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CRUISE REPORT

Ship Name: R/V VEMA   Cruise No: 33-01

Departure: 11/17/75 (Date) from Melbourne, Australia (Port)

Arrival: 12/17/75 (Date) at Adelaide, Australia (Port)

Days at Sea: 30   Days Foreign Port: 4 (No. of days in arrival port)

Area of Operation: Southeast Indian Ocean

Program Description: Investigation of origin of regional depth anomaly across Indian and Antarctic plates by seismic refraction measurements (explosives with OBS and long-range sonobuoys), heat flow (T Grad and Multigrad), dredging from ridge crest, and U/W geophysical techniques.

Participants: (All L-DGO unless otherwise specified)

J.K. Weissel, Chief Scientist
G. Carpenter, Co-Chief Scientist
A. Engvik, Gravity E.T.
G. Conrad, Camera/Shooter
G. Gunther, OBS Technician
P. Ledman, OBS Technician
J. Powell, Airgun Technician
D. Quick, E.T.
W. Van Steveninck, Heatflow Technician
M. Sundvik, Core Describer
H. Giddy, Coring Bosun
L. Tanner, Coring A.B.
A. Rock, Computer Operator
R. Dulski, E.T., Bureau of Mineral Resources, Australia
L. Tilbury, Bureau of Mineral Resources, Australia

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

CRUISE REPORT: V33-01

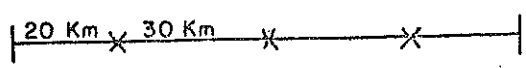
V33-01 was the first of two legs designed to investigate the origin of the regional "depth anomaly" across the Indian and Antarctic plates in the southeast Indian Ocean. A variety of marine geological/geophysical tools were implemented to examine whether the observed depth anomaly is reflected in other geophysical parameters such as seismic layer thicknesses and velocities, heat flow values, petrologic geochemical and magnetic properties of dredged rocks, and free-air gravity anomalies. We also attempted to survey in detail two small areas of the same age on each flank of the ridge that were generated in an asymmetric manner to examine further the scale at which asymmetric crustal accretion occurs. The accompanying figure shows ship's stations and the track which consists pricipally of three east-west traverses (along anomaly 6A north and south of the ridge and along the ridge crest) and two small areas of more intensive study on both ridge flanks near 134°E. That we could not achieve all our aims can be mainly attributed to the extreme weather encountered, especially in the first half of the leg and the consequent toll on the ship and on the scientific equipment. The dredge program and the seismic re-fraction program came closest to being completely realized. The heat flow objectives were inadequately met and the gravity program was curtailed when the gyrotable blew during the second week of the leg. The detailed survey on the north flank was cut short due to weather, and the detailed survey on the south flank was abandoned when the OBS was lost.

The dredge program consisted of 5 stations, 4 regularly spaced along the ridge axis in Zone A and 1 on the only known central anomaly in the Discordance zone. Each station was positioned using magnetics and morphology. In Zone A, the target area is characterized by the association of a magnetic bump inside the central anomaly and a morphologic horst or hill about 10 km wide. In the Discordance where the amplitude of the central anomaly is about half that in Zone A, the magnetic bump is associated with a sharp V-shaped valley about 10 km wide. Each dredge haul returned mainly fine-grained massive basalts, pillow fragments, and glass. Although all samples seemed "fresh", all except the most easterly in Zone A showed some iron staining and manganese coating. It is interesting that some basalt samples recovered from the axis in the Discordance have larger phenocrysts than those from Zone A, at least on preliminary examination. It is felt that all the dredge hauls are geographically located within a few kilometers of the zone of active accretion.

Nearly all of the stated objectives of the cruise with respect to refraction work were met. The initial OBS drop at 44°17'S, 137°07'E (single unit) yielded a 40-mile profile as well as engineering checks on filter circuit modifications installed at Lamont. The high frequency response of the instrument appears much improved. Clear, sharp "D" arrivals were recorded for the first 20 km or so of the profile.

