LAMONT-DOHERTY GEOLOGICAL OBERVATORY

DATA REDUCTION CRUISE SUMMARY

" A *GLORIA, HYDROSWEEP, geophysical* investigation of the Juan Fernandez microplate"

PAPEETE, TAHITI - VALPARAISO, CHILE
06/16/91 (JD 167) -- 07/27/91 (JD 208)

CHIEF SCIENTIST: Roger Larson, URI

DATA REDUCTION: Suzanne O'Hara

POST PROCESSING: Stefanus Budhypramono

R/V *MAURICE EWING*

EW-9104

SCIENCE OVERVIEW:

A *GLORIA, Hydrosweep,* geophysical investigation of the Juan Fernandez microplate at the Pacific-Antartica-Nazca triple junction.

COMMENTS:

The data on the JD 167, 168, 169, 206, 207 and 208 were left unprocessed on the ship for reason unknown to us. These data represents the 3 days at the beginning of cruise and three days at the end of cruise. JD 167, 168, 169 and part of JD 206 was later processed back at Lamont. Due to the limited amount of time assigned into finishing up these data sets, JD 207 and 208 were still left unprocessed.

TRUE TIME CLOCK:

Instrument: *Kinemetric/TrueTime Division Model 468-DC*
Kinemetric/TrueTime Division Model GPS-DC GPS Synchronized Clock
Logging: 1 minute intervals
Checking: visual check of plot of data

Note:
Both true time are connected to a 5065A Rubidium Vapor Frequency Standard and GPS-DC true time is being used throughout the cruise to calibrate the data.

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

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

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 = 6.0, east = 6.0
carrier signal-noise ratio minimum: 35.0
standard deviation maximum: north =6.0, east = 6.0
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:
GPS Set #1 was used to reduce LAMONT navigation

DAY	TIME	COMMENTS
169	0804-2358	GPS #1 data was not available ; reason unknown GPS #2 was used towards final nav.

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 navigation.

FORMAT: 9104n.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.

Note :
The navigation was processed daily by Suzanne O'Hara during the cruise. The final navigation files for this data set was contructed based on the most current version of GPS fixes left at the end of the cruise.

BATHYMETRY:

Instrument: *Krupp Atlas Hydrosweep Center Beam*
Logging: At each ping of *Hydrosweep*, data is being broadcasted real time to the network, which is received by data logger. The logger computer then extracted the center beam depth.
Checking: minimal visual check of plot of the interpolated data

Chief scientist's final data: final calibrated and cleaned data
Depth is in meters.

FORMAT: 9104hb.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: final calibrated and cleaned data.
Depth is in fathoms.

Note:
The *Hydrosweep* instrument hasn't been performing very well. It is apparent in the number of spikes and the general noise seen in the data.The data was cleaned minimally to preserve its contour.

DAY	TIME	COMMENTS
168	0205	started logging
178	0026-0117	no hydrosweep data ; reason unknown
180	1811-1944	no hydrosweep data ; reason unknown
178	0026-0117	no hydrosweep data ; reason unknown
206	0206	end of cruise, stopped processing

MAGNETICS:

Instrument: *Varian V75 magnetometer*
Logging: 6 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.
Residual field: Applied by bi-linear interpolation across a 1 degree square.

Chief Scientist's final data: final calibrated and cleaned data.

