*** looks better with -B -f"Helvetica12" ***

LAMONT DATA REDUCTION CRUISE SUMMARY

CRUISE: EW-9008

START: 29/09/90 272 Bergen, Norway

END: 26/10/90 299 Newark, U.S.A.

PURPOSE: To examine mid ocean ridge (crustal accretion and deformation) at the obliquely-spreading plate boundary of the Reykjanes Ridge.

CHIEF SCIENTISTS: Lindsay Parson, IOS

DATA REDUCTION: Stefanus Budhypramono

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TRUE TIME CLOCK:

Instrument: Kinemetric True Time Division Model 468-DC
Logging: 1 minute intervals
Checking: visual check of plot of data
Note: There are two true time clock on board the ships. Both are being logged.
True Time #1 is connected to the antenna and has been proven to give mutant record. True Time #2 on the other hand is connected to a 5065A Rubidium Vapor Frequency Standard and has been proven to provide more accurate time.
Therefore, True Time #2 is being used to calibrate data files on this cruise.

SPEED AND HEADING:

Instrument: Furuno CI-30 2-axis Doppler speed log, Sperry MK-27 gyro
Logging: 3 second intervals
Checking: visual check of plot of data
Smoothing: mean value of all good values within the same minute
Note: The Furuno speed has been suspected of being slightly inconsistent. For most cases, it has no effect toward reducing the navigation. Only in few instances this Furuno speed has a slight effect on the set and drift calculation. Also in one instance, the Furuno heading was found to give faulty reading during a turn, resulting in a faulty navigation.

TRANSIT SATELLITE FIXES:

Instrument: Magnavox MX-1107RS dual frequency Transit satellite receiver
Logging: all fixes
Checking: reject receiver flagged fixes, fixes with high drifts in navigation and fixes producing Eotvos correction errors in gravity

Note: Throughout the cruise transit sat #2 (bridge) was being used to reduce
navigation

GPS SATELLITE FIXES:

Instrument: Magnavox T-Set Global Positioning System receiver
Logging: 2 second intervals on GPS set #1 and
20 second intervals on GPS set #2
Checking:
minimum number of sats: 2
dilution of precision maximum: north = 10.0, east = 10.0
carrier signal-noise ratio minimum: 35.0
standard deviation maximum: north = 10.0, east = 10.0
time step maximum: 3
speed maximum: 15.0
compared GPS speed and course with Furuno smooth speed and heading
compared positions with Transit-Furuno navigation
reject fixes with high drifts in navigation
reject fixes producing Eotvos correction errors in gravity
Interpolation: interpolated positions at 00, 30 seconds of each minute
Smoothing: smoothed interpolated positions with 9 point running average
Note: Throughout the cruise, GPS set #1 was being used to reduce
navigation. Except for day 282 in which GPS set #2 was performing much
better than GPS set #1. The 2 second data was being reduced to 20
second prior
to processing.

INTERNAV LORAN FIXES:

Instrument: Internav Loran LC408
Logging: 1 (one) minute intervals
Checking:
reject fixes with high drifts in navigation
reject fixes producing Eotvos correction errors in gravity
Interpolation: interpolated positions at 00, 30 seconds of each minute
Smoothing: smoothed interpolated positions with 9 point running average
Note: Loran Internav was tracking and used toward final navigation until
day 294 when we changed chain and lost track of all station.
Chain used: 7970 : Norwegian Sea Chain
9980 : North Atlantic Chain
7930 : Labrador Sea Chain

NORTHSTAR LORAN FIXES:

Instrument: DMEC Northstar 6000 Automatic Receiver
Logging: 20 second intervals
Checking:
    reject fixes with high drifts in navigation
    reject fixes producing Eotvos correction errors in gravity
Interpolation: interpolated positions at 00, 30 seconds of each minute
Smoothing: smoothed interpolated positions with 9 point running average
Note: Northstar Loran was not tracking any station throughout the cruise.

NAVIGATION:

A "1 minute navigation" is produced from the above sources. Acceptable fixes are merged at 1 per minute with priority given to GPS.
The smooth speed and heading data is used to fill any gaps of 2 minutes or longer between fixes by computing 1 minute DR'ed positions corrected for set and drift between fixes. The DR'ed positions are produced at 00 seconds of each minute.
Chief scientist's final data: 1 minute final navigation.

