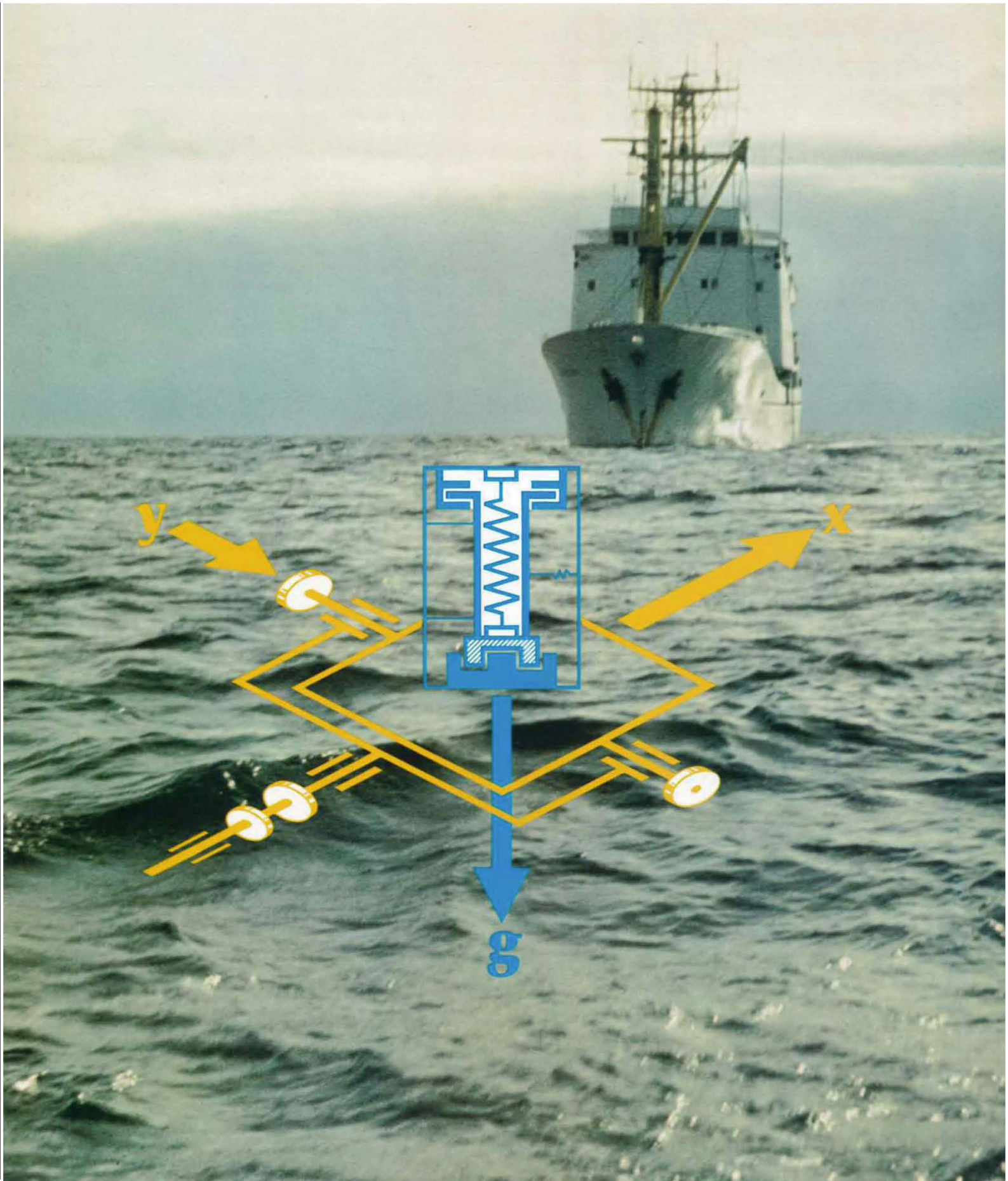
PRAKLA-SEISMOS INFORMATION No.36

Highly Accurate Sea Gravity



Highly Accurate Sea Gravity

The gravity meter Bodenseewerke type KSS-30 is PRAKLA-SEISMOS' most modern sea gravity meter. It can be used independently, or simultaneously with other marine geophysical operations. The system is constructed for flexible installation in a wide range of existing vessels. The sensor, mounted on a gyro-stabilized platform, should be set-up as near as possible to the vessel's centre of gravity in a compact airconditioned container, while the electronic part can be located up to 30 m distant in an existing room or additional office container. This system, described below, proved to be three to four times more accurate than comparable other systems.

