# LAMONT DATA REDUCTION CRUISE SUMMARY

CRUISE: EW9209

START: 23 August 1992  [236] Bridgetown, Barbados

END: 25 September 1992  [269] Bridgetown, Barbados

PURPOSE: Cenozic History of Deep Water Circulation and Chemistry at Ceara Rise

CHIEF SCIENTISTS: Dr. William B. Curry - Woods Hole Oceanographic Institution
and Dr. Gregory S. Mountain - Lamont-Doherty Geological Observatory

DATA REDUCTION: Thomas D. Aitken and Stefanus Budhypramono

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TIME:
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Instrument: Kinemetrics/TrueTime Division Model GPS-DC, GPS Synchronized clock
Logging: 60 second intervals
Checking: Visual check of plot of data
    Note: True Time is connected to a 5065A Rubidium Vapor Frequency Standard.

SPEED AND HEADING:
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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

TRANSIT SATELLITE FIXES:
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Instrument: Magnavox MX-1107RS dual frequency Transit satellite receiver
Logging: All fixes from two receivers Transit #1 (lab) and Transit #2 (bridge)
   Note: The fixes from the Transit system are logged in case there is a
         significant gap in GPS coverage, not needed on this cruise.

GPS SATELLITE FIXES:
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Instrument: Magnavox T-Set Global Positioning System 5 channel receiver
          Magnavox MX-4200 Global Positioning System 6 channel receiver
Logging: T-Set #1 at 2 second intervals, T-Set #2 at 20 second intervals.
       MX-4200 at 1 second intervals.
    Notes: (1) T-Set #1 is logged at 2 second intervals to provide realtime
           positioning for the Hydrosweep; this GPS data is decimated to
           20 second intervals before use in the reduction.
         (2) MX-4200 is logged at 1 second intervals, but decimated to 10
         second intervals before use in interpolation and smoothing.
Checking:
    minimun number of sats: 3

dilution of precision maximum: north = 4.0, east = 4.0
carrier signal-noise ratio minimun:35.0
standard deviation maximum: north = 4.0, east = 4.0
time set maximun: 3
speed maximun: 30.0
compared GPS speed and course with Furuno smooth speed and heading
compared positions with Transit-Furuno 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
Notes: (1)Using GPS MX4200 for this cruise.
(2)The GPS data has a sinusoidal-like wave in it which is assumed to come from some degrading of the GPS quality for civilian users. This wave seems to vary in period and shape and is not a perfect sine curve. The periods are less than 20 minutes. The amplitudes and period will vary over 24 hours but always seem to be present in the data. This degrading produces a false ship's track for realtime navigation and introduces extreme errors, up to 10 mGals, in the Eotvos correction for the gravity. To handle this problem the remaining smooth GPS data is decimated to 20 minute intervals. This dithering was in effect only for jdays 236-244 at start of the cruise, and then back on around 1800 on jday 265 to end of the cruise on jday 269.

This GPS processing, together with using the smooth speed and heading data from the Furuno for DR'ing between the decimated GPS positions produces good navigation and gravity data.

NAVIGATION:
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A "1 minute navigation" is produced from the GPS and Furuno sources. The smooth speed and heading data is used to fill the gaps between the processed GPS positions by computing 1 minute DR'ed positions corrected for set and drift. The DR'ed positions are produced at 00 seconds of each minute.

Navigation started on jday 236 at 1400 and ended on jday 269 at 1920.

BATHYMETRY:
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Instrument: Krupp Atlas Hydrosweep DS
Logging: At each ping of hydrosweep , data is being broadcasted in real time to the network, which is received by the data logging computer, which then extracts the center beam depth.
Checking: visual check of plot of data. Bad data points removed with an interactive graphics editor.
Final data: interpolated depth value (meters) at 00 seconds of each minute

Center beam bathymetry started on jday 236 at 1423 and ended on jday 269 at 1254

Gaps:

| start jday:time | end jday:time | reason |
|---|---|---|
| 239:1749 | 239:2011 | put into Cayenne, French Guiana |
| 240:0211 | 240:0212 | ? not recorded in any file |
| 250:1140 | 250:1249 | replaced a card in hydrosweep |
| 253:2033 | 253:2140 | replaced a card in hydrosweep |
| 262:1832 | 262:1846 | SQC logging computer full |

