Lamont-Doherty Geological Observatory | *Palisades, N.Y. 10964*
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CRUISE REPORT

Ship Name: R/V VEMA Cruise No: V36-10

Departure: April 8, 1980 (Date) from Guam (Port)

Arrival: April 29, 1980 (Date) at Pago Pago, American Samoa (Port)

*

Days at Sea: 22
(Count day of departure but not day of arrival in port)

Days Foreign Port: 3
(number of days in arrival port before next leg)

Area of Operation:

Central Equatorial Pacific, transits through Western Equatorial Pacific

Program Description:

Detailed study of the relations between the sea-floor spreading pattern, the Nova-Canton Trough, and the seismic reverberant layer. Shipboard techniques include underway MG&G, large and small airgun profiling, and sonobuoys.

Program supported by what contract: OCE 79-18793

Participants: (All L-DGO unless otherwise specified)

Name	Title
R. D. Jarrard	Chief Scientist
S. Hudson	Data Technician
P. W. Woodroffe	E. T.
R. Roessler	E. T.
D. Medlicott	Computer programmer/operator
A. Hazelman	Airgun Technician

* includes additional day because crossed Int. Date Line

All inquiries regarding cruise should be made to the chief scientist.

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CRUISE REPORT

Ship Name: R/V VEMA

Cruise No: V36-11

Departure: May 2, 1980 (Date) from Pago Pago, American Samoa (Port)

Arrival: May 21, 1980 (Date) at Guam (Port)

*

Days at Sea: 18
(Count day of departure but not day of arrival in port)

Days Foreign Port: 3
(number of days in arrival port before next leg)

Area of Operation:
Central Equatorial Pacific, transits through Western Equatorial Pacific

Program Description:

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CRUISE REPORT
V3610 Guam to Pago Pago
V3611 Pago Pago to Guam
April 8 - May 21, 1980

General

Because of the long transit distance between the primary work area of this study and adjacent cruises, this expedition was broken into two cruises: V3610 left Guam on April 8 and arrived in Pago Pago, American Samoa 22 days later (including crossing the date line) on April 29, and V3611 left Pago Pago on May 2 and arrived in Guam 18 days later (including crossing the date line) on May 21, 1980. Each leg included 11-12 days transit between Guam and the primary study area and 4-5 days transit between the study area and Pago Pago.

During the 40 days of V3610 and V3611 a total of 7794 n.m. of track were steamed; no stations were occupied. Seas were calm throughout both legs. The location of the ship tracks for V3610 and 3611 is shown in Figures 1 and 2.

The main scientific objectives of these legs were:

1) determination of the location of Fracture Zone 2 of Larson (1976) south of the equator;
2) confirmation of tentative correlations of M-sequence magnetic anomalies west of Fracture Zone 2 and south of the equator;
3) determination of the location and crustal structure of the Nova-Canton Trough System on both sides of Fracture Zone 2, using large airgun seismic profiling and sonobuoys;
4) mapping the thickness and distribution of the reverberant layer in the vicinity of Fracture Zone 2 and Robbie Ridge;

5) determining the relative ages and interactions of Fracture Zone 2, the Nova-Canton Trough System, and the reverberant layer;

6) reconnaissance mapping of possible sea-floor spreading magnetic anomalies east of Fracture Zone 2, and testing of possible ridge jumps in this region; and

7) confirmation of tentative magnetic anomaly correlations in the Lyra Basin.

Objectives 1, 2, 5, 6, and 7, were largely met through underway marine geological and geophysical techniques. Objective 3 was only partially met due to time constraints and the prevalence of topography too rough to attempt sonobuoys. Objective 4 was only partially met due to very weak hydrophones on the eels, leading to limited resolution on profilers. Two original objectives--mapping of magnetic anomalies north of Robbie Ridge and in the Samoa Basin--were abandoned due to time constraints two weeks prior to the beginning of the leg, when the two leg with imbedded transit format was decided upon.