It was hoped that a long range SB could be deployed at the end of OBS Line 1 for a reversal, but high levels of FM radio noise from a nearby fishing fleet delayed this until we got out of range of the interference. The buoy was finally deployed about 25 miles from the OBS drop site. It was recorded wiggly line fashion on the SIE galvanometer recorder and run out to about 32 miles. A travel time graph of the raw data was plotted, and probable mantle was seen as a first break at about 20 seconds of D time.

OBS Line 2 employed 3 units deployed in a linear array 100 km in length



Positions of the units: 1 44°15'S, 134°24'E

2 44°16'S, 134°44'E

3 44°16'S, 135°07'E

A BT was taken at Site 2. Total expenditure of explosives for this line was 2700 pounds; in individual charge weights of 7-105 pounds. Preliminary playbacks of all three units show a well-recorded profile with D arrivals on at least one unit throughout the profile.

OBS line 3 again used 3 units in a 100-km linear array. Because of a fortuitous accident, we had more explosives aboard than we paid for; it was decided to drastically overshoot line 3. Some 3800 pounds of TNT were used in shot sizes of 15-150 pounds.

By the time the shooting run began the wind had built up to force 7. In the fianl analysis, this line will doubtless have many minor navigational errors due to constantly changing winds and currents.

Units 1 and 2 were recovered normally after the shooting run, but unit 3 could not be located. The instrument was observed to have lifted off the botton at the proper time but the radio beacon failed after surfacing. After waiting the calculated time for the lowest conceivable ascent rate, a search pattern was initiated which was hampered by low (¼-½ mile) visibility. The following day the ship was stopped for a heat flow station and to try to calculate the magnitude and direction of the current-induced drift. On resuming the search the wind force rose to roughly 11, again sorely hindering visibility. The two-day search was reluctantly terminated. Some feel the mast to which the location aids are fixed had probably fallen off so that nothing short of collision would have found it.

On the return run conditions had moderated to the point where a long-range sonobuoy profile could be attempted with some confidence. LRSB #2 was deployed at 43°36'S, 129°54'E in sea state 4. Bad buoy, signal level decayed to ½ scale after about 4 miles. Deployed LRSB #3 on same line and ran out to 30 miles. A T-T graph of the raw data was plotted and a poorly defined high velocity (mantle?) was detected. This line was reversed with a standard short-range buoy using air gun and variabel density recording, but the record is very poor due to electronic problems in SB receiver and "A" profiler.

The heat flow program was beset by instrumental problems at the start of the leg, and station time was severely restricted by adverse weather conditions. On the north flank two T-Grad stations were taken in the north survey area near 134°E and one showed an unusually high heat flow value. On the return trip to Adelaide a multigrad station was occupied on the anomaly 6A lineation near 129.5°E. Five excellent penetrations and four conductivity measurements were obtained. On the southern anomaly 6A lineation one poor multigrad (1 penetration) and one good T-Grad station were occupied near 134°E. A good T-Grad station was taken near 132°E and a station near 129.5°E failed when the core hit basement outcrop. Despite the small number of measurements obtained during the leg and the bad weather conditions, both heat flow instruments are in proved working condition for the next leg of the project.

Gravity measurements were taken until Nov. 29 when heavy, rising seas resulted in failure of both the pitch and roll gyros. The system was clamped for the remainder of the leg and only if a replacement gyro is obtained in Adelaide will gravity measurements be taken next leg.

Although some damage was sustained during rough weather, most other underway geophysical equipment performed well and almost uninterrupted magnetics, bathymetric and seismic reflection data were recorded during the leg. Midway through the leg the 3.5 kHz echo sounder failed, and this made heat flow station selection very difficult on the poorly sedimented flanks of the ridge (this led to core hitting outcrop mentioned above). The source of the failure was traced to the transducer where an electrical leak was located and to the signal transformer where an open circuit exists between two of the terminals. The ±15 gammas noise is still prevalent on the magnetometer trace, especially at lower magnetic latitudes, and the source of the noise still has not been located. On the profilers, channel A1 seemed to require a moderate amount of stylus cleaning to maintain good quality records.

