at rates of 0.1 mm/y to 10 m/y. Our objective is to provide an independent and direct measurement of long term flow rates along a critical representative hydrologic transect to address the following questions: (1) What are the characteristic fluid fluxes at basement highs and surrounding regions of the low heat flow region of the northern Costa Rican incoming plate, (2) by what paths does water enter and exit the area, and (3) is this flow temporally variable? The data from instruments deployed during this cruise, when combined with those of the previous TicoFlux expeditions, will supply us with co–located temperature, chemical gradient, and direct fluid flux data sets that will ultimately build upon each other to generate a more complete hydrologic picture of the surface (i.e. sea bed) boundary flux distribution across the incoming plate.

Cruise Members

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Cruise Notes

All data in this report is logged using GMT time and Julian days in order to avoid confusion with local time changes.

Spectra

Although no seismic work was done on this transit, an new gun towing arrangement was tested on julian day 323 with mixed results.

Hydrosweep

A sound velocity profile based on a local XBT and Levitus was entered into the hydrosweep on day 321 @ 19:30 which was used for the remainder of the cruise.

Gravity

As a result of a gyro table failure, no gravity data was logged.

Data Logging/Processing

In an effort to switch our primary source of GPS navigation from the Carmin WAAS recievers to the Trimble Tasmon receiver, the first forty–seven minutes of both Tasmon and WAAS gps data was lost. As the official departure time did not occur until 54:00 UTC, there was no "official" data loss. Navigation data from the Trimble NT300D was used for smoothing purposes for the abovementioned gap.

Ship Diagrams

Ship Offset Diagram

Data Logging

The R/V Maurice Ewing data logging system is run on a Sparc Ultra Enterprise Server. Attached are 48 serial ports via 3 16-port Digi International SCSI Terminal Servers. Generally, all data logged by the Ewing Data Acquisition System (DAS) is time stamped with the CPU time of the server, and broadcast to the Ewing network using UDP packet broadcasts. The CPU time of the server is synchronized once every half hour to a Datum UTC gps time clock.

GPS times are also time-tagged with cpu time, although the time of the GPS position is from the GPS fix itself.

The following tables describe the data instruments which performed logging during this cruise. The tables associated with the instruments describe logging periods and data losses for that instrument.

Time Reference

Datum StarTime 9390-1000

logging interval: 30 minutes
file id: tr2

Used as the CPU synchronization clock. This clock is polled once every half hour to synchronize the CPU clock of the data logger to UTC time. The logger (octopus) is responsible for updating the times of the other CPUs.

This clock was running and synchronizing the system the entire cruise.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+321:00:23:29.732		Truetime logging starts
2002+324:23:53:29.753		Truetime logging ends

Spectra

Spectra uses its own Trimble gps receiver for synchronizing its hardware to UTC time. This is the time the shot points are referenced to; not the CPU time.

GPS Receivers

GPS data is usually logged at 10 second intervals. The NMEA strings GPGGA and GPVTG are logged for position, speed, and heading fixes. This data was logged constantly throughout the cruise.

The Tasmon GPS was the primary GPS for this cruise.

Trimble Tasmon P/Y Code Receiver

logging interval: 1 second
file id: gp1

The Tasmon is the primary GPS receiver for the Ewing Logging system and the primary GPS for Spectra fixes. The accuracy is around 15 meters.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+321:00:48:31.489		Tasmon logging starts
2002+324:11:46:02.169		Tasmon logging ends

Trimble NT200D

logging interval: 2 seconds
file id: gp2

The Trimble is the secondary receiver for GPS data. Data is logged at 2 second intervals and is also used as an input to Spectra, although it is weighed at a lower value than the Tasmon receiver.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+321:00:00:00.024		Trimble logging started
2002+324:11:46:02.245		Trimble logging ends

Garmin WAAS

logging interval: 2 seconds
file id: gp1

The WAAS is the tertiary receiver for GPS data. Data is logged at 2 second intervals and is also used as an input to Spectra.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+321:00:48:51.558		WAAS logging started
2002+324:11:46:01.465		WAAS logging ends