Scientific Results

Fracture Zone 2 and the Phoenix magnetic anomalies were extended south of the equator to anomaly M-1 time (about 111 m.y.B.P.). A southward ridge jump at this time was documented for the crust east of this fracture zone, and a similar ridge jump may have occurred west of the fracture zone, resulting in the incorporation of a substantial portion of Phoenix plate onto the Pacific plate. Previous models for the sea-floor spreading history of this region were shown to be inaccurate. Tensional cracking of old Pacific plate was caused by this jump, forming

part of the Nova-Canton Trough System. This major plate reorganization was probably accompanied and followed by widespread intraplate volcanism, partially obscuring the magnetic anomaly fabric in much of the region south of the Nova-Canton Trough System. Thus transits from this region to Samoa yielded suggestive but unconfirmed anomaly correlations.

Transits between this region and Guam were chosen to optimize their ancillary scientific usefulness and take maximum advantage of currents in the equatorial region. On the V3610 transit from Guam, fracture zones bounding magnetic anomalies of the Nauru Basin were tentatively identified. On the V3611 transit to Guam, strong following winds and currents freed sufficient time near the end of V3611 to allow a track through the Lyra Basin, where previous tentative magnetic anomaly correlations were checked by a long track that yielded very low amplitude uncorrelatable anomalies.

Evaluation of On-Board Equipment

Ship: No breakdowns or significant problems of the ship itself were encountered. Because of the long time since the hull was cleaned, the maximimum cruising speed at 240 RPM's in sea state 1 or 2 with no winds or currents was only 9 knots. Hull cleaning is recommended.

H.P. Computer: All systems in good working condition for the entirety of both legs.

Sperry pit log: Erratic and nearly useless for all of V3610. To a considerable extent, D. Medlicott was able to compensate for this problem through entering ship's RPM's and course plus satellite navigation into the computer, and correcting this preliminary navigation through

on-board analysis of gravity Eotvos variations. During port call between V3610 and V3611, R. Roessler dove and cleaned the outside of the transducer, and then adjusted and recalibrated the Sperry Electronics. These efforts greatly reduced the standard deviation of pit log speeds and allowed apparently accurate pit log values for V3611. However, because of strong currents during most of V3611, we cannot confirm that the absolute calibration of through-the-water speeds is better than about 4%. This calibration can be easily changed by an E. T. in the future in less than an hour.

Dredging/coring winch: Inoperable both legs. The clutch was taken off in Guam, repaired during V3610 and V3611, and reinstalled when VEMA returned to Guam at the conclusion of V3611. Original plans for possibly one or two dredge stations were consequently cancelled.

Profilers: On board electronic equipment worked reasonably well both legs, with one exception: two modulation units failed and were replaced, and the time varying gain is inoperable on two modulation units. Backup electonics are at present very limited. Tripping problems were very common and were largely but not complete alleviated by change in tripping frequencies and in location of streaming of the trip eel. V3610 began with four very weak eel active sections and 20 used hydrophones hand-carried by R. D. Jarrard. Nearly all of these hydrophones were used to replace the weakest and inoperable hydrophones in the four sections; nevertheless, breakdown in eels was very common, requiring the majority of the non-watch standing efforts of the E. T.'s. All four active sections were never operable at the same time during V3610. The very weak nature of most hydrophones lead to fair to poor low frequency profiler records during much of V3610, due to strumming of the eels

swamping signal with noise. During the last few days of V3610 the low-frequency records were substantially improved by towing two active sections from one boom and one active section from the other, and wiring the two eels in parallel. In Pago Pago we received one new active section, which was found to have a signal strength about 10 times that of the other four. This new section was so much superior to the old ones that streaming two active old sections in parallel with it accomplished no noticeable improvement in signal-to-noise ratio; thus the one new section was used almost exclusively on V3611. We strongly recommend that most of the old hydrophones be replaced with new ones and that a large number of new hydrophones be kept on board for replacements. Studies of the reverberant layer on V3610 and V3611 were largely unsuccessful because of the poor quality of the eels. Use of the Bolt large airguns increased signal-to- noise ratio by substantially increasing signal, but their value was greatly diminished by poor eel quality, particularly because noise was greatest in the low frequencies at which deep penetration with the large guns is normally achieved. As is usual, decreasing ship speed to 5 knots greatly decreased noise, but the large amount of transit required in V3610 and V3611 generally eliminated this option. Small airguns broke down daily during the first week of V3610, and much less often subsequently, due to O-ring failures and hose leaks.

