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# CRUISE REPORT

Ship Name: VEMA Cruise No: 33-04

Departure: 23 February 1976 (Date) from Melbourne, Australia (Port)

Arrival: 15 March 1976 (Date) at Fremantle, Australia (Port)

Days at Sea: 21 Days Foreign Port: 4 (No. of days in arrival port)

Area of Operation:

South and southwest of Australia

Program Description:

Geophysical survey of the Naturaliste Fracture Zone and environs

Participants: (All L-DGO unless otherwise specified)

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|---|---|
| Rudi Markl | chief scientist |
| Anthony Rock | computer technician |
| Michael Sundvik | core describer |
| Van Paisley-Smith | gravity |
| David Holland | electronic technician |
| Dennis Quick | electronic technician |
| John Powell | seaman/airgun technician |
| George Conrad | camera/nephelometer |
| Bruce Herman | heat flow |

Observers:

| | |
|---|---|
| Peter Dehlinger | University of Connecticut |
| Peter Petkovic | Bureau of Mineral Resources, Australia |

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

## Objective

VEMA cruise 3304 was originally conceived as a 30-day leg between Fremantle and Fremantle whose overall objective was to verify whether the southern Wharton Basin was formed by bilateral spreading as suggested by Markl (1974). This involved studies of (1) suspected Mesozoic anomalies north of Broken Ridge, (2) apparent magnetic lineations in the Cretaceous quiet zone, and (3) the morphology and sediments of the Naturaliste Fracture Zone. Time limitations imposed by the rescheduling of the leg into a 21-day run between Melbourne and Fremantle caused the study of the Naturaliste Fracture Zone and environs to become the principal objective.

## Cruise Narrative

VEMA 3304 left Melbourne about noon on 23 February 1975 after a one-day delay caused by incompleted repairs on the core winch and a ship's generator. From the beginning, every attempt was made to maintain "top" speed and avoid delays.

The track from Melbourne to the study area west of Australia traversed the length of the South Australian abyssal plain. The track was constrained by the profusion of existing tracks south of Australia and the need to obtain three heat flow stations near particular isochrons, one each east, within, and west of the Discordance zone. Minor course changes were made to help define certain seamount provinces and particular isopachs mapped by Houtz and Markl (1972). The seismic profiler was adjusted to achieve maximum penetration in order that basement might be followed continuously beneath the thick turbidite sediments of the abyssal plain and lower continental rise.

Seven and one-half days later, essentially on schedule, we arrived

at the southern edge of the study area (Fig. 1). The overall survey plan was to run a long line on either side of and parallel to, the Naturaliste Fracture Zone in order to identify magnetic anomalies. A number of departures from the NW line were planned in order to survey specific areas; however, in each case, the NW line was resumed. The surveys were done from the NW line rather than the SE line to ensure that they would be accomplished before time ran short.

Although only a single crossing of the Naturaliste-Diamantina Convergence had been planned, the temptation was too great and we conducted a box survey calculated to delineate the junction and took station 59 (core/heat flow) in the Naturaliste Fracture Zone (primarily to determine the bottom water temperature). Then we began the long NW line between the two fracture zones; it was positioned so as to profile the thickest portion of the anomalously thick sediment accumulation sandwiched between the bounding ridges of the fracture zones; it was also hoped that Mesozoic anomalies might be present here (this area was quite probably occupied by a corner of India) and therefore we attempted to steer clear of known basement topography. A preliminary shipboard analysis of the data showed no obvious Mesozoic anomalies.