Instrumentation

The sea gravity meter KSS 30 is divided into three sub-systems

- Gravity sensor GSS 30
- Gyro-stabilized platform KT 30
- Data handling and control system ZE 30

Best precision mechanics and electronics guarantee highest accuracy

- Vertical non-astatized tube shaped mass
- Non-sensitive in horizontal direction
- Temperature stabilized, pressure tight and magnetic shielded housing
- Ball calibration device
- Electrical damping of superposed vertical accelerations
- PI-feedback loop
- Capacitive displacement transducer. Sensitivity $<0{,}02$ mgal
- Detection of changes in gravity by an electromagnetic system
- Analog/pulse rate conversion of the sensor output, range: 10 000 mgal, instrument drift: $<$ 3 mgal/month

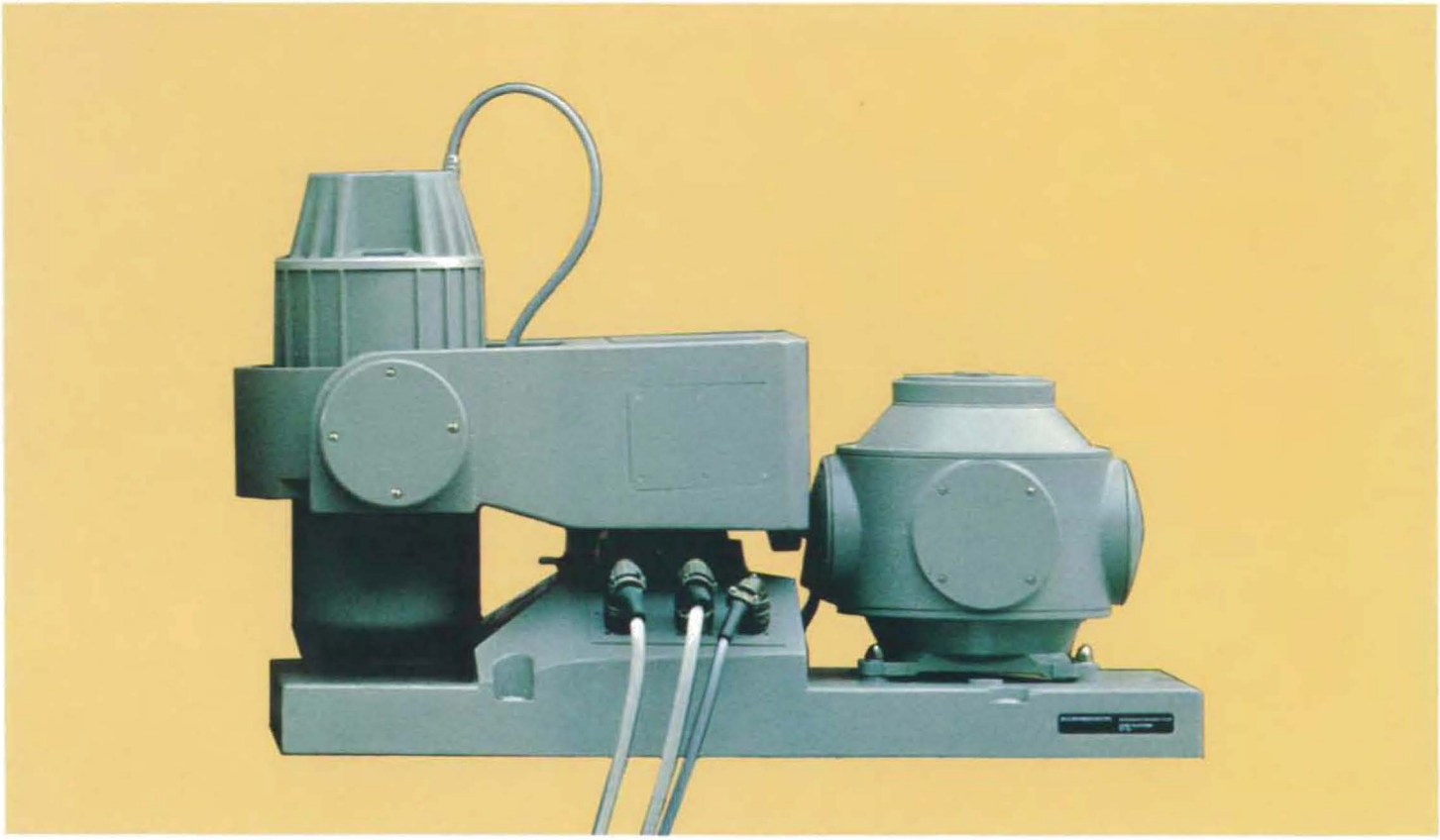
Gyro-stabilized platform with high dynamic accuracy