On many, but not all days, the data is missing at 0203 and 0204, reason unknown

MAGNETICS:

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Instrument: Varian V75 magnetometer
Logging: 6 second intervals
Checking: visual check of plot of data. Bad data points removed with
    an interactive graphics editor.
Reference field: International Geomagnetic Reference Field 1990 (IGRF 1990)
    model of the main field at 1990.0 and a predictive model of the
    secular variation for adjusting to dates between 1990.0 and 1995.0

Final data: median values at 00 seconds of each minute calculated from
    the values +-30 seconds of this time.

Magnetics started on jday 237 at 1117 and ended on jday 268 at 1217

Gaps:

| start jday:time | end jday:time | reason |
|---|---|---|
| 238:1211 | 238:1217 | |
| 238:1223 | 238:1223 | |
| 238:1326 | 238:1332 | |
| 238:1338 | 238:1341 | |
| 238:1343 | 238:1443 | |
| 238:2203 | 240:1610 | put into Cayenne, French Guiana |
| 244:1049 | 244:2309 | off for coring (cores 1 and 2) |
| 247:0933 | 248:0123 | off for coring (cores 3 and 4) |
| 251:0655 | 251:1222 | off for coring (core 5) |
| 253:1749 | 254:0143 | off for coring (core 6) |
| 254:1555 | 254:2217 | off for coring (core 7) |
| 255:1344 | 255:1852 | off for coring (core 8) |
| 256:1320 | 257:0744 | off for coring (core 9) |
| 257:0747 | 257:0751 | noise |
| 257:1212 | 257:1218 | noise |
| 257:1341 | 257:1345 | noise |
| 257:1411 | 257:2141 | problems |
| 258:1122 | 259:0758 | off for coring (cores 10 and 11) |
| 260:0333 | 260:1151 | off for coring (core 12) |
| 261:0308 | 261:0948 | off for coring (core 13) |
| 261:2247 | 262:1013 | off for coring (core 14) |
| 262:1832 | 262:1846 | SQC logging computer full |
| 262:2244 | 263:1301 | off for coring (core 15) |
| 266:0659 | 267:1402 | off |
| 267:1820 | 267:1916 | ship power problems |

GRAVITY:
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Instrument: Bodenseewerks KSS-30 Marine Gravity meter
Logging: mGal values at 6 second intervals
Smoothing: mean values at 00 seconds of each minute calculated from
    the logged values +-30 seconds of this time. This stage also adjusts
    the times of the logged values for a 75 second delay due to the
    filtering of the gravity by the KSS-30.
Merge with navigation: calculate Eotvos correction and Free Air Anomaly.
    The velocities, from the navigation, used in the Eotvos
    correction are smoothed with a 5 point running average for all days
Checking: visual check of plot of data to determine satisfactory Eotvos
    corrections, delete spikes of data at turns
Dc shift: -980169.50 mGal
Drift rate: 0.0050 mGal per day
Final data: Free Air Anomaly value at 00 seconds of each minute.
    1930 theoretical gravity formula.

KSS-30 gravity started on jday 236 at 1502 and ended on jday 269 at 1918

    Note: This is the gravity data used for this cruise.

The 1930 theoretical gravity formula, without Potsdam correction, is used for data sent to Lamont for inclusion in their data base.

Instrument: Bell Aerospace BGM-3 marine gravity meter
Logging: 1 second counts
Filtering: an observed gravity value in mGal is calculated by filtering
    the 1 second counts with a 360 second Gaussian filter, scaling the result
    and adding a bias. A value in mGal is calculated for 00 seconds of
    each minute.
Merge with navigation: calculate Eotvos correction and Free Air Anomaly.
    The velocities, from the navigation, used in the Eotvos
    correction are smoothed with a 5 point running average for all days
Checking: visual check of plot of data to determine satisfactory Eotvos
    corrections, delete spikes of data at turns
Dc shift: -6.4 mGal
Drift rate: 0.0447 mGal per day
Final data: Free Air Anomaly value at 00 seconds of each minute.
    1930 theoretical gravity formula.

