FILE

INTERNAL DOCUMENT

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I.O.S.

A COMPILATION OF SEISMIC REFLECTION PROFILE AND CORE DATA FOR THE NORTH EAST ATLANTIC

30° - 45°N, 6° - 35°W

S McGiveron

NATURAL ENVIRONMENT RESEARCH COUNCIL

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S McGiveron

SUMMARY

A compilation of seismic reflection profile and core data for the north-east Atlantic between 30° and 45°N is described. Preliminary interpretation of this data has identified the extent of the distal abyssal plains and produced isopachs with special emphasis on possible high level radioactive waste disposal sites.

CONTENTS

INTRODUCTION

A preliminary assessment of areas which might prove suitable for the disposal of high level radioactive waste beneath the seabed (SEARLE, 1979) identified several potential areas in the northern Atlantic, either on sedimented plateaux or the sedimented lower flanks of the Mid-Atlantic Ridge. It also stated that distal abyssal plains might prove suitable if it could be shown the these areas are not likely to be, or have been, adversely affected by turbidity currents. As a preliminary to further studies in the distal abyssal plains and to facilitate the selection of several study areas in these areas, a compilation and analysis of existing seismic reflection and coring data has been carried out and is described here. The study encompasses the area from 30°N to 45°N and 6°W to 35°W.

SECTION 1

SEISMIC REFLECTION PROFILES COMPILATION

Seismic reflection profiling (SRP) data has been comoiled from the following sources:

a) All Institute of Oceanographic Sciences (IOS) data

b) Lamont-Doherty Geological Observatory (LDGO) data to 1970

c) All Glomar Challenger data

d) All data from the Vening Meinesz Laboratorium

No information from the Woods Hole Oceanographic Institution, Centre Oceanologique de Bretagne, or post-1970 LDGO data sets has been included. If it appears they can add significantly to this reconnaisance study, they will be added in the future.

The SRP data compiled was available in two forms:

a) photographically reduced sections of analogue recordings (IOS, LDGO, Glomar Challenger data)

b) Sections plotted by computer from digitised data on 1:1 million charts.

DATA COVERAGE

The data coverage in the Northeast Atlantic is generally sparse, except in special survey areas (figure 1-in pocket). The IOS, LDGO and Glomar Challenger seismic lines are widespread with no particular overall directional trend. As a result, intersections are frequent and data control is fair.

In contrast, the Vening Meinesz lines are closely spaced, typically parallel and concentrated into a narrow corridor striking northeast-southwest. Very few intersections occur, resulting in poorer data control.

DATA INTERPRETATION

The aims of the data interpretation were threefold:

a) to annotate the ship's tracks according to sediment morphology and reflection character;

b) to define the limits of the abyssal plains on the basis of sea bed morphology and acoustic character of the sediments;

c) to produce isopachs for the areas under consideration.

Both forms of data were interpreted by measuring the thickness of the sediment above the basement at 30 minute (time) intervals along the ships's tracks. In areas of more complex basement topography, this interval was considerably reduced.

SEDIMENT MORPHOLOGY

Annotated tracks indicating bottom types were plotted from the seismic lines on working sheets at a scale of 1:1 million. Four broad bottom types were distinguished:

a) Flat lying sediments with parallel, horizontal acoustic reflectors

b) gently undulating or sloping sediments

c) draped sediments overlying a pronounced basement topography

d) sediment free rock outcrops

Various regions of a particular sediment morphology, e. g. abyssal plains, can be defined from the annotated tracks.

DEFINITION OF ABYSSAL PLAINS

The boundary of an individual abyssal plain was defined as the furthest extent in that area of the flat lying sediments with parallel acoustic reflectors. On this basis, several abyssal plain regions and smaller areas of ponded sediments have been identified (see later section).

ISOPACHS

Isopachs were originally plotted at a scale of 1:1 million and contoured at an interval of 0. 2 seconds two-way time. The working sheets produced were then compiled at a scale of 1:2, 400, 000 to form a master chart (figure 2 - in pocket).

In areas of good data control, the isopachs reveal a rapidly changing buried basement topography. In other areas of poorer data, they only indicate general trends and little detail.

The plotting of isopachs for sediment draped seamounts was a particular problem. An isopach implies a continuance of sediment cover between the two points joined. Rough topography may, in fact, break up this cover into smaller, isolated patches. This situation would not be immediately obvious from widely spaced seismic lines.

SECTION 2

ABYSSAL PLAINS AND ENVIRONS

Several abyssal plain areas have been recognised from the seismic reflection profile records, the morphologies and environs of which are described in turn below.

IBERIAN ABYSSAL PLAIN

The Iberian Abyssal Plain lies to the west of Portugal in Admiralty Plotting Area 60. The more proximal part of this plain lies within 200 miles of land and so has not been dealt with in any detail.