TSS POS/MV 320

logging interval: 1 second
file id: pm01

The POS/MV is the tertiary receiver for Gps data. Data is logged at 2 second intervals and is also used as an input to Spectra, although it is weighed at a lower value than the Tasmon receiver.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	Log Date	Comment
2002+321:00:00:00.007		POS/MV logging starts
2002+324:11:46:02.255		POS/MV logging officially ends

Tailbuoy Garmin GP8

logging interval: 1 second
file id: tb1

The tailbuoy GPS is a WAAS receiver. No tailbuoy data was logged.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
		Tailbuoy logging starts
		Tailbuoy logging officially ends

Speed and Heading

Furuno CI-30 Dual Axis Speed Log Sperry MK-27 Gyro

logging interval: 6 seconds
file id: fu

The Furuno and Gyro are combined to output speed, heading and course information to a raw Furuno file, as well as an NMEA VDVHW signal used as an input to various systems including steering and Spectra.

Interruptions greater than 30 minutes are displayed in the following table

Log Date	Log Date	Comment
2002+321:00:00:01.143		Furuno logging starts
2002+324:11:46:02.149		Furuno logging ends

Gravity

Bell Aerospace BGM-3 Marine Gravity Meter System

logging interval: 1 second
file id: vc. (raw), vt. (processed)
drift per day: 0.035

The BGM consists of a forced feedback accelerometer mounted on a gyro stabilized platform. The gravity meter outputs raw counts approximately once per second which are logged and processed to provide real-time gravity displays during the course of the cruise as well as adjusted gravity data at the end of the cruise.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	Log Date	Comment
		Gravity logging starts
		Gravity logging ends

Bathymetry

Krupp Atlas Hydrosweep-DS2

logging interval: variable based on water depth
file id: hb (centerbeam), hs (swath)

The hydrosweep full swath data is continuously logged for every cruise, and centerbeam data is extracted and processed separately. The centerbeam operates at a logging frequency dependent on the water depth.

The full swath data is not routinely processed, but can be processed with the MB-System software which can be downloaded for free. For instructions, use the website:
<http://www.ldeo.columbia.edu/MB-System>.

MBSYSTEM, version 5.0beta3 is necessary to process data after June 1, 2001.

Interruptions greater than 10 minutes are displayed in the following table

Log Date	LogDate	Comment
2002+321:00:54:50.000		Hydrosweep logging starts
2002+324:11:45:34.000		Hydrosweep logging ends

Weather Station

RM Young Precision Meteorological Instruments, 26700 series

logging interval: 1 minute
file id: wx

The weather station is used to log wind speed, direction, air temperature, and barometric pressure. We log this information at 1-minute intervals.

Log Date	LogDate	Comment
2002+321:00:00:00.127		Weather logging starts
2002+324:11:46:00.855		Official end logging

Magnetics

Varian Magnetometer

logging interval: 12 seconds
file id: mg

The following table shows the times the magnetometer was logging

Log Date	LogDate	Comment

Seismic Line

Currently, we use data from the Spectra header, data from the Digicourse cable output, data from the gun depths, and real-time data from the Ewing logging system to compose a Ewing standard SEG-D header readable by SIOSEIS to place on the 3490 tape for each shot.

There are several files for each line reflecting the line status:

File	Description
ts.n	Shot time is merged with Ewing navigation to determine shot location
nb2.r	Navigation is from Spectra, and includes tailbuoy, tailbuoy range and bearing
shotlog.p1	Shots are from the p1 file. (should be identical to nb2.r), includes source position
shotlog.p2	Shots are from the p2 file (should be identical to tss.n), includes source position

Gravity Ties

LOCATION 1

Gravity Ties

Location 2

File Formats

For all formats, a – in the time field means an invalid value for some reason.

Streamer Compass/Bird Data

cb.r

This data is not processed, but can still be found in the "processed" data directory.

