LAMONT DATA REDUCTION CRUISE SUMMARY

CRUISE: EW9101

START: 02/01/91 032 Punta Arenas, Chile

END: 03/16/91 075 Punta Arenas, Chile

PURPOSE:
From John Mutter's cruise report:
"...Geophysical study of the Pacific Margin of Antarctica including the Antarctic Peninsula and areas south to the intersection of the Heezen Fracture Zone with the margin at approximately 69 deg. south. The objectives of the program were, broadly, to study an area which is believed to be the modern counterpart of the Andean orogenic belt. In its relatively recent development the tectonic events that have effected this margin include ridge subduction between the Hero and Heezen Fracture Zones, extension in the orogenically thickened continental crust to form the Bransfield Straits, and subduction along the South Shetland Trench."

CHIEF SCIENTISTS: James Austin, John Mutter, Tom Shipley

DATA REDUCTION: Robert Blaes

Description of Instruments and Processing

As the 1st step in processing for all data types, we check the ascii records and discard any that are not in the proper format or sequence.

SPEED AND HEADING:

Instrument: Furuno CI-30 2-axis Doppler speed log, Sperry MK-27 gyro
Logging: 3 second intervals
Checking: data plotted and checked visually
Smoothing: mean value of all good values within the same minute

TRANSIT SATELLITE FIXES:

Instrument: Magnavox MX-1107RS dual frequency Transit satellite receiver
Logging: 2 receivers logging all fixes.
Checking: rejected receiver flagged fixes, fixes with high drifts in navigation and fixes producing improbable track lines.
Note: For this cruise, we used no Transit derived fixes in the final navigation. The more accurate GPS left no need for another nav. source.

GPS SATELLITE FIXES:

Instrument: Magnavox T-Set Global Positioning System receiver
Logging: set #1 : 2 second intervals; set #2 : 20 second interval
Checking:
- minimum number of sats: 3
- dilution of precision maximum: north = 6.0, east = 6.0
- carrier signal-noise ratio minimum: 35.0
- standard deviation maximum: north = 10.0, east = 10.0
- time step maximum: 3
- speed maximum: 18.0
- 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 improbable track lines

Interpolation: interpolated positions at 00, 30 seconds of each minute
Smoothing: smoothed interpolated positions with 9 point running average
Note: GPS receiver #1 was the predominantly used as a source for the the final navigation. GPS receiver #2 was used when it showed a more credible track, after meeting the same standards for checking. Below is a list of time ranges when the #2 receiver was used in the final navigation:

032:18:37	to	032:19:59
035:01:30	to	035:01:59
036:18:17	to	036:18:58
054:20:00	to	054:20:59
056:18:00	to	056:18:59
056:23:00	to	056:23:54
057:00:03	to	057:01:39
066:08:31	to	066:09:00
069:00:35	to	069:00:55

072:15:00 to 072:15:59
073:15:30 to 073:17:59

TRUE TIME CLOCK:

Instrument: Kinemetric True Time Division Model 468-DC # 1
Logging: 1 minute interval.
Checking: Plot of calibration results compared to the time according to Transit Satellite Receiver #1.

Note: True Time clock #1, used to calibrate the cpu time tags, remained solely referenced by the the 5 Mhz frequency standard. This was done to insure a steady time source despite the fact that we were operating out of the range of the True Time satellite. The GPS clock was logged as data type "tr2". It was analyzed and plotted, but was not used to calibrate data. These facts have no bearing on the final data except to emphasize that the time of each record has stood up to scrutiny.

NAVIGATION:

A "1 minute navigation" is produced from the above sources. Acceptable fixes are merged at 1 per minute with priority given to GPS receiver # 1, then to #2. 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. This navigation set was plotted along side that derived by URI. By visual comparison, we found them not to differ by any discernible distance most of the time. Rarely they differed as much as .2 miles.
Principal Investigators' final data: 1 minute navigation.
Lamont database & MGD77: 1 minute navigation.

BATHYMETRY:

Instrument: KRUP ATLAS HYDROSWEEP
Logging: The center beam of each SURVEY record of Hydrosweep is used. Intervals vary, dependent on depth: about every 6 sec. at 4000 m., more often at less depth.
Checking: visual check of plot of data
Note: For the most part, the data derived from the Hydrosweep vertical beam is taken as the valid depth. Over the whole cruise, there were 9 points that the HS data was flagged as bad and not used for depth in the final bathymetry:

91-035:20:08:00.000	176.3
91-035:20:09:00.000	169.0
91-035:20:10:00.000	172.5
91-035:20:11:00.000	170.0
91-035:20:12:00.000	89.0
91-036:00:32:00.000	92.2
91-036:00:33:00.000	2206.9
91-061:18:40:00.000	1026.1
91-061:18:41:00.000	902.0

BATHYMETRY (continued):

The Hydrosweep was not operating from 040+09:00 to 040+18:00, the bathymetry for this period was hand digitized at 5 minute intervals from the 12.5 KHz PDR records.