- Electrically erected vertical gyro (Anschütz)
- Continuous gyro erection control
- Continuous compensation for earth rotation, ship's speed, accelerations, and heading errors (deviations) by internal computer system

Improved accurycy and high reliability by computer control of sensor and gyrotable

- The amplitudes of accelerations caused by sea motion are reduced by approx. 75 dB
- Data exchange with navigation computer at 1 sec intervals
- Gyro erection control and compensation of acceleration
- Overall system control, display and monitoring of system functions
- Remote control of sensor and gyro
- Internal test routines for hard and software functions

▼ **Gyro, platform and gravity-sensor**

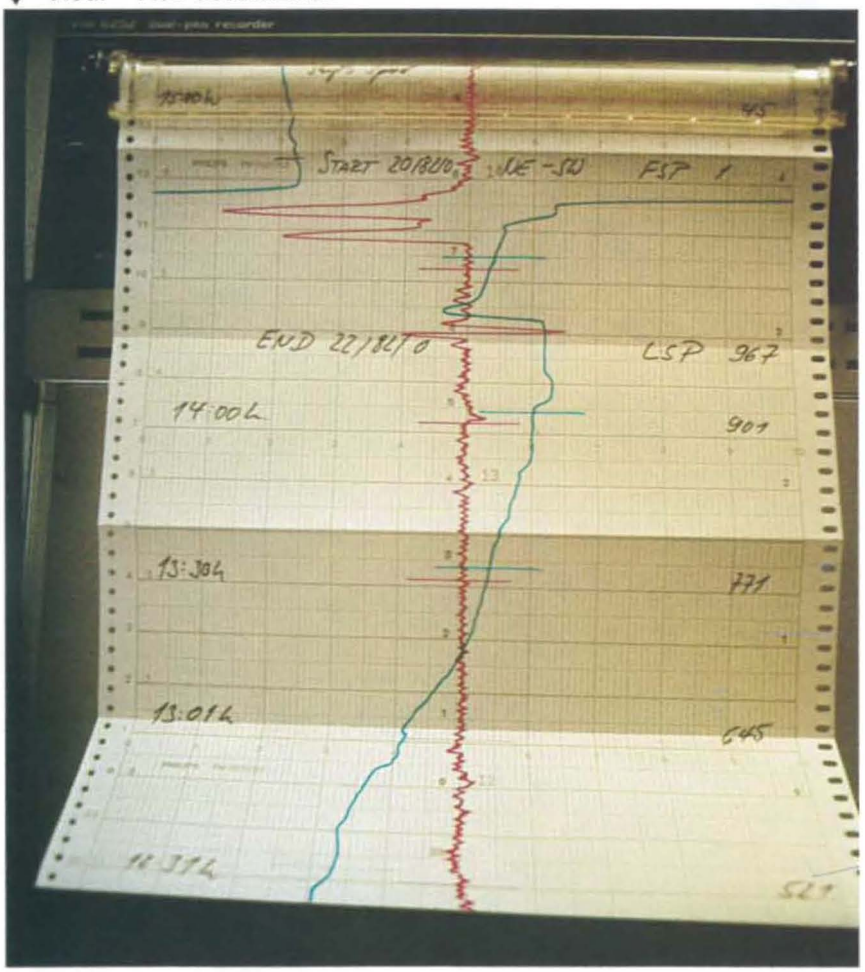


Airconditioned container housing platform and sensor to be installed at the ship's centre