<u>Shot Time</u>	<u>Line</u>	<u>Shot</u>	<u>Latitude</u>	<u>Longitude</u>
2000+079:00:08:40.085	strike1	000296	N 15 49.6217	W 060 19.8019
<u>2nd GPS Position</u>		<u>Tailbuoy Position</u>		
<u>Latitude</u>	<u>Longitude</u>	<u>Latitude</u>	<u>Longitude</u>	
N 15 49.6189	W 060 19.8101	N 15 47.1234	W 060 20.1901	
<u>Furuno Streamer Gyro Compasses & Heading</u>				
344.1	C01 2.3	C02 1.7	...	

Gun Depths

dg

Gun depths in tenths of meters. There will always be 20 gundepths even if only one gun was configured and shooting.

<u>Shot Time</u>	<u>Gun Depths</u>																		
	1	2	3	4	5	6	7	8	9	...	20								
2001+089:06:47:05.909	189	068	005	005	096	005	060	054	005	...	6								

Raw Furuno Log

fu.s

This data has been smoothed and output 1 fix per minute.

<u>CPU Time Stamp</u>	<u>Track</u>	<u>Speed</u>	<u>Hdg</u>	<u>Gyro</u>
2000+166:00:01:53.091	-	4.4	140.5	148.3

Hydrosweep Centerbeam

hb.n

Hydrosweep data merged with navigation

<u>CPU Time Stamp</u>	<u>Centerbeam</u>		<u>Depth</u>
	<u>Latitude</u>	<u>Longitude</u>	
2000+074:09:55:00.000	N 13 6.6206	W 59 39.3908	134.9

Merged Data

m

<u>CPU Time Stamp</u>	<u>Latitude</u>	<u>Longitude</u>	<u>GPS</u>			<u>Drift</u>	<u>Depth</u>
			<u>Used</u>	<u>Set</u>			
2000+200:12:25:00.000	N 45 54.1583	W 42 47.1770	gp1	0.0		0.0	
<u>Magnetic</u>		<u>Gravity</u>		<u>EOTVOS</u>		<u>Drift</u>	<u>Shift</u>
<u>Total Intensity</u>	<u>Anomaly</u>	<u>FAA</u>	<u>GRV</u>				
49464.7	55.5	22.2	980735.0	-8.4	-0.1		2.8
<u>Temperature Salinity Conductivity</u>							
0.0	0.0	0.0					

The gravity drift and shift are values that have been added to the raw gravity to make up for drift in the meter that has been lost in accordance with a gravity check at each port stop.

Temperature, Salinity and Conductivity will only be valid while logging a Thermosalinograph, which is not usually the case.

Magnetics Data

mg.n

- A minus sign in the time stamp is flagged as a spike point, probably noise...
- Anomaly is based on the International Geomagnetic Reference Field revision 2000

CPU Time Stamp	Latitude	Longitude	Raw Value	Anomaly
200+077:00:23:00.000	N 16 11.2918	W 59 47.8258	36752.2	-166.8

Navigation File

n

CPU Time Stamp	Latitude	Longitude	Used	Set	Drift
2000+074:00:03:00.000	N 13 6.2214	W 59 37.9399	gpl	0.0	0.0

Navigation Block

nb0

Navigation is a compendium of Ewing logged data at shot time. The shot position here is the shot position from the Spectra system.

Shot Time	Shot #	CPU Time	Shot Position
2001+088:00:00:00.606	016967	2001+088:00:00:03.031	N 30 11.8324 W 042 10.8162

Water	Sea	Wind	Dir	Tailbuoy	Line
Depth	Temp	Spd	Dir	Latitude	Longitude
2565.1	20.7	16.4	164	N 30 12.0427	W 042 14.7319

Range	Bearg	Name	Speed	Heading
6296.3	93.5	MEG-10	4.2	101.1

Tailbuoy Navigation

tbl.c

Raw tailbuoy fixes

CPU Time Stamp	Latitude	Longitude	GPS Precision
2001+088:00:00:02.000	N 30 12.0424	W 042 14.7309	SA

GPS Precision is either SA, DIFF or PCODE

Ewing Processed Shot Times

ts.n

Shot times and positions based on the Ewing navigation data processing

CPU Time Stamp	Shot #	Latitude	Longitude	Line Name
2000+079:00:08:01.507	000295	N 15 49.5703	W 060 19.7843	strikel