There is a gap in the bathymetry data set from 073:01:09 to 073:03:25

Principal Investigators' final data: depth linear interpolated from center beam values closest to zero seconds of each minute. Depth is in meters.
Lamont database: Same as above. Depth is in fathoms.
MGD77: Same as above, depth is in seconds of 2 way travel time.

MAGNETICS:

Instrument: Varian V75 magnetometer
Logging: 20 second intervals for days 32 through 58, 6 second intervals from day 58 on to the end of the cruise.
Checking: data plotted and checked visually

Note: Before interpolating to the even minute values, the magnetic total intensity data was COMPARED to a set of the data that had been filtered. If the difference between the raw and filtered data was greater than a certain value, it was flagged as invalid and not used in interpolating the final data. This value was varied from day to day to maximize the sensitivity to spikes, and thus keep the number of data points flagged to a minimum. The magnetics total intensity data represented in the final data set has NOT been filtered in any way other than the linear interpolation necessary to derive a value at zero seconds of each minute.
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 1991.0
Residual field: Applied by bilinear interpolation across a 1 degree square.
Principal Investigators' final data: interpolated total intensity value at 00 seconds of each minute. Magnetic anomalies at 00 seconds of each minute.
Lamont Database: interpolated total intensity value at 00 seconds of each minute
MGD77: Interpolated total intensity and residual field at 00 seconds of each minute.

There is no magnetics data during the following range of times:
prior to 036:14:10
038:00:30 to 039:02:34
054:17:32 to 055:03:11
056:12:40 to 057:09:22
057:15:46 to 057:15:53
063:04:03 to 063:04:08
069:14:08 to 069:14:11
071:08:52 to 071:12:22

073:00:45 to 073:00:52
after 074:20:00

GRAVITY:

Instrument: Boogenwerk KSS-30 Marine Gravity Meter,
Logging: Observed gravity at 6 second intervals, 1st record after
the even minute was used to represent that minute in the
final data.

Instrument: Bell Aerospace BGM-3 marine gravity meter
Logging: 1 second count minute intervals.
Note: processing to derive observed gravity: 60 point filter
width used to derive 15 second observed gravity using the
"k_grv.c" program, which uses a bias of 855758.1 and a
scale factor of 4.952164 in the counts to mgals of gravity
conversion. Then this is filtered with the "gmt" software
package using a 8 minute wide Gausian filter with the robust
option, "-R" to remove spikes. The program used is
"filter1d", written by Paul Wessel.
His address is: wessel@kiawe.soest.hawaii.edu

The KSS-30 gravity meter performed better on this cruise, and
is predominantly the source of the final gravity. This
meter is more susceptible to being put out of commission
by rough weather. Data from the BGM was spliced in on
occasions when its data was acceptable and the KSS was
down.
The BGM was inoperable from 058:05:00 (Feb 27) until 072:20:20
(Mar 13), when it was repaired by Joe Stennett.

This is a list of times when the BGM derived gravity was used
in the final data set, otherwise the KSS-30 was used:

035:03:06 to 035:12:27
036:16:35 to 036:19:45
054:19:40 to 054:21:58
056:09:58 to 057:03:56
073:13:58 to 073:18:39

This is the list of time when there was no acceptable gravity
recorded:
034:15:50 to 035:03:06
036:19:43 to 037:01:25
061:17:01 to 062:20:14
073:18:39 to 074:07:53

Merge with navigation: calculate Eotvos correction and Free Air Anomaly.
Checking: data plotted and checked visually for satisfactory
Eotvos corrections, rejected spikes of data at turns.
See note for magnetics above for technique used in
flagging spikes. A similar method was use here comparing
the free air anomaly to a filtered data set, and from the
comparison judging spikes and flagging the point unacceptable.
Velocity smoothing: 5 minute running average.
P.I.s' final data & MGD77: 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).
Lamont database: Free Air Anomaly value at 00 seconds of each minute.
1930 International gravity formula.

CRUISE GRAVITY TIE-IN: pre ew9101 ** looks better with tabstop=8 **
Port: Punta Arenas, Chile Date: Jan 28,91 Operator: Stennett
Reference Station: TIED TO PIER, USING PREVIOUS GRAVITY VALUE
Filtration Plant (see C2901 cruise summary for original tie.)
Pier/Ship's position: Taken from c2901 tie on 12-13 Feb. 1988.
The conrad was 100m. from the end of the P.A. pier.

Gravity meter:
Temperature of meter:

TIME	LOCATION	L&R READING	G	Potsdam corr.
____Z	Pier	____.___+- .05		
____Z	Ref	____.___+- .05	981315.9	NO
____Z	Pier	____.___+- .05		

READ FROM DEVICES BY DATA LOGGING COMPUTER:
1738Z BGM filtered mgals: 981365.8
1738Z KSS-30 unbiased mgals: 1176.07
Pier reading 0.5 m above waist deck. Waste deck is 5.5 m. above gravity lab. Difference between pier and gravity lab: 6.0 m. hgt.