To the east of 14°W, most of the plain has a sedimentary cover greater than 1.0 seconds thick, except in the immediate vicinity of isolated basement outcrops. Several buried abyssal hills at a depth of 0.2 to 1.2 seconds have also been identified from the isopach configuration. The sediment thickness increases rapidly away from these localised high spots down to a general basement level of between 1.0 and 1.2 seconds below the sea bed. Small, isolated basins may contain sediments up to a maximum thickness of 2.0 seconds.

The number of buried abyssal hills apparently decreases north of latitude 41°N resulting in a relatively flat basement at a depth of around 1.4 seconds below the sediment surface. This may be a result of the poorer data coverage in this area.

To the west of 14°W, the sediment cover thins and is generally less than 1.0 second. Outcropping abyssal hills and seamounts are numerous and are nearly all devoid of sediment. The isopachs reveal an undulating basement beneath the sediment surface which progressively outcrops further to the west. One exceptionally large outcrop worthy of special note occurs at 40°15'N 14°30'W.

The southern limit of the abyssal plain is abrupt where the sediments abut directly against the bare rock outcrop of Tore Seamount. The seamount itself is relatively free of sediment except in the small, isolated basin in the central part.

In contrast, the western limit of the plain is the Azores-Biscay rise where the sediments gradually become undulating and abyssal hill outcrops become more common.

The northern limit of the Iberian Abyssal Plain again consists of undulating sediment and abyssal hill outcrops. This is connected in the north-east to the shallower Biscay Abyssal Plain via Theta Gap. Sediments may be transported in a southerly direction through this gap. (LAUGHTON, 1960).

Large areas of rough topography and bare rock exist to the south-west of the Iberian Abyssal Plain. Sediment caps of around 0.4 seconds thick become more common on the larger seamounts. Ridges and troughs trending E-W associated with the East Azores Fracture Zone pass through the area at around 37°N. The isopachs reveal a similar trend in the buried basement where elongate troughs with a sediment infill up to 1.2 seconds thick occur.

TAGUS AND HORSESHOE ABYSSAL PLAINS

Both these abyssal plains lie within 200 miles of land and so have not been investigated in any detail. They are relatively isolated from the Iberian and Madeira Abyssal Plains, being bounded in the west by the Madeira-Tore rise and in the north by Tore Seamount and associated abyssal hills.

MADEIRA ABYSSAL PLAIN

Only a small portion of the Madeira Abyssal Plain lies within 200 miles of land (the island of Madeira). Data coverage is generally good in this area, except in the southwestern extremity.

The isopachs reveal that the abyssal plain has a central basin with a sediment thickness in excess of 1.0 second and a maximum of 1.6 seconds.

Outcrops of sediment-free basement are sparse although the isopach evidence suggests that buried abyssal hills are common. In contrast to the Iberian Abyssal Plain, the sediment thickness does not increase as rapidly away from these basement highs so suggesting a more subdued buried relief.

At the northern edge of the Abyssal Plain (34°N, 22°W) is a deep north-easterly trending trough containing a maximum sediment thickness of 2.0 seconds. The trough is relatively steep-sided and a possible shallower extension curves around from the southernmost part to a northwesterly direction. The origin of this buried trough is unknown.

The boundary to the north and west is sharper where the flat beds of the plain give way to the undulating, draped sediments and abyssal hill outcrops. Sediment caps are common on the larger seamounts, e.g. Cruiser Seamount, where the draped sediments may be up to 1.0 second thick. Isolated, relatively small basins with sediment infills up to 1.0 second thick also occur in the depressions between the seamounts.

OTHER AREAS

Several unnamed small areas of ponded flat sediments superficially similar to the larger abyssal plains also occur between 30° and 40°N (figure 2). Most are too small, and too near to the continental margin, the coast or seismically active areas to be of interest for waste disposal.

SECTION 3

CORE COMPILATION

Core data for the area 30°-45°N, 6°-35°W has been compiled from many different sources (Appendix A). However, the compilation is not exhaustive.

Cores described in the literature have been put to various uses and as a result their manner of description varies greatly. All the cores identified for this compilation have been re-logged using a standard format (figure 3) so that comparisons can be more easily drawn.

In addition to logging the cores, the cruise, the station number/core number and position of each core has been listed for easy access on a computer file enabling computer plotted charts and listings to be rapidly obtained for any desired area at any desired scale.

Working sheets at a scale of 1:1 million were produced in this way corresponding to the Admiralty Plotting Areas 42, 59, 60, 79 and 80. The standard core logs were reduced photographically and mounted on these sheets at their respective positions to give an instant visual reference. The distribution of the coring stations is illustrated in figure 4 (in pocket). The greatest density occurs to the southwest of Portugal and less so to the north of the Azores. South of the Azores and west of Madeira is very poorly sampled.