Shot Data Status

ts.n.status

The ts.nxxx.status file describes the line information for that day, giving some basic statistics about the line: start, end times; missing shots; start and end shots.

```
LINE   strikel: 98+079:00:00:15.568 : 000283 .. 002286
      MISSING: 347, 410, 1727
```

```
LINE   dip2: 98+079:23:05:22.899 : 000002 .. 000151
```

This example says that on Julian Day 079 of 1998, two lines (strikel and dip2) were run: the end of strike 1 (shots 000283 to 002286) and the start of dip2 (shots 000002 to 000151).

Line strikel had some missing shots in the data file (probably missing on the SEG-d header as well).

Spectra Shot Times

nb2.r

The shot times and positions based on the Spectra positioning; with raw tailbuoy range and bearing.

CPU Time Stamp	Shot #	Latitude	Longitude	Line Name
----------------	--------	----------	-----------	-----------

2001+084:00:00:05.924	009245	N 23 31.2410	W 045 25.0894	
-----------------------	--------	--------------	---------------	--

Latitude	Longitude	Tailbuoy Range	Bearing	Line Name
N 23 30.4540	W 045 21.4338	6389.8	283.2	KANE-4

Raw Gravity Counts

vc.r

sample BGM-3 gravity count record (without time tag):

pp:dddddd ss

			status: 00 = No DNV error; 01 = Platform DNV
			02 = Sensor DNV; 03 = Both DNV's
			count typically 025000 or 250000
			counting interval, 01 or 10

The input of data can be at 1 or 10 seconds.

Gravity Data

vt.n

- * A minus sign in the time stamp is flagged as a spike point
- * m_grv3 calculates the Eotvos correction as:
$$\text{eotvos_corr} = 7.5038 * \text{vel_east} * \cos(\text{lat}) + .004154 * \text{vel} * \text{vel}$$
- * The theoretical gravity value is based upon different models for the earth's shape.
 - 1930 = 1930 International Gravity Formula
 - 1967 = 1967 Geodetic Reference System Formula
 - 1980 = 1980 Gravity Formula
- * The FAA is computed as:
$$\text{faa} = \text{corrected_grv} - \text{theoretical_grv}$$
- * Velocity smoothing is performed w/ a 5 point window

CPU Time Stamp	Latitude	Longitude	Model	FAA	RAW
2000+148:00:10:00.000	N 09 34.7255	W 085 38.5826	1980	9.48	978264.16

Eotvos	Drift DC	Raw Velocity	Smooth Velocity		
Smooth	Total Shift	North	East	North	East
-74.78	0.06	4.16	1.875	-10.373	1.927 \10.166

Datum Time

ts2.r

CPU Time	Datum Time	Time Reference
2001+069:00:15:29.727	069 00 15 29.378	datum

Raw GPS

gp(12).d, tb1.d

Raw GPS is in NMEA Format.

Meteorological Data

WX

```

                                True
CPU Time Stamp      Spd Dir
2001+045:00:00:00.967  7.8 22

Bird1:
Speed              Direction
Inst 60sA 60mA 60sM Inst 60sA 60mA
7.8  6.6  8.5  16.8 277 291 5

Bird 2
Speed              Direction
Inst 60sA 60mA 60sM Inst 60sA 60mA
0.0  0.0  0.0  0.0  0  0  0

Temperature
Inst 60mA 60mm 60mM
15.0 14.2 14.3 15.1
Humidity
Inst 60mm 60mM
92 90 93
Barometer
1027.5

Inst:      Current
60sA:      60 second average
60mA:      60 minute average
60sM:      60 second maximum
60mm:      60 minute minimum
60mM:      60 minute maximum
```