During this leg we were fortunate to have onboard two officers from the Bureau of Mineral Resources, Canberra, Australia. As psrt of our plans to cooperate with the BMR, two short-range sonobuoys were shot on the Australian continental slope west of Tasmania at the beginning of the leg, and another three were shot on the upper slope just south of Adelaide at the completion of the leg.

The PDP11 performed very erratically and unsatisfactorily throughout the leg and the following statement by A. Rock, the computer operator, explains what went wrong.

In Melbourne, the system was wired to the bus switch monitor and appeared to be functioning properly. Four days outside Melbourne, I began having problems accessing BANAV25 from the disk to processor 1. Processor 2 functioned normally. I tried all possible wiring arrangements to the bus switch, to no avail, and finally connected the paper tape side (#1) directly to the RK11. After several days, I had intermittent failure of BANAV25 directly from disk. I switched to paper tape NAV25 but the system seemed to have trouble holding the program. Sometimes the program would load properly but would not process the fix tape or would function normally for 3-4 fixes, then crash and require constant reloading. I tried loading at 12K and it would not take the program. For a time, the fixes were run by hand on processor 2 connecting to the RK11 and having no problems. When I retested the bus switch monitor, the disks would not run at all, indicating a power failure somewhere in the bus, according to Walter's troubleshooting guide. Testing the disk alone again on #1 side, I now could access nothing. Immediately after I typed the command, (i.e. $RU PIP or $BANAV25) the system would crash. I was careful to switch disks so that I used the batch library when not linked to the bus. Eventually, it began to crash as I was typing in the date, or immediately after DIALOGUE or anywhere up to, and sometimes including, the first $. The paper tape seemed to be doing better though and I switched to paper tape NAV25 again, reloading when necessary. I tried linking the expander box on #1 side (with XY plotter, scope, paper tape reader and punch)to processor 2 and the disk, but received F342 messages with every command.

My first message from Doug was very helpful and allowed me to make use of the plotter without actually being linked to the bus switch monitor. But the system kept crashing in the middle of commands and within a day I could not access programs or make use of BA READMG to compile the magnetics data on #1 side. I began typing MAG 8 Data by hand on #2 side but could not get DTFLS program to run. I traced the program itself and eventually found that the MCHNG format required a single blank space at the end of each data line and, once corrected, it allowed the whole program to work. However, I was unable to access the plotter. Even the #2 side would not take the input, given to me by Doug, when I linked it with the #1 expander box. The system would not get on the air at all.