Monitor recorder

Blue: Raw Gravity

Red: Roll-acceleration



Electronics unit of Gravity Meter

Sensor Electronic GE 30

Central System Control Unit ZE 30

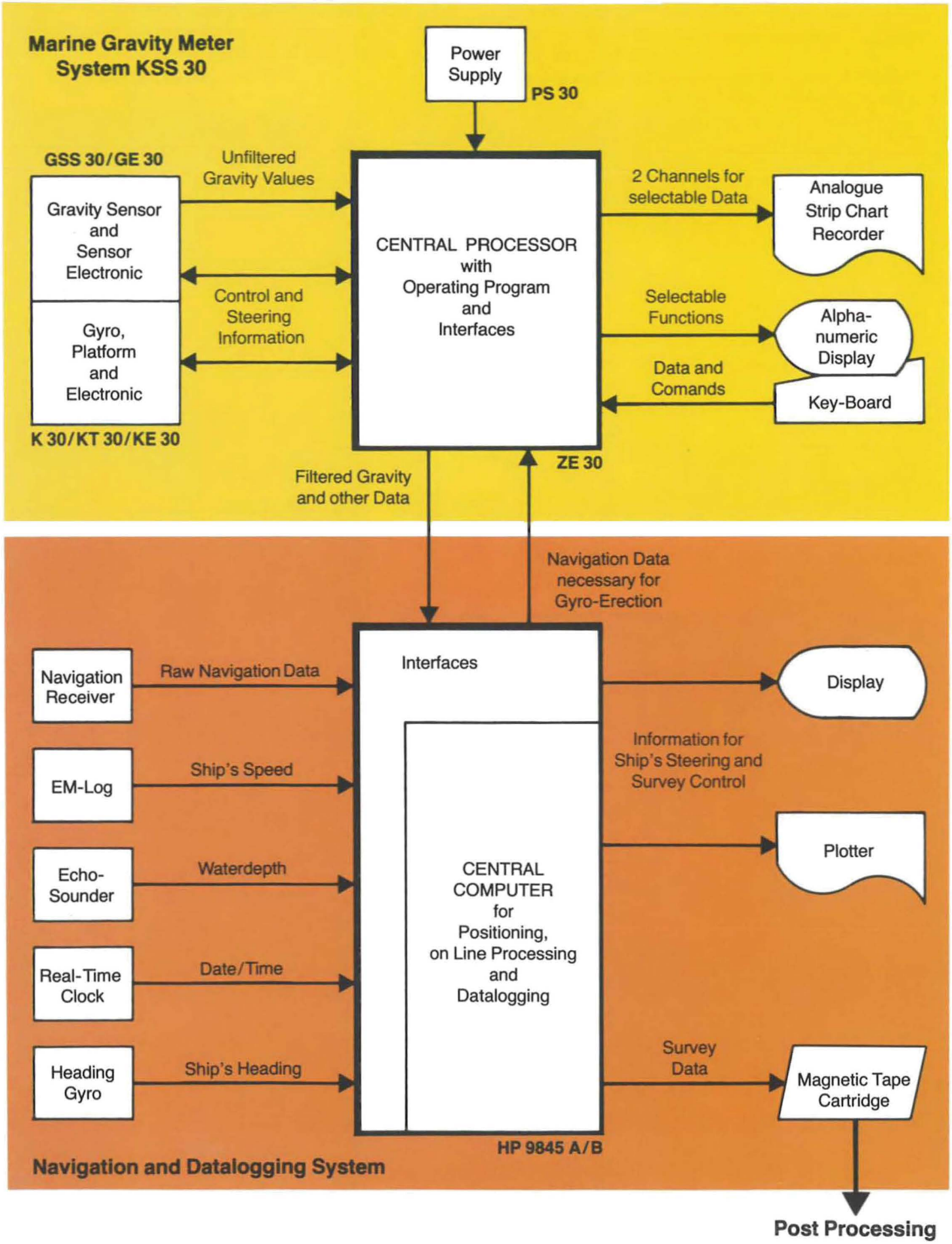
Analogue Recorder

Platform Electronic KE 30

Central Power Supply PS 30

Measuring Principle

Diagram of Data-flow



To obtain high quality sea gravity results accurate positioning, headings, and water depths are required.