FORMAT: 9008n.ddd
      yy+ddd:hh:mm:ss.mmm N 12 12.1234 E 123 12.1234 id 123.1 12.1
      yr   day   time lat   lon   id set   drift

Lamont database: 1 minute navigation.

BATHYMETRY:

Instrument: Krupp Atlas Hydrosweep Center Beam
Logging: At each ping of Hydrosweep, data is being broadcasted real time to the network, which in turn is being received by data logger. The logger computer then extracted the center beam depth. Intervals vary, dependent on depth: about every 12 sec. at 4000 m., more often at less depth.
Checking: visual check of plot of data
Chief scientist's final data:
   Final calibrated and cleaned data merged with final navigation.
   Depth is in meters.

FORMAT: 9008hb.nddd
      yy+ddd:hh:mm:ss:mmm N 12 12.1234 E 123 12.1234 2222.0
      yr   day   time lat   lon   depth_in_meters
Lamont database: Same as above. Depth is in fathoms.

MAGNETICS:

Instrument: Varian V75 magnetometer
Logging: 20 second intervals
Checking: visual check of plot of data
Reference field: International Geomagnetic Reference Field 1985
(IGRF 1985)
model of the main field at 1985.0 and a predictive model of the secular variation for adjusting to dates between 1985.0 and 1990.0

Note: The magnetic anomaly calculated at the end of the cruise are not the real magnetic value since the IGRF90 is not available yet. This anomaly value should be treated as a reference only untill the IGRF90 is available or an interpolation program is written.

Residual field: Applied by bilinear interpolation across a 1 degree square.

Chief Scientist's final data:
Cleaned and calibrated reaw magnetics.
Merged interpolated magnetic and navigation along with magnetic anomaly value.

FORMAT: 9008mg.nddd

```
yr+ddd:hh:mm:ss.mmm N 12 12.1234 E 123 12.1234 41200.8  -367.1
yr   day     time lat         lon            total_     anomaly
                                          intensity
```

Lamont Database: interpolated total intensity value at 00 seconds of each minute

Note: The magnetic data for this cruise was very noisy. A sincere effort has been made to take out all the noise out of data. No form of filtering were applied to the data. All the noise were taken out manually. As a result, there are still some minor spikes left in the data on some places. There are also part of the data that just simply not used due to the amount of noise existing in the data.

DAY	TIME	COMMENTS
273	1100	started logging
273	1700	Maggie was pulled in to go to Ferroes Island
275	1900	Maggie went back to the water
277	0900	Maggie was pulled in to go to Iceland
278	0440	Maggie went back to the water
278	1200	Maggie was pulled in to launch Tobi
278	1510	Maggie went back to the water
280	1030	Maggie was pulled in to launch Tobi
281	1030	Maggie went back to the water
283	0000-0130	Too many noise in the data. Data not used.
283	1430	Maggie was pulled in to launch Tobi
285	0500	Maggie went back to the water
287	1450	Maggie was pulled in to launch Tobi
289	1525	Maggie went back to the water
292	1200-2359	Too many noise in the data. Data not used.
294	0240-1800	Too many noise in the data. Data not used.

BGM-3 GRAVITY:

Instrument: Bell Aerospace BGM-3 marine gravity meter
Logging: 1 second intervals
Merge with navigation: calculate Eotvos correction and Free Air Anomaly.
Checking: visual check of plot of data to determine satisfactory Eotvos corrections.
Velocity smoothing: 5 point running average
Free air smoothing: 15 min. cubic-spline filter
Chief scientist's final data: Observed, Eotvos, Free Air Anomaly value at 00 seconds of each minute. 1980 theoretical gravity formula:

```
Yo    = 978.0327 * ( 1 + a - b ) where
a     = .0053024 * sin( theta ) * sin( theta ) and
b     = .0000058 * sin( 2 * theta ) * sin( 2 * theta ).
```

and final calibrated and cleaned data

FORMAT: 9008vt.nddd

```
yy+ddd:hh:mm:ss.mmm N 10 20.1234 W 120 23.1234 1980  77.1
yr   day     time lat         lon            theog  FAA

979317.5   64.1   1.5  10.2  -1.7  9.7  -1.6  9.8
raw_grav eotvos drift dc_shift raw_vel  smo_vel
```

Note: A '-' sign after the year in the record indicates that those record has been flagged bad and should not be used.