Merged Meteorological Data

mmet

```

TSG, WX, CT merged with Nav at 1 minute fixes
date      time      lat      lon      gpu head spd
2001+244:00:00:00.000 12.14071 44.98469 gp1 10.2 83.0
```

```

tws twd temp hum press cti cte con sal ct
26.5 228.0 30.6 87.0 1000.8 28.8 28.8 5.9 36.3 28.8
```

```

gpu  = gps unit in use
head = ship's heading
spd  = ship's speed in knots
tws  = true wind speed
twd  = true wind direction
temp = air temp (celcius)
hum  = relative humidity (%)
press= pressure in mb
cti  = sea temp from the internal TSG sensor
cte  = sea temp from the external TSG sensor
con  = conductivity, Siemens/meter
sal  = salinity, practical salinity units
ct   = sea temp from the C-keel sensor (to tenths of a degree)
```

Shot Times from Spectra P1 Files

shots.p1

These files were created with the script: `extract_shots_from_p1 -a 1`

```

Epoch Time  Shot#  Source Lat/Lon      TB Lat      TB Lon
985788741.000 015570 30.283881 -41.854536 30.320144 -41.886642
Vessel Ref Lat/Lon  Antenna GPS Lat/Lon  Water Depth
```

30.283478 -41.854117 30.283531 -41.854078 2894.2

- Source is the Center of the Guns
- TB is the Tailbuoy, according to Spectra
- Vessel Ref is the location of the center of the Mast
- Antenna GPS is the location of Antenna 1 (-a 1 flag); in this case is the Tasmon GPS
- Water Depth is the HS Centerbeam depth

Shot Times from Spectra P2 Files

shots.p2

These files were created with the script: `extract_shots_from_p2 -o "V1 G1"`

Epoch Time	Shot#	Vessel Ref	Lat/Lon	Source	Lat/Lon
985716772.4	00015572	30.282803	-41.866136	30.283207	\41.866540

- Vessel Ref is the location of the center of the Mast
- Source is the Center of the Guns

Included are some scripts for extracting information out of the P1 and P2 formatted files. In order to use these scripts you will also need to install the Ewing Perl libraries included in the scripts directory, or at least include that directory in your PERL5LIB environment. The use of perl is beyond the scope of this document.

extract_shots_from_p1 [-a antenna] [-h] filename

Given an input P1 File, create a shotpoint file with the times, and the positions of the given antenna [1 = tasmon, 2 = Trimble] and optionally the header records at the beginning of the file.

The output will be:

```
epochtime shotnumber sourcePos tbPos vesselPos antennaPos depth
```

- **epochtime** is the # of seconds since Jan 1, 1970
- **shotnumber** is the shot number
- **sourcePos** is the center position of the sound source [lat lon]
- **tbPos** is the position of the tailbuoy [lat lon]
- **vesselPos** is the position of the vessel reference (center of mast) [lat lon]
- **antennaPos** is the position of the specified antenna [lat lon]
1 = tasmon, 2 = trimble
- **depth** is the water depth in meters

extract_shots_from_p2 [-s shotnumber] [-o "output values"]

-s define if you only want the statistics for a single shot

-o "outputs" defines the outputs you want from the P2 file.

This routine will output by default the shotpoint, the line name and the shot time. Optionally, you can output position (Lat Lon) info for a number of items:

Outputs can be one or more of the following:

- V1 Vessel 1 Reference
- V1G1 Tasmon GPS Receiver
- V1G2 Trimble GPS Receiver
- V1E1 Hydrosweep Transducer
- TB1 Tailbuoy 1
- S1 Streamer 1
- V1SC Streamer Compasses
- G1 Gun Array 1

All the formats output a Lat Lon pair in decimal degrees. (*West and South being negative*)

Output will be: epochtime shotnumber [output lat/lon pairs]

Tape Contents

EW0212/

CruiseReport_EW0212.pdf	this document
ew0212.cdf	NetCDF database file of this cruise
ew0212.cdf_nav	NetCDF database file of this cruise' navigation
configs/	Ewing logging/reduction configuration files
docs/	File Formats
XBT/	XBT data and HS SVPs
mbsystem/	latest mbsystem source
processed/	Processed datafiles merged with navigation
trackplots/	daily cruise track plots (<i>postscript</i>)
raw/	Raw data directly from logger
reduction/	Reduced data files
clean/	daily processing directory, includes daily postscript plots of the data.