The software of the navigation computer system handles:

- Continuous computation of position, position accuracy, speed and course
- Collection of data from peripheral units
- Transfer of data selected for gyro erection to the central system control unit ZE 30
- Presentation and display of survey result at selectable time intervals

Navigators position ▲

◀ **Navigation Electronics**
Echosounder and receivers

Printout of all Data recorded on cassettes ▼

FIX|LINE	TIME	RANGE 1	RANGE 2	RANGE 3	EASTING	NORTHING
	GRAVITY RAW EOTVOS	SEASTATE	LOTUNG	GYRO	HEADING	SPEED
1445|118/82/	05:06:23:35:08	40900.1	87791.9	13632.8	382266.86	49154.86
	-29.04 29.53	2	14.40	40.40	40.94	8.44
1447|118/82/	05:06:23:35:36	40991.6	87914.4	13604.7	382346.18	49249.06
	-28.86 29.45	2	14.40	41.20	40.97	8.45
1449|118/82/	05:06:23:36:04	41083.1	88034.7	13583.4	382426.98	49337.99
	-28.65 29.60	2	13.80	41.40	41.09	8.45
1451|118/82/	05:06:23:36:33	41177.0	88162.1	13558.5	382509.42	49434.42
	-28.66 29.36	2	14.30	39.80	40.82	8.46
1453|118/82/	05:06:23:37:01	41266.5	88283.0	13534.8	382587.34	49526.73
	-28.57 29.37	2	13.90	41.00	40.74	8.45
1455|118/82/	05:06:23:37:29	41359.9	88404.3	13514.2	382668.25	49618.03
	-28.44 29.45	2	13.90	40.50	40.91	8.45
1457|118/82/	05:06:23:37:57	41449.5	88526.3	13492.6	382746.39	49710.99
	-28.26 29.40	2	14.50	40.80	40.91	8.43