Lamont database: Free Air Anomaly value at 00 seconds of each minute. 1930 International gravity formula.

KSS-30 GRAVITY:

Instrument: KSS-30 marine gravity meter
Logging: 6 second intervals
Merge with navigation: calculate Eotvos correction and Free Air Anomaly.
Checking: visual check of plot of data to determine satisfactory Eotvos corrections.
Velocity smoothing: 5 point running average
Free air smoothing: 15 min. cubic-spline filter
Chief scientist's final data: Observed, Eotvos, Free Air Anomaly value at 00 seconds of each minute. 1980 theoretical gravity formula:

```
Yo = 978.0327 * ( 1 + a - b ) where
a = .0053024 * sin( theta ) * sin( theta ) and
b = .0000058 * sin( 2 * theta ) * sin( 2 * theta ).
```

and final calibrated and cleaned data

FORMAT: 9008vk.nddd

```
yy+ddd:hh:mm:ss.mmm N 10 20.1234 W 120 23.1234 1980  77.1
yr   day     time lat         lon            theog  FAA

979317.5   64.1   1.5  10.2  -1.7  9.7  -1.6  9.8
raw_grav eotvos drift dc_shift raw_vel  smo_vel
```

Note: A '-' sign after the year in the record indicates that those record has
been flagged bad and should not be used.

Lamont database: Free Air Anomaly value at 00 seconds of each minute.
1930 International gravity formula.
Note: KSS-30 gravimeter was found to be very sensitive during rough weather
During some of the roughest weather, the gravimeter would stop working.

DAY	TIME	COMMENTS
283	0000-2300	KSS-30's sensor went bad due to rough weather.
286	1300-2359	KSS-30's sensor went bad due to rough weather.
287	0000-1800	KSS-30's sensor went bad due to rough weather.
287	1945-2359	KSS-30's sensor went bad due to rough weather.
288	0000-1015	KSS-30's sensor went bad due to rough weather.
291	1520-2359	KSS-30's sensor went bad due to rough weather.
292	0000-2359	KSS-30's sensor went bad due to rough weather.
293	0000-2230	KSS-30's sensor went bad due to rough weather.

PRE-CRUISE GRAVITY TIE-IN:

Port: Bergen, Norway
Date: Sep 24, 1990
Operator: Joe Stennett
Reference Station: No tie, used value from previous tie
Pier/Ship's position: from the Gravity Tie Report:
   Ship is docked at the very end of the pier near the custom house
   (Tollbodkaien) Skotegrunnaskai Pier #2.
Gravity meter: L & R Model G, serial number 237.
Temperature of meter: 49 C.
Readings and Calculations:

TIME	LOCATION	L&R READING	G	Potsdam Corr?
23 Aug 90 0816Z	Pier	5427.632+- .05		
23 Aug 90 0857Z	Ref	5426.940+- .05	981951.1	NOT corrected
23 Aug 90 0918Z	Pier	5427.635+- .05		

		G READING
24 Sep 90 1800Z	BGM	981955.2
24 Sep 90 1800Z	KSS-30	1785.83

Pier reading .5 m above waist deck. Waste deck is 5.5 m above gravity lab. 5.5 + .3 = 6.0 m.