BGM-3 gravity started on jday 236 at 1510 and ended on jday 269 at 1918

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LAMONT GRAVITY TIE REPORTS
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R/V Ewing gravity meters: Bodenseewerk KSS-30 marine gravimeter
Bell Aerospace BGM-3 marine gravity meter
scale factor = 5.0940744
bias = 852680

Port: Bridgetown, Barbados

Date: 20 August 1992  (jday 233)  pre EW9209

Operator: Joe Stennett and Bill Robinson

Reference Station:
ACIC 0865-4
Adopted value: 978294.44 mgals
Estimated Accuracy: +- 0.5 mgals
Date: 2/72
Location: Station is located on the Deep Water Pier, two feet north
of third bollard (bollard #34) from the northern end of pier.

Pier/Ship's position:
R/V Ewing is moored on the Deep Water Pier with bollard #31
at mid-ships.

Readings and Calculations:
Since the gravimeters were located only 3 bollard lengths from
the reference station location, the reference value was used for
pier gravity value.

Reference value = 978294.44 mgal

Pier gravity value:
pier_grv_val = 978294.44 mGal

On 20 August 92 at 1510 Z the BGM/KSS was 6.0 meters below the pier. (The gravity meters are 5.5 meters below C-deck, which was 0.5 meters below the pier.)

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  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_corr = hgt * constant
      hgt_corr = 6.0 * .31
      hgt_corr = 1.9

  Gravity at BGM/KSS level:
      grv_at_BGM/KSS_level = pier_grv_val + hgt_corr
      grv_at_BGM/KSS_level = 978294.44 + 1.9
      grv_at_BGM/KSS_level = 978296.3

BGM-3 reading:
      On 20 August 92 (day 233) at 1510 Z
      BGM_grv_val = 978289.9

BGM-3 Mistie:
      BGM_mistie = BGM_grv_val - grv_at_BGM_level
      BGM_mistie = 978289.9 - 978296.3
      BGM_mistie = -6.4

BGM-3 DC shift:
      BGM_dc_shift = -6.4 mGal

BGM drift:
      pre_BGM_mistie: -7.7 mgal on 13 July 1992 (day 195)
      BGM_drift = BGM_mistie - pre_BGM_mistie
      BGM_drift = (-6.4) - (-7.7)
      BGM_drift = 1.3 mgal

      BGM drift rate per day = BGM_drift/number of days from last tie
      BGM drift rate per day = 1.3/38
      BGM drift rate per day = 0.0342

KSS-30 reading:
      On day 233 at 1510 Z
      KSS_grv_val = -1873.19
        (note: used the value at 233 1511:16 from the KSS data
        file to adjust for the 75 second filtering delay.)

KSS-30 DC shift:
      KSS_dc_shift = KSS_grv_val - grv_at_KSS_level
      KSS_dc_shift = (-1873.19) - (978296.3)
      KSS_dc_shift = -980169.5

KSS-30 Mistie:
      BIAS of 980170.29
      KSS_mistie = (BIAS  +  KSS_grv_val) - grv_at_KSS_level
      KSS_mistie = (980170.29 + (-1873.19)) - 978296.3
      KSS_mistie = 0.8

KSS-30 drift:
      prev_KSS_mistie: 0.97 mgal on 13 July 1992 (day 195)

      KSS_drift = KSS_mistie - prev_KSS_mistie
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KSS_drift = (0.8) - (0.97)
KSS_drift = -0.2

KSS-30 drift rate per day = KSS_drift/number of days from last tie
KSS-30 drift rate per day = -0.2/38
KSS-30 drift rate per day = -0.0053
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Port: Bridgetown, Barbados

Date: 27 September 1992  (jday 271)  post EW9209

Operator: Joe Stennett and Tom Aitken

Reference Station: ACIC 0865-4
Adopted value: 978294.44 mGals
Estimated Accuracy: +- 0.5 mgals
Date: 1972
Located on the Deep Water Pier, two feet north of the third bollard (bollard #34) from the northern end of the pier.