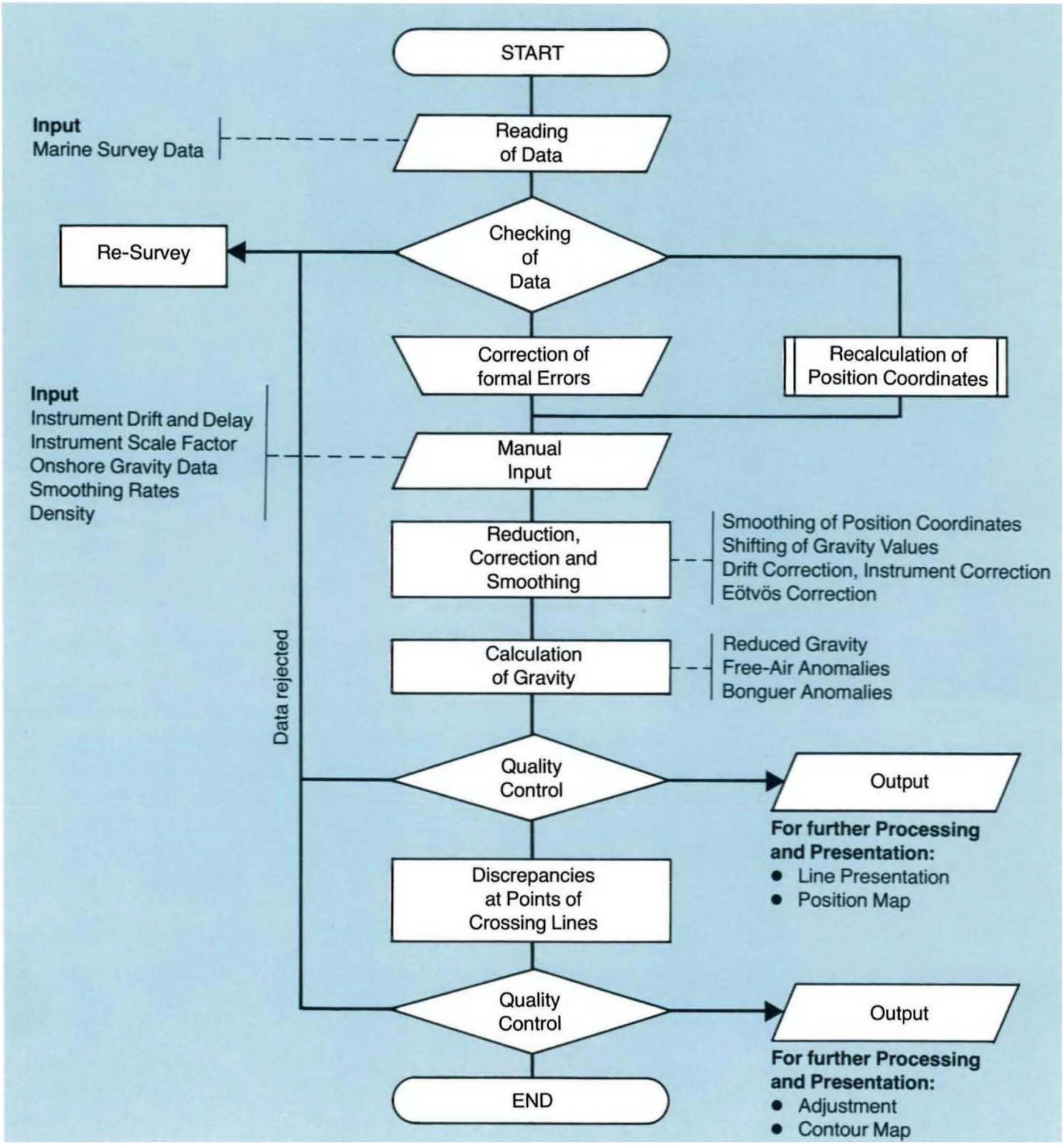
Onboard Processing and Quality Control

All field data recorded on cassettes are directly used for quality control and off-line processing of line-plots on board.

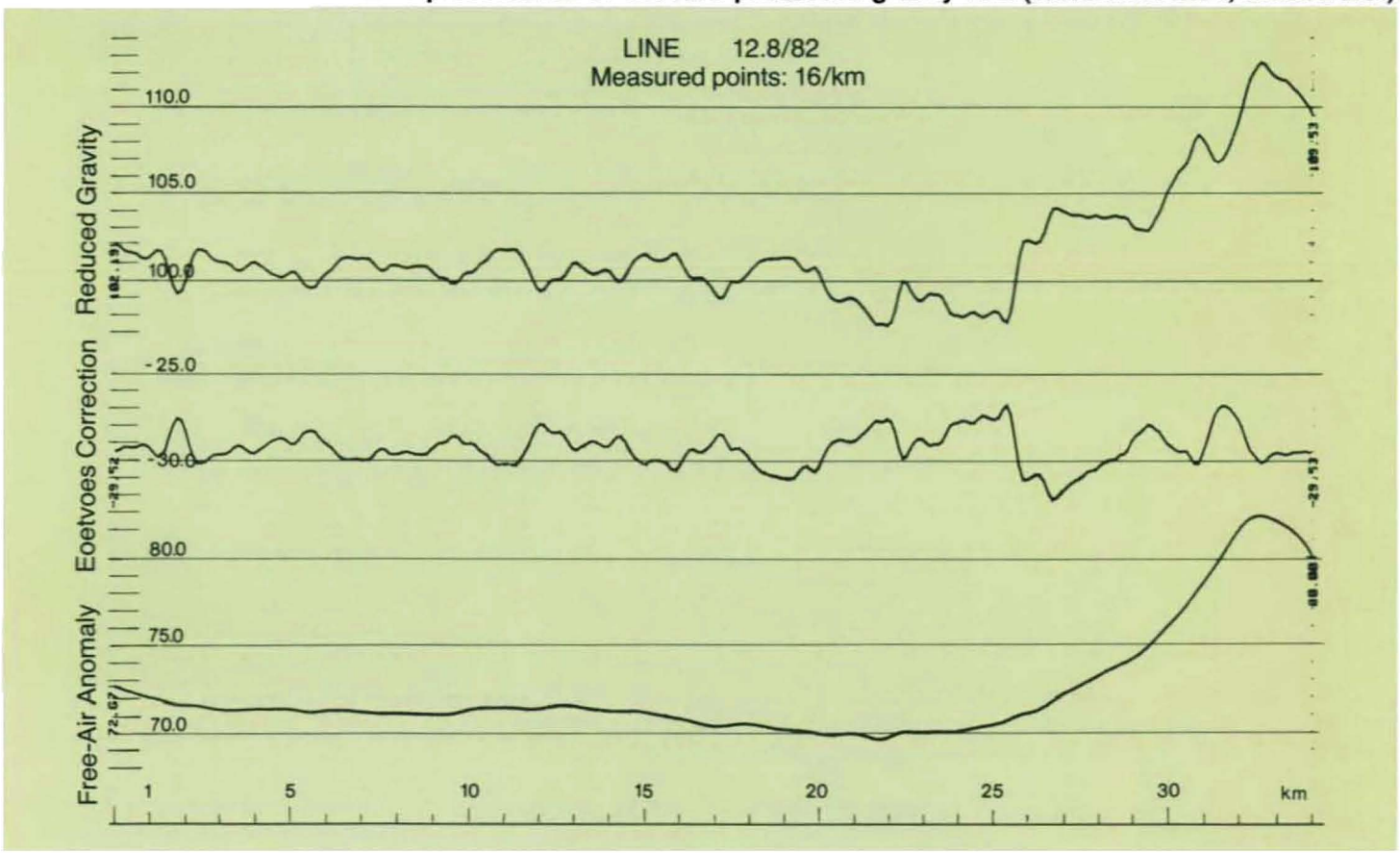
Field data recorded are:

- Fix no./line no.
- Date/time
- Raw navigation data
- Ship's coordinates at fixtime
- Raw gravity values
- Type of filter used
- Ship's heading
- Course over ground
- Speed
- Waterdepth

Flow-chart of Onboard Processing



Line presentation of onboard processed gravity data (Windforce: Bft 4; swell: 2 feet)



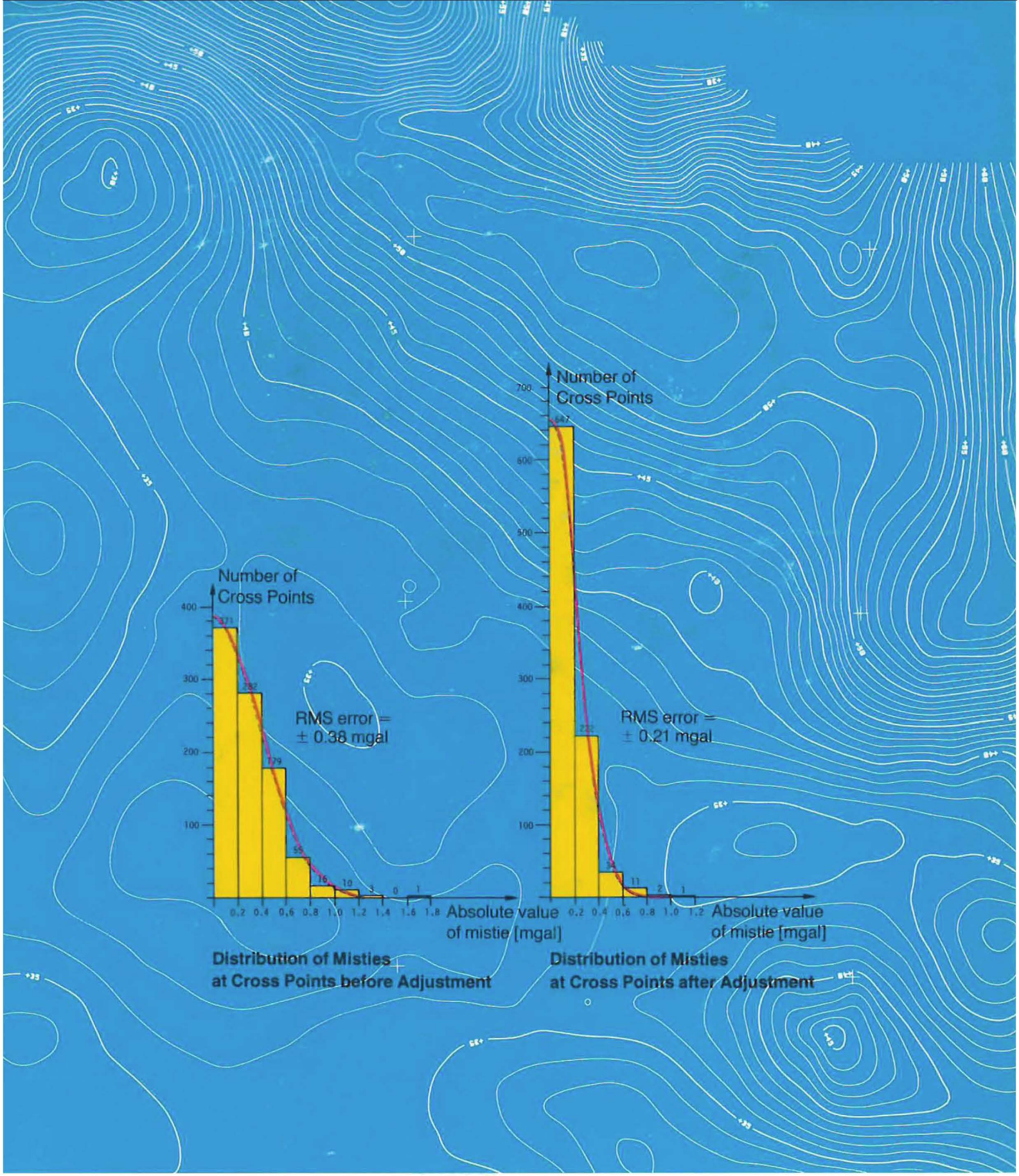
Printout for 2 lines showing, in the coloured columns at crosspoints with other lines, the discrepancies of water depth and Bouguer anomalies