Lacoste difference in LR units:

delta_LR	= pier_LR - ref_LR
.7	= 5427.63 - 5426.94

Difference in mgal: (1 LR unit = 1.06 mGals)

delta_mgal	= delta_LR * constant
.7	= .7 * 1.06

Pier gravity value in mgal: ref_val = G - 13.6 = 981951.1 - 13.6 = 981937.5

pier_grv_val	= ref_val	+ delta_mgal
981938.2	= 981937.5	+ .7

Height correction:

Height correction in mgal:

note: free-air constant of +0.31 mgal per meter going towards the center of earth; -0.31 mgal per meter going away.

hgt_cor	= hgt * constant	
1.9 mGal	= 6.0 * 0.31 mGal/m	

Gravity at gravity lab level in mgal:

grv_at_lab_level	=	pier_grv_val	+ hgt_corr
981940.1	=	981938.2	+ 1.9

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BELL GRAVIMETER
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Mistie in mgal:
      mistie      = BGM_grv_val     - grv_at_lab_level
      15.1  = 981955.2  -  981940.1

Drift in mgal since last tie:
      prev_mistie: 9.4  mgal on 23 Aug 1990
      drift = mistie - prev_mistie
      5.7   = 15.1      - 9.4

KSS-30
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KSS_grav_val      = kss_unbiased_output   + bias
981956.12   =     1785.83           + 980170.29

Mistie in mgal:
      mistie            = KSS_grv_val     -  grv_at_lab_level
      16.2        = 981956.12       -  981940.1

Drift in mgal since last tie:
      prev_mistie: 15.3 mgal on 23 Aug 1990

      drift = mistie - prev_mistie
      .72   = 16.2       - 15.3
```

POST-CRUISE GRAVITY TIE-IN:

Port: Newark, N.J., U.S.A.
Date: Oct. 28, 1990 (JD 301)
Operator: Joe Stennett
Reference Station: Room 106 of the Oceanography Bldg. on the LDGO campus.
Pier/Ship's position: from the Gravity Tie Report:
Ship is docked at Berth 9 on North side of Port Newark Channel. Position is about 330 meters East of the end of the channel where a kilometer long converter ends.
Gravity meter: L & R Model G, serial number 237.
Temperature of meter: 49 C.
Readings and Calculations:

TIME	LOCATION	L&R READING	G	Potsdam Corr?	
1618Z	Ref	3828.830+- .05	980240.96	YES	
1744Z	Pier	3817.640+- .05			

		G READING
1744Z	BGM-3	980252.8
1744Z	KSS-30	79.5

Pier reading .0 m above waist deck. Waist deck is 5.5 m above gravity lab. 5.5 + .0 = 5.5 m.

Lacoste difference in LR units:

delta_LR	= pier_LR - ref_LR
-11.2	= 3817.640 - 3828.830

Difference in mgal: (1 LR unit = 1.06 mGals)

delta_mgal	= delta_LR * constant
-11.9	= -11.2 * 1.06

Pier gravity value in mgal:

pier_grv_val	= ref_val + delta_mgal
980229.1	= 980240.96 + (-11.9)

Height correction:

Height correction in mgal:
note: free-air constant of +0.31 mgal per meter going towards the center of earth; -0.31 mgal per meter going away.

hgt_cor	= hgt * constant
1.7 mGal	= 5.5 * 0.31 mGal/m

Gravity at gravity lab level in mgal:

grv_at_lab_lvl	=	pier_grv_val	+ hgt_corr
980230.8	=	980229.1	+ 1.7

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BELL GRAVIMETER
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Mistie in mgal:
      mistie      = BGM_grv_val     - grv_at_lab_level
      22.0  = 980252.8  - 980230.8

Drift in mgal since last tie:
      prev_mistie: 15.1  mgal on 24 Sept 1990
      drift = mistie - prev_mistie
      6.9   = 22.0       - 15.1

==>   DC Shift    = prev_mistie     = 15.1
      Drift/Day   = drift/(tot. # of day)
                  = 6.9/(301-267)
                  = 6.9/34    = .202941

KSS-30
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KSS_grav_val      = kss_unbiased_output   + bias
980249.79   =     79.5        + 980170.29

Mistie in mgal:
      mistie            = KSS_grv_val     -  grv_at_lab_level
      18.99       = 980249.79 -  980230.8

Drift in mgal since last tie:
      prev_mistie: 16.02 mgal on 24 Sept 1990

      drift = mistie - prev_mistie
      2.97  = 18.99      - 16.02

==>   DC Shift    = prev_mistie     - bias
                  = 16.02           - 980170.29
                  = -980154.27
      Drift/Day   = drift/(tot. # of day)
                  = 2.97/(301-267)
                  = 2.97/34   = .087353
```