SECTION 4

STUDY AREAS FOR HIGH LEVEL RADIOACTIVE WASTE DISPOSAL

Three study areas are considered below. All lie at the distal edges of abyssal plains.

IBERIA 1 40°40'N - 41°40'N, 13°30'W - 14°30'W

Study area Iberia 1 lies at the distal (western) edge of the Iberian Abyssal Plain approximately 330 miles from the Portuguese coast (figure 5).

A large portion of this area was subject to a special survey (RRS 'Discovery II' unpublished survey, IOS) when a detailed bathymetric chart was compiled and the edge of the abyssal plain accurately defined (figures 6, 7).

The major part of 'Iberia 1' is abyssal plain with a sediment surface dipping gently to the south-east. Two small abyssal hills outcrop within the plain rising to around 100-200 m above the general level of the sediment.

Six seismic reflection profiles cross the area (figure 8). Isopachs produced from the interpreted seismic sections (figure 9) indicate that apart from the immediate vicinity of the two outcropping hills, the sediment cover increases in thickness towards the east and south-east from 0. 4 seconds in the north to greater than 1. 2 seconds in the east. A small buried basement high is also revealed to the south of the central abyssal hill.

Only one core has been collected from the central part of the study area (figure 10). However, a relatively large number of samples have been recovered from the surrounding area, especially to the south-east, where a series of twelve cores have been taken from Discovery.

Cores RC9-211, V23/85, and V27/144 (figure 11) were collected from beyond the abyssal plain and contained foraminiferal marls and clays. All the cores from the abyssal plain to the east of the study area contain varying proportions of mottled and laminated clays, silts and sharp-based graded sand sequences indicating turbidity current activity. Truncated bedding in several of the cores suggest that the turbidity currents had an erosive capability. The core taken from the centre of 'Iberia 1' (D5603) consists of only clays and silts and may represent the distal portion of these turbidite sequences seen to the east.

Cores taken from north of the area are significantly different in character as they contain large amounts of coarse sands and clay. This change in lithology coupled with the fact that the regional slope of the area is towards the south-east suggests a second sediment source exists to the north, probably the Biscay Abyssal Plain via Theta Gap. (KEEN, 1961; DAVIES, 1967).

GREAT METEOR EAST (31°00' - 32°00'N, 24°30' - 25°30'W)

The Great Meteor East study area appears to have subdued relief of low hills striking approximately east-west at a water depth of 5200-5400 m (figure 12). One small hill at 31°22'N, 25°22'W rises above the general level to a depth of 5000 m. The maximum topographic relief therefore is only 400 m with a general value around 200 m.

Eight Vening Meinesz seismic lines cross the study area (figure 13). Of these seven strike north-east - south-west and are approximately parallel. The eighth line intersects them at about 45°.

Sediment morphology interpretation indicates that the area lies at the distal (western) extremity of the Madeira Abyssal Plain where it abuts against the abyssal hills.

The isopachs produced (figure 14) show the sedimentary cover to increase in thickness from nil in the west to a maximum of 1.2 seconds in the east. Large rock outcrops are common to the north and west of the region and smaller outcrops to the south.

Bottom sampling data is sparse (figure 15). No cores are available from within the study area and only three have been recovered within a one-hundred-mile radius. All are sandy foraminiferal clays, oozes, marls and chalks (figure 16), with occasional laminations. Calcium carbonate content varies from very high in the foraminiferal oozes to nil in the clays. Pebbles are present in a sandy clay matrix below 90 cm depth in core MB/H6 and some sedimentary rock fragments also occur at the top of core V23/93. Volcanic glass shards occur at various levels in all the cores.

MADCAP 28°40' - 29°40'N, 24°00' - 26°00'W

The bathymetry and sediments of this area were studied in detail by Belderson and Laughton (1965). The region is again distal abyssal plain, but large abyssal hill outcrops are frequent (figure 17). No large expanse of open sediment exists.

Seven cores have been described from within the area and a further six in the immediate environs (figure 18). Most of the abyssal plain cores consist of foraminiferal lutite and turbidite sequences. All the cores recovered away from the abyssal plain were foraminiferal lutites. (Figure 19).

This area does not seem suitable for further study owing to the large number of outcrops, small areas of sediment and frequency of turbidites.

REFERENCES

1 BELDERSON R H and LAUGHTON A S, 1965. Correlation of Some Atlantic Turbidites. SEDIMENTOLOGY, 7 103-116.

2 DAVIES TA, 1967. Recent Sedimentation in the North-East Atlantic. PhD Thesis, UNIVERSITY OF CAMBRIDGE.

3 KEEN M J, 1961. PhD Thesis, UNIVERSITY OF CAMBRIDGE.

4 LAUGHTON A S, 1960. An interplain deep-sea channel system. DEEP SEA RESEARCH 7 75-88.

5 SEARLE R C, 1979. Guidelines for the selection of sites for disposal of Radioactive Waste on or beneath the seafloor. INSTITUTE OF OCEANOGRAPHIC SCIENCES REPORT No 91.