CROSS POINTS OF LINE 5.0 A

Line	Record	o/e	East	North	W Depths		Bouguer	o/e	Diff W [m]	Diff B [mgal]
16.2	105	569	369592	29945	26	26	-4.17	-4.19	-0	.02
28.1	403	56	356013	41770	19	18	-12.03	-12.00	1	-.04
14.1	56	221	371878	28006	28	28	-3.03	-2.99	-1	-.04
30.0	450	57	353762	43761	17	18	-14.01	-14.42	-1	.42
18.2	156	55	367323	31913	27	28	-5.81	-6.06	-1	.25
20.2	207	491	365071	33906	26	26	-7.44	-7.27	-0	-.17
22.1	258	58	362821	35871	23	23	-8.54	-8.59	-0	.06
24.1	308	320	360567	37865	21	21	-9.45	-9.43	-0	-.02
26.1	356	54	358265	39807	22	23	-10.54	-10.58	-0	.04
24.0	308	1024	360579	37855	21	21	-9.45	-9.71	0	.26
26.0	356	53	358272	39802	22	22	-10.54	-10.24	-0	-.30
28.0	403	1003	356018	41765	19	19	-12.03	-12.39	-0	.36
18.1	156	54	367317	31919	27	27	-5.81	-5.79	0	-.02
20.1	206	657	365086	33893	26	27	-7.43	-7.62	-1	.19
22.0	258	54	362798	35892	23	24	-8.54	-8.59	-1	.04
16.1	105	749	369597	29941	26	26	-4.17	-4.38	-0	.21

CROSS POINTS OF LINE 7.0 B

Line	Record	o/e	East	North	W Depths		Bouguer	o/e	Diff W	Diff B
16.2	351	508	372245	33003	24	24	-4.41	-4.25	-0	-.15
28.1	57	121	358637	44800	17	17	-13.92	-13.65	0	-.27
14.1	400	283	374505	31026	24	24	-2.88	-3.12	-0	.24
18.2	303	120	369956	34972	25	25	-6.31	-6.61	-0	.30
20.2	255	429	367700	36935	25	25	-8.51	-8.34	0	-.18
22.1	207	123	365446	38893	22	21	-9.88	-9.92	0	.04
24.1	158	253	363158	40865	19	19	-10.84	-10.66	0	-.19
26.1	107	117	360890	42838	20	20	-12.09	-12.10	-0	.00



The background shows a contour map of Bouguer Anomalies as a final result of post-processed survey data. The histograms present the distribution of discrepancies at line intersections before and after adjustment. These were obtained on a sea gravity survey of nearly 4600 line km with 917 crosspoints. The vessel used was a freighter of 500 GRT, 74 m in length, 10.8 m beam, 4.0 m draught. The wind force varied between Bft 3 and 8, swell was up to 6 feet.

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