Bolt large airguns: Ran adequately when needed; however, breaking of compressor mounting bolts is a continuing problem. The blowers cut out every 10-20 minutes during hot weather (generally 83-86° F outside temperatures); moving the thermostats might alleviate this problem.

Gravity: Operated normally during most of V3610, but roll stability problems in the gravity table developed during the last two days.

P. Woodroffe corrected this problem in Pago Pago by replacing a gyro and accelerometer. However, the cross-coupling multiplier failed in port; this problem was not detected until underway on V3611 (because of calm waters in port), and the only backup multiplier on-board was also inoperable. Thus, cross-coupling corrections were not possible on V3611, and replacement parts were ordered for arrival in Guam. Gravity measurements were, nevertheless, of usable quality during V3611 because of very calm seas (generally sea state 1 or 2).

Magnetometer: Worked continuously during V3610 and V3611. The only problem was the occurrence of slight offsets in readings at course changes. This problem was at first thought to be due to the ship's magnetic field on the magnetometer because of a too-short magnetometer cable. However, a preliminary calculation failed to show any correlation between the directions of observed and theoretical offsets. No electronic backup (except for a spare magnetometer bottle) or backup cable exists at present for the magnetometer system; both are needed.

Sonobuoy receiver: Worked adequately. All six Navy sonobuoys used were operable.

3.5 kHz and 12 kHz echo sounders: Only one working PDR and one UGR were on-board during V3610; consequently only 3.5 kHz records were obtained. The 3.5 kHz system worked continuously and adequately with one minor and one major exception. A minor problem during the first week of V3611 was the occurrence of intermittent short-term ($\leq$ 1 min) drifts of the bottom return upward by about 20 fathoms. These drifts were generally V-shaped (rather than hyperbolas) and were thus definitely artifacts; no corresponding drift in the outgoing signal was noted. The cause of these drifts is unknown (stylus drive variations?) and the

problem subsequently disappeared. The major problem was that the 3.5 kHz transceiver output drive repeatedly cuts out at great than ½ power. As the antiquated backup transceiver is even lower power, this problem could only be avoided by running at low power. In spite of this problem, bottom penetration of 30 m was commonly achieved, with rare penetration of as much as 100m. One UGR and one PDR were received in Pago Pago; however, both were in need of major overhauls (particularly for keying modes). Even after extensive repair by the two E. T.'s and Steven Hudson, none were fully operational at the conclusion of V3611.

Satellite Navigation: Bridge satellite navigation was operable throughout V3610 and V3611; the only problems were occasional human recording errors. The antiquated backup satellite navigation system in the upper lab was inoperable for all of V3610. During V3611 it was brought up to running condition and its numbers compared to those from the bridge satellite navigation. These numbers were clearly incorrect, but the cause of the malfunction was not isolated.