Pier/Ship's position:
R/V Ewing was located at on the Deep Water Pier with midships at bollard #23.

Portable Gravity meter: L & R meter G-237
meter at 49.5 deg. C.

Readings and Calculations:

| Time | Location | L-R reading |
|---|---|---|
| 1310 | ship | 1976.44 |
| 1322 | reference | 1977.00 |
| 1333 | ship | 1976.40 |

Because of pier movement (wind etc) the pier readings are only good to plus or minus 0.2 miligals.

Reference value = 978294.44 mgal

Good values to use in the reduction of the gravity-tie are:
-1873.60 for the KSS-30 and
979291.0 for the BGM-3
These values are from the data collected between 1523 and 1638

Pier gravity value:
pier_grv_val = 978294.44 mGal -0.6mGal = 978293.84

On 27 September at 1600 GMT the BGM/KSS meters were 6.0 meters below the pier.  (The gravity meters are 5.5 meters below C-deck, which was 0.5 meters below the pier.)

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_corr = hgt * constant
1.86 = 6.0 * .31

Gravity at BGM/KSS level:
grv_at_BGM/KSS_level = pier_grv_val + hgt_corr
grv_at_BGM/KSS_level = 978293.84 + 1.86

grv_at_BGM/KSS_level = 978295.70

BGM-3

BGM-3 reading:
On 27 September 92 (jday 271) at 1600 Z
BGM_grv_val = 978291.0

BGM-3 Mistie and Dc shift:

BGM_mistie = BGM_grv_val - grv_at_BGM_level
BGM_mistie = 978291.0 - 978295.70
BGM_mistie = -4.7

BGM_dc_shift = -4.7 mGal

BGM drift in mgal since last tie:

pre_BGM_mistie: -6.4 mgal on 20 Augest 1992 (day 233)
BGM_drift = BGM_mistie - pre_BGM_mistie
BGM_drift = (-4.7) - (-6.4)
BGM_drift = 1.7 mgal

BGM drift rate per day = BGM_drift/number of days from last tie
BGM drift rate per day = 1.7/38
BGM drift rate per day = 0.0447

KSS-30

KSS-30 reading:

On 27 September 92 (jday 271) at 1616 Z
KSS_grv_val = -1873.60

KSS-30 DC shift:

KSS_dc_shift = KSS_grv_val - grv_at_KSS_level
KSS_dc_shift = (-1873.60) - (978295.70)
KSS_dc_shift = -980169.30

KSS-30 Mistie:

BIAS of 980170.29
KSS_mistie = (BIAS + KSS_grv_val) - grv_at_KSS_level
KSS_mistie = (980170.29 + (-1873.60)) - 978295.70
KSS_mistie = 0.99

KSS-30 drift:

prev_KSS_mistie: 0.8 mgal on 20 Augest 1992 (day 233)
KSS_drift = KSS_mistie - prev_KSS_mistie
KSS_drift = (0.99) - (0.80)
KSS_drift = 0.19

KSS-30 drift rate per day = KSS_drift/number of days from last tie
KSS-30 drift rate per day = 0.19/38
KSS-30 drift rate per day = 0.0050

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Also logged on this cruise, were continueous pCO2 data of the sea surface and of the air.

The Woods Hole Oceanographic Institution also took 15 Jumbo Piston Cores.

| CORE | JDAY | Hit time |
|---|---|---|
| 1 | 244 | 1336 |
| 2 | 244 | 2113 |
| 3 | 247 | 1228 |
| 4 | 247 | 1817 |
| 5 | 251 | 0900 |

| | | |
|---|---|---|
| 6 | 253 | 2114 |
| 7 | 254 | 1921 |
| 8 | 255 | 1629 |
| 9 | 256 | 1551 |
| 10 | 258 | 2024 |
| 11 | 259 | 0328 |
| 12 | 260 | 0700 |
| 13 | 261 | 0619 |
| 14 | 262 | 0425 |
| 15 | 262 | 0208 |