FORMAT: 9104mg.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_intensity anomaly
```

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

NOTE:

DAY	TIME	COMMENTS
172	0418	started logging
172	1851-1947	no magnetic data, reason unknown
201	0104-0153	no magnetic data, reason unknown
203	2101	maggie off the water, end of logging

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 throughout the cruise

Chief scientist's final data: none.

1980 theoretical gravity formula:

$$Y_0 = 978.0327 \times (1 + .0053024 \times \sin(\Theta) \times \sin(\Theta) - .0000058 \times \sin(2 \times \Theta) \times \sin(2 \times \Theta))$$

FORMAT: 9104vt.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

Lamont database: none.

Note:

The BGM-3 data was determined to be inaccurate through out the entire cruise.The data was collected and later processed to fill the gaps in KSS-30 data.

As a result of the discussion amongst the MG&G group, it is decided that Lamont Data Reduction will use gravity Ref. value without Potsdam correction for gravity data sent to MG&G data base at Lamont.

Further discussion also revealed that *1980 theoretical gravity formula* has incorporated Potsdam correction in its formula.

DAY	TIME	COMMENTS
167	1925	started logging
206	0206	end of cruise; stopped processing

KSS-30 GRAVITY:

Instrument: *Bodenseewerke 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, reject spikes of data at turns.
Velocity smoothing: 5 point running average throughout the cruise

Chief scientist's final data: Observed, Eotvos, Free Air Anomaly value
at 00 seconds of each minute.

1980 theoretical gravity formula:

$$Y_0 = 978.0327 \times (1 + .0053024 \times \sin(\Theta) \times \sin(\Theta) - .0000058 \times \sin(2 \times \Theta) \times \sin(2 \times \Theta))$$

FORMAT: 9104vk.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

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

Note:

KSS-30 is used as the primary gravity source.

As a result of the discussion amongst the MG&G group, it is decided that Lamont Data Reduction will use gravity Ref. value without Potsdam correction for gravity data sent to MG&G data base at Lamont.

Further discussion also revealed that *1980 theoretical gravity formula* has incorporated Potsdam correction in its formula.

DAY	TIME	COMMENTS
167	1926	started logging
171	1520-1701	no KSS-30 data, used BGM-3 data to fill gaps
175	1645-2359	no KSS-30 data, used BGM-3 data to fill gaps
176	0000-0031	no KSS-30 data, used BGM-3 data to fill gaps
179	2220-2359	no KSS-30 data, used BGM-3 data to fill gaps
180	0000-2359	no KSS-30 data, used BGM-3 data to fill gaps
181	0000-1640	no KSS-30 data, used BGM-3 data to fill gaps
191	1930-2030	no KSS-30 data, used BGM-3 data to fill gaps
192	0245-0650	no KSS-30 data, used BGM-3 data to fill gaps
206	0206	end of cruise; stopped processing

PRE-CRUISE GRAVITY TIE-IN:

Port: Papeete, Tahiti
Date: Jun 15, 1991 (JD 166)
Operator: William J, Robinson, Suzanne O'Hara
Reference Station: Code THT-N Papeete - Quai d'Honnenur
17 35.5 S 149 34.1 W. Alt = 2m, This reference station is 50 m. from the pier and was used as the pier value.
Pier/Ship's position: The ship is docked in front of the custom house, Area of Quai d'Honnenur
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?
	Pier			
	Ref		978699.3	YES
	Pier			

TIME	GRAVITY	G READING
2205Z	BGM-3	978779.4
2205Z	KSS-30	-1454.49

Pier reading -1.0 m above waist deck. Waist deck is 5.5 m above
Difference between pier and gravity lab : 5.5 + (-1.0) = 4.5 m.

Lacoste difference in LR units:
delta_LR = pier_LR - ref_LR
0.0 =

Difference in mgal: (1 LR unit = 1.06 mGals)
delta_mgal = delta_LR x constant
0.0 = 0.0 x 1.06

Pier gravity value in mgal: rev_val = G + 13.6 if IT IS Potsdam corrected.
pier_grv_val = ref_val + delta_mgal
978712.9 = 978699.3 + 13.6 + 0.0

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_corr = hgt x constant
1.4 mGal = 4.5 x 0.31 mGal/m

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

978714.3 = 978712.9 + 1.4

BGM-3:

Mistie in mgal:

mistie	= BGM_grv_val	- grv_at_lab_level
65.1	= 978779.4	- 978714.3

Drift in mgal since last tie:

prev_mistie: 53.8 mGal on date May 10, 1991

drift	= mistie - prev_mistie
11.3	= 65.1 - 53.8

KSS-30:

KSS_grav_val	= kss_unbiased_output	+ bias
978715.8	= -1454.49	+ 980170.29

Mistie in mgal:

mistie	= KSS_grv_val	- grv_at_lab_level
1.5	= 978715.8	- 978714.3

Drift in mgal since last tie:

prev_mistie: 7.3 mGal on date May 10, 1991

drift	= mistie - prev_mistie
-5.8	= 1.5 - 7.3

POST-CRUISE GRAVITY TIE-IN:

Port: Valparaiso, Chile
Date: July 27, 1991 (JD 208)
Operator: Joe Stennett
Reference Station: ACIC 0301-1, 33 02' S 71 37' W
Pier/Ship's position: at pier, 33 02' S 71 37' W
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?
1406Z	Pier	3242.5+- .05		
1431Z	Ref	3241.5+- .05	979632.5	NO
1445Z	Pier	3242.5+- .05		

TIME	GRAVITY	G READING
1720Z	BGM-3	979720.4
1720Z	KSS-30	-533.51

Pier reading 1.5 m above waist deck. Waist deck is 5.5 m above gravity lab.
Difference between pier and gravity lab : 5.5 + 1.5 = 7.0 m.

Lacoste difference in LR units:
delta_LR = pier_LR - ref_LR
1.0 = 3242.5 - 3241.5

Difference in mgal: (1 LR unit = 1.06 mGals)
delta_mgal = delta_LR x constant
1.06 = 1.0 x 1.06

Pier gravity value in mgal:
pier_grv_val = ref_val + delta_mgal
979633.56 = 979632.5+ 1.06

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_corr = hgt x constant
2.17 mGal = 7.0 x 0.31 mGal/m

Gravity at gravity lab level in mgal:
grv_at_lab_level = pier_grv_val + hgt_corr
979635.73 = 979633.56 + 2.17

BGM-3:

BGM_filt_grv = (scale factor x counts) + bias = 979720.4
using s.f. 4.952164 and bias 855758.1, filter width 480. (8 minutes)

Mistie in mgal:

mistie	= BGM_grv_val	- grv_at_lab_level
84.67	= 979720.4	- 979635.73

Drift in mgal since last tie:

prev_mistie: 65.1 mgal on date June 15, 1991

drift	= mistie - prev_mistie
19.57	= 84.67 - 65.1

==> ***DC Shift*** = prev_mistie
= 65.1

Drift/Day = drift / (tot. # of day)
= 19.57 / (208 - 166)
= 19.57 / 42 = 0.466

KSS-30:

KSS_grav_val	= kss_unbiased_output	+ bias
979636.78	= -533.51	+ 980170.29

Mistie in mgal:

mistie	= KSS_grv_val	- grv_at_lab_level
1.05	= 979636.78	- 979635.73

Drift in mgal since last tie:

prev_mistie: 1.5 mgal on date June 15, 1991

drift	= mistie - prev_mistie
-0.45	= 1.05 - 1.5

==> ***DC Shift*** = prev_mistie - bias
= 1.5 - 980170.29
= -980168.79

Drift/Day = drift / (tot. # of day)
= 2.77 / (208 - 166)
= -0.45/42 = -0.0107