Richard D. Jarrard

Chief Scientist

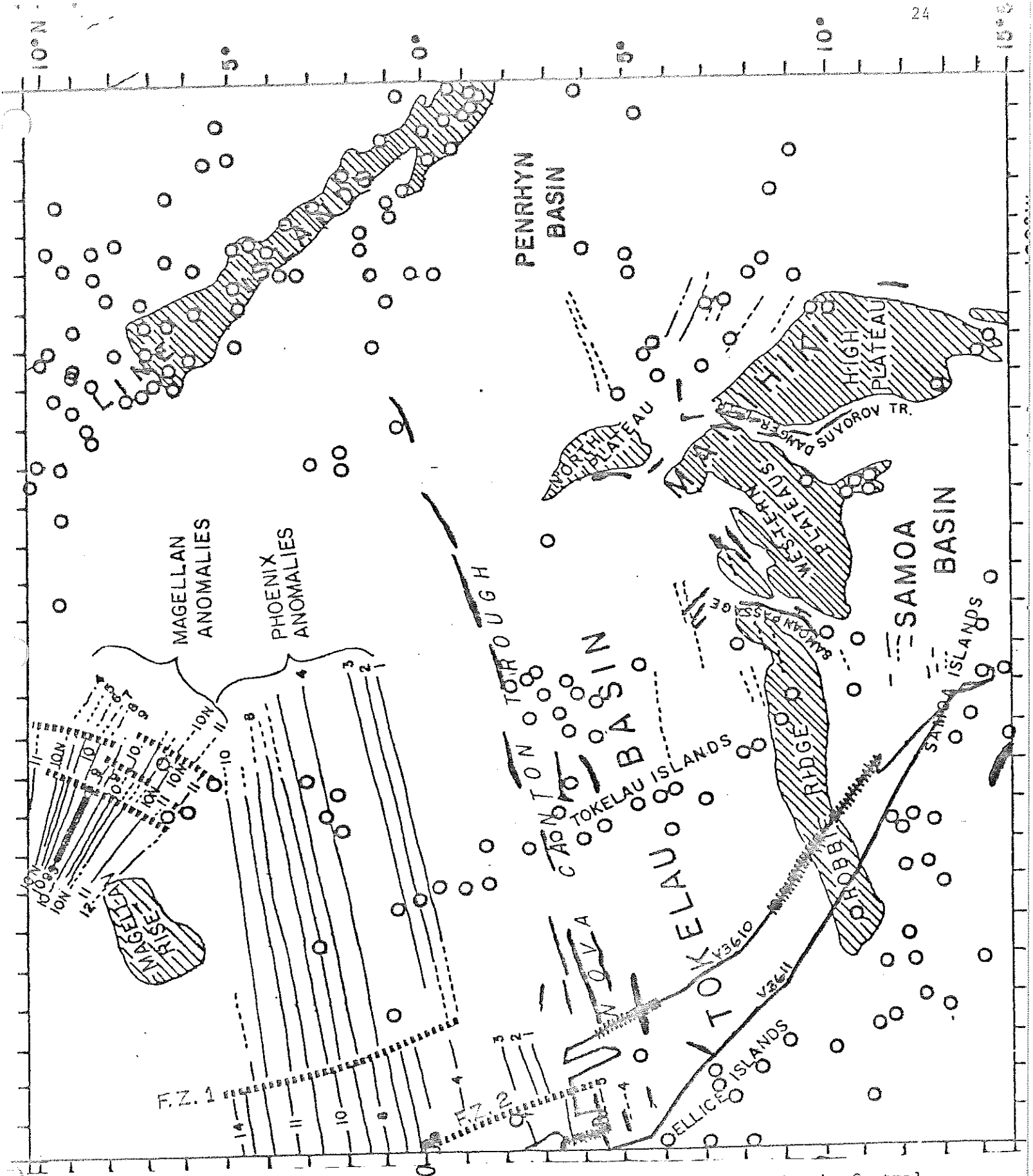

Figure 1: Tectonic features and magnetic anomaly correlations in the Central Pacific. Solid patches indicate troughs, diagonally hatchured pattern indicates rises, and circles indicate seamounts (from Chase et al., 1971; Mammerickx et al., 1975). Magellan anomalies are from Tamaki et al. (in press), Phoenix anomalies are from Larson (1976), and anomalies south of the equator are unpublished. Solid lines indicate reliable correlations and dashed lines indicate speculative correlations.