GRAVITY AT SENSOR CALCULATION: Lacoste difference in LR units:
delta_LR = pier_LR - ref_LR
_._ = ____.__ - ____.__

Difference in mgal: (1 LR unit = 1.06 mGals)
delta_mgal = delta_LR * constant
_._ = _._ * 1.06

Pier gravity value in mgal: ref_val = G - 13.6 if NOT Potsdam Corrected
pier_grv_val = ref_val + delta_mgal
981321.7 = 981302.3 + 19.4 <--from P.A. tie 2/13/88

Height correction in mgal: (constant is + if meter is below pier)
hgt_corr = hgt * constant
1.9 mGal = 6.0 m * (+/-) 0.31 mGal/m

Gravity at gravity lab level in mgal:
grv_at_lab_level = pier_grv_val + hgt_corr
981323.6 = 981321.7 + 1.9

DRIFT CALCULATION:
BELL GRAVIMETER:
BGM_filt_grv = (scale factor * counts) + bias = 981365.8
using s.f. 4.952164 and bias 855758.1, filter width 480. (8 minutes)

Mistie in mgal:
mistie = BGM_filt_grv - grv_at_lab_level
42.2 = 981365.8 - 981323.6

Drift in mgal since last tie:
prev_mistie: 34.0 mgal on date Dec 16, 1990
drift = mistie - prev_mistie

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                8.2  =  42.2  -   34.0
      KSS-30:
            KSS_grv_val =  kss_unbiased_output + bias
             981346.36  =       1176.07        +  980170.29

            Mistie in mgal:
                  mistie = KSS_grv_val - grv_at_lab_level
                   22.76 =   981346.36 -  981323.6

            Drift in mgal since last tie:
            prev_mistie:  19.41 mgal on date   Dec 16, 1990
                  drift = mistie - prev_mistie
                   3.35 =  22.76 -  19.41
INCLUDE SKETCHES, MAPS AND COPIES OF REFERENCE BELOW.
CRUISE GRAVITY TIE-IN:   pre ew9102       ** looks better with tabstop=8 **
      Port: Punta Arenas, Chile   Date: Mar 18,91     Operator:  Stennett
      Reference Station:   TIED TO PIER, USING PREVIOUS GRAVITY VALUE
      Filtration Plant ( see C2901 cruise summary for original tie. )
      Pier/Ship's position:   Taken from c2901 tie on 12-13 Feb. 1988.
      This tie, the Ewing is in same place, as the previous tie, but turned
      around.  hdg 340, gps w/ 4 sats: S 53 10.1770 W70 54.3954
      Gravity meter:
      Temperature of meter:
      TIME  LOCATION    L&R READING       G     Potsdam corr.
      ____Z Pier        ____.___+- .05
      ____Z Ref         ____.___+- .05         981315.9         NO
      ____Z Pier        ____.___+- .05

      READ FROM DEVICES BY DATA LOGGING COMPUTER:
      1900Z BGM filtered mgals:            981377.9
      1900Z KSS-30 unbiased mgals:           1175.50
      Pier reading 0.0 m above waist deck. Waste deck is 5.5 m. above
      gravity lab.  Difference between pier and gravity lab: 5.5 m. hgt.
GRAVITY AT SENSOR CALCULATION: Lacoste difference in LR units:
            delta_LR = pier_LR - ref_LR
            _._    = ____.__ - ____.__

      Difference in mgal:   ( 1 LR unit = 1.06 mGals )
            delta_mgal = delta_LR * constant
            _._        = _._      *   1.06

      Pier gravity value in mgal: ref_val = G - 13.6 if NOT Potsdam Corrected
            pier_grv_val = ref_val   + delta_mgal
            981321.7     = 981302.3  +  19.4  <--from P.A. tie 2/13/88

      Height correction in mgal:  ( constant is + if meter is below pier )
            hgt_corr = hgt * constant
             1.7  mGal =  5.5 m * (+/-) 0.31 mGal/m

      Gravity at gravity lab level in mgal:
            grv_at_lab_level =  pier_grv_val + hgt_corr
                 981323.4    =    981321.7   + 1.7
DRIFT CALCULATION:
      BELL GRAVIMETER:
      BGM_filt_grv = ( scale factor * counts ) + bias  = 981365.8
      using s.f. 4.952164 and bias 855758.1, filter width 480. ( 8 minutes)
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Mistie in mgal:
mistie = BGM_filt_grv - grv_at_lab_level
54.5 = 981377.9 - 981323.4

Drift in mgal since last tie:
prev_mistie: 42.2 mgal on date Jan 28, 1991
drift = mistie - prev_mistie
12.3 = 54.5 - 42.2

KSS-30:
KSS_grv_val = kss_unbiased_output + bias
981345.79 = 1175.50 + 980170.29

Mistie in mgal:
mistie = KSS_grv_val - grv_at_lab_level
22.39 = 981345.79 - 981323.4

Drift in mgal since last tie:
prev_mistie: 22.76 mgal on date Jan 28, 1991
drift = mistie - prev_mistie
-0.37 = 22.39 - 22.76

INCLUDE SKETCHES, MAPS AND COPIES OF REFERENCE BELOW.