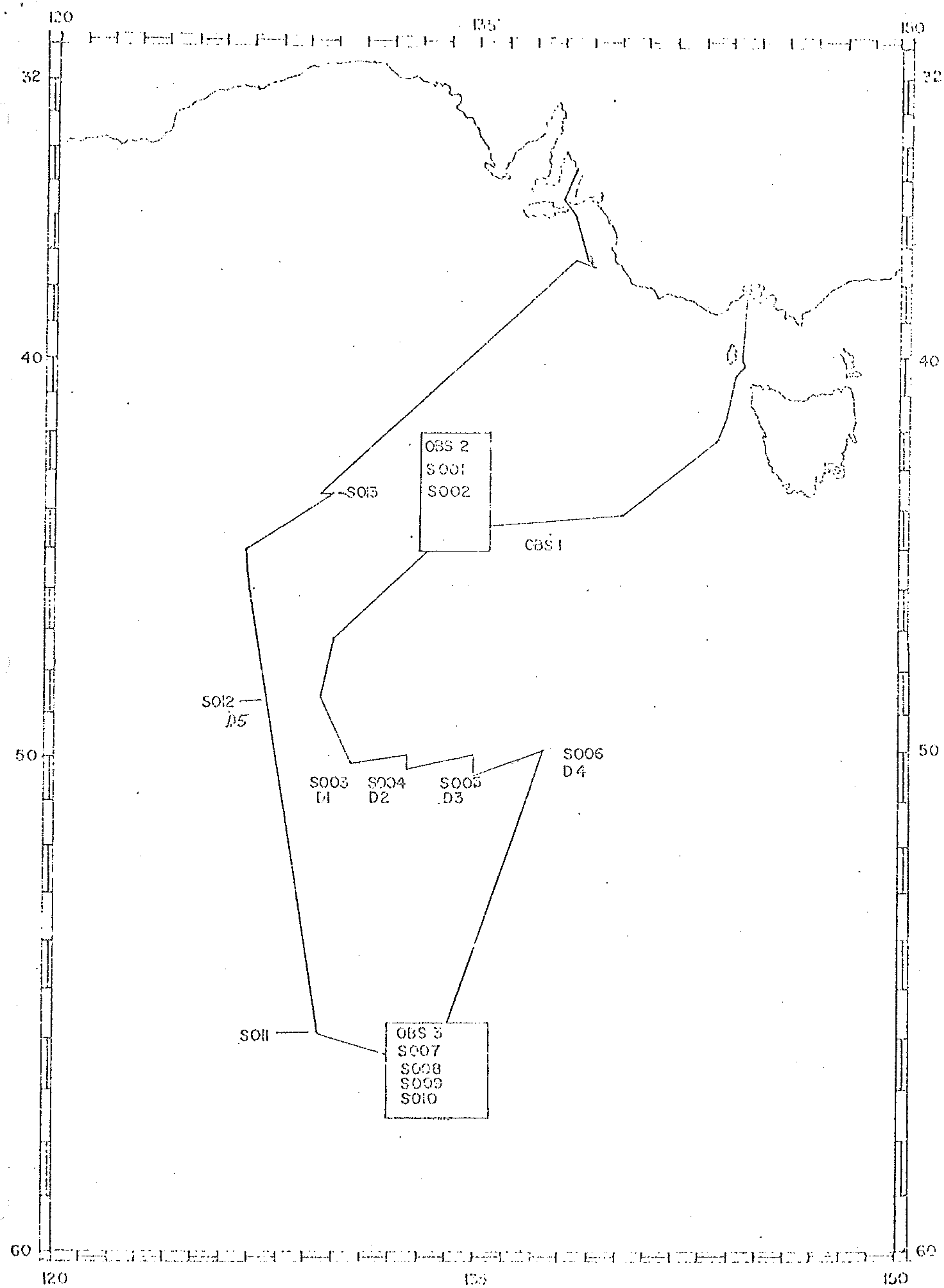
In addition, since I was unable to access the disk on #1 side, I could not read the fix summary tapes by PIP into

NAV.LST and had to type them by hand into FXPT.TMP using the individual printouts. We do not have a paper tape version of PIP on board and I tried loading DECTAPE but, while the TU56 itself functioned, I could not get power to processor #1 even when I linked the expander box directly to the TC11 making side #1 a separate and distinct unit. I eliminated the cable to the bus switch and ran directly from memory box to TC11. Perhaps this is not possible and the wiring was wrong. I enclosed a diagram of this arrangement.

Finally, Walter found a problem with the PDM program one day before he left. He began working on it but my disk shows that it is multiply allocated at the load module (PDM.LDA). I'll have to correct this before attempting the real time next leg.

At present, I am switching the bus cable from the RK11 to each processor depending upon whether I am running fixes (#1) or doing other programs (side #2). Other than this there are no problems. I'm looking forward to a nice conversation with the DEC representative in Adelaide.

George Carpenter / Jeffrey Warner
Chief Scientist



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