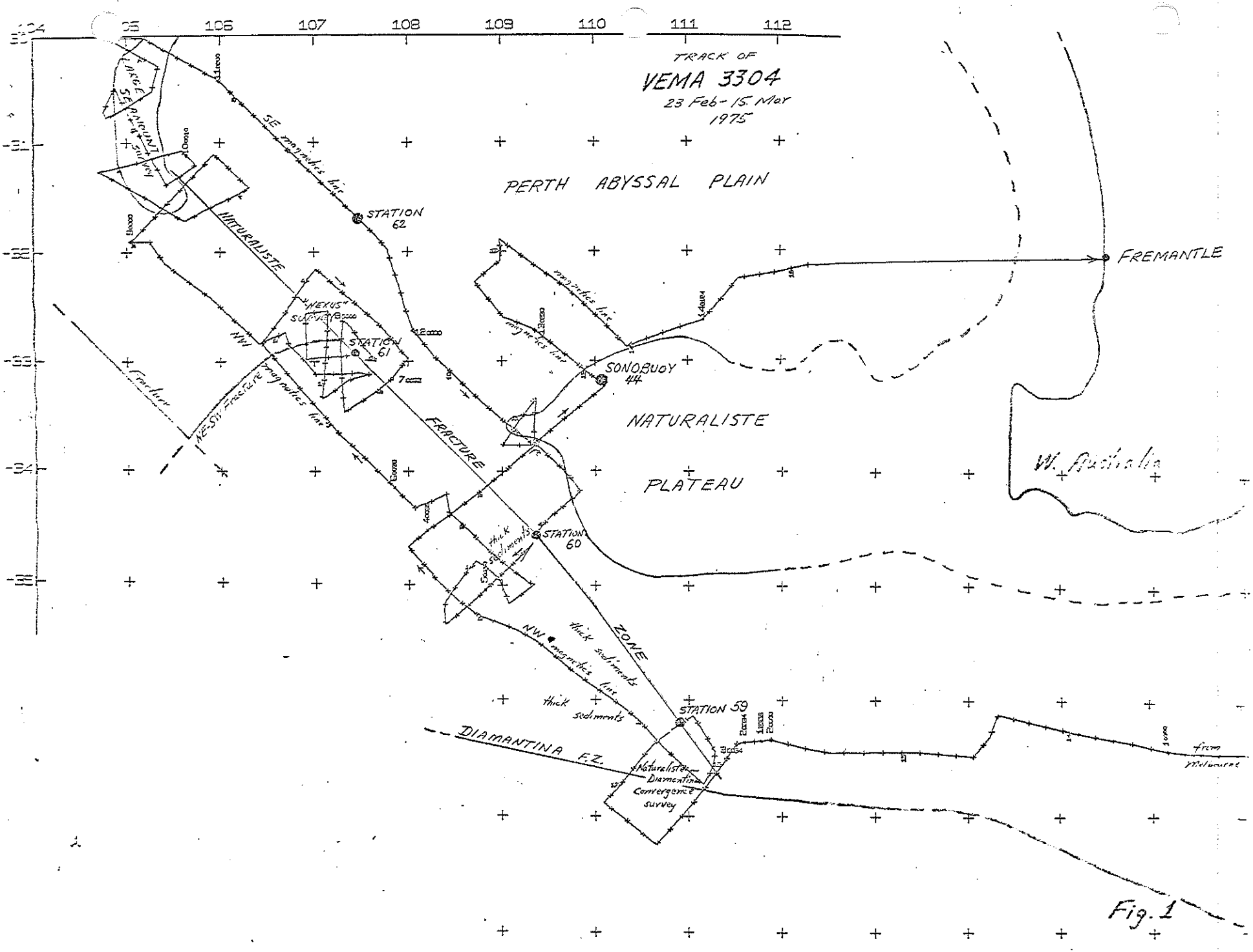
A pair of NE-SW lines were run across the Naturaliste Fracture Zone and onto the Naturaliste Plateau; these lines were laid out so that later lines would link up with them colinearly. Station 60 (core/heat flow) was taken in the NFZ at the base of the Plateau. Additional zig-zagging SW of the Plateau revealed the distribution of a thick sediment lense (1 1/2 sec ) that is related to the N-D Convergence sediment drift.

The NW line was continued until we crossed the western arm of the "Naturaliste Nexus", an inferred junction of the NFZ and a morphologically-similar NE-SW-trending fracture (Markl, 1974); the junction was found to exist essentially as predicted, although we ascertained that the NE-SW limb does not

cross the NFZ (Fig. 1). The relationship between acoustically transparent "drift" sediments in the cross fracture and flat-lying stratified sediments in the NFZ is complex, but should provide indications of current direction and provenance. Station 61 (core/heat flow/nephelometer) was taken in the NFZ just south of the intersection.

After resuming the NW line, we attempted to locate the terminus of the NFZ; this goal was complicated by the presence of a huge (120-mi.-long) seamount/ridge which lies across the projection of the fracture zone; the NFZ becomes less and less prominent toward the NW and appears to terminate at the seamount.

With time running out, the SE magnetics line was run; this line supported existing data in showing that the character of basement is drastically different on either side of the NFZ (smooth on the NE and rough/uplifted on the SW). An unplanned station (62; core/heat flow) was taken when we stopped for routine engine maintenance. A triangular survey was run on the westward protrusion of the Naturaliste Plateau discovered by ELTANIN 54; the basement protrusion was shown to be forked toward the west. A sonobuoy was deployed on the NW edge of the Plateau near the zone of maximum sediment thickness and at the junction of two BMR multichannel seismic lines in order to determine the depth to basement and the velocity structure. Two short lines were run across the NW margin of the Plateau, the only margin segment in which L-DGO had no prior crossings; these lines were intended to cross M-series anomalies; I believe that M-0 can now be traced from the Perth sequence all the way SW to the NFZ. With a couple of jogs to clarify the strike of a basement valley/canyon (that might be the manifestation of a transform) on the north flank of the Plateau, VEMA took one of the few remaining paths between existing tracks and returned to Fremantle on 15 March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TRACK OF
VEMA 3304
23 Feb - 15 Mar
1975
PERTH ABYSSAL PLAIN
NATURALISTE
PLATEAU
W. Australia
FREMANTLE
from Melbourne
STATION 62
STATION 61
STATION 60
STATION 59
SONOBUOY 44
"NEXUS" SURVEY
NATURALISTE
FRACTURE
ZONE
DIAMANTINA F.Z.
SE magnetics line
NW magnetics line
thick sediments
Naturaliste-Diamantina Convergence survey
Fig. 1