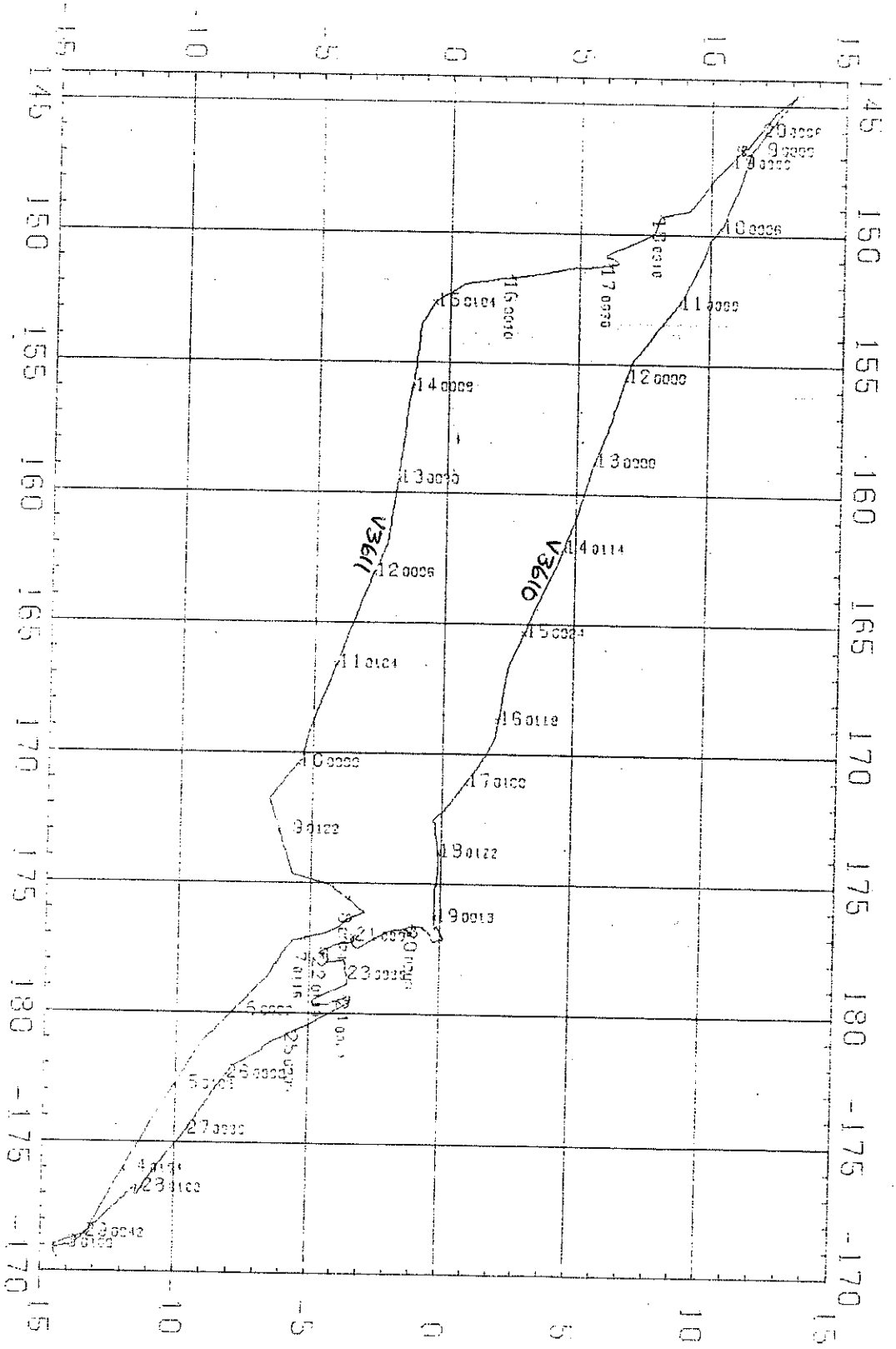

Fig. 2