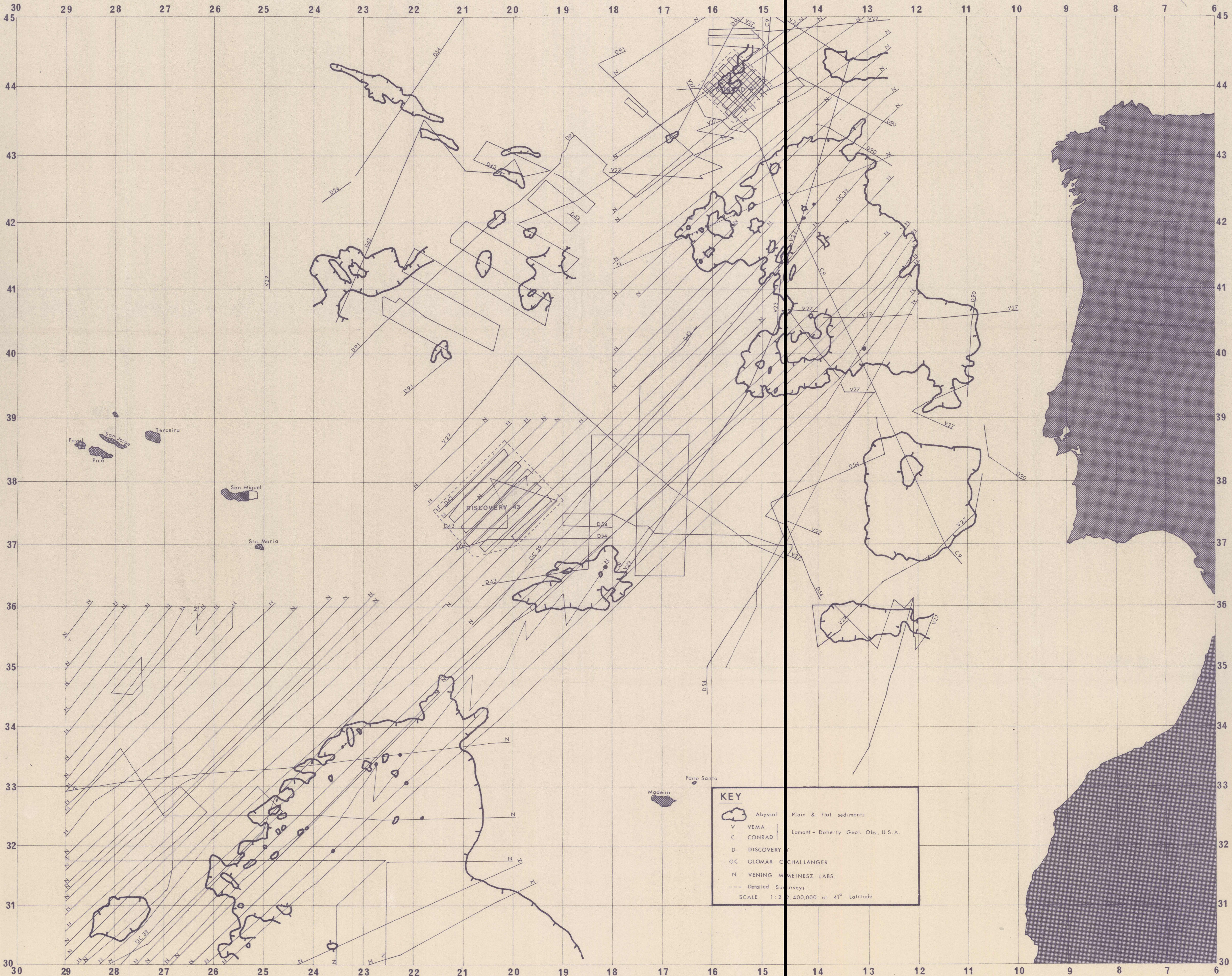

KEY
Abyssal Plain & flat sediments
V VEMA
C CONRAD
Lamont – Doherty Geol. Obs., U.S.A.
D DISCOVERY
GC GLOMAR CHALLANGER
N VENING MEINESZ LABS.
--- Detailed Surveys
SCALE 1:2,400,000 at 41° Latitude
Fayal
San Jorge
Terceira
Pico
San Miguel
Sta. Maria
Madeira
Porto Santo
DISCOVERY 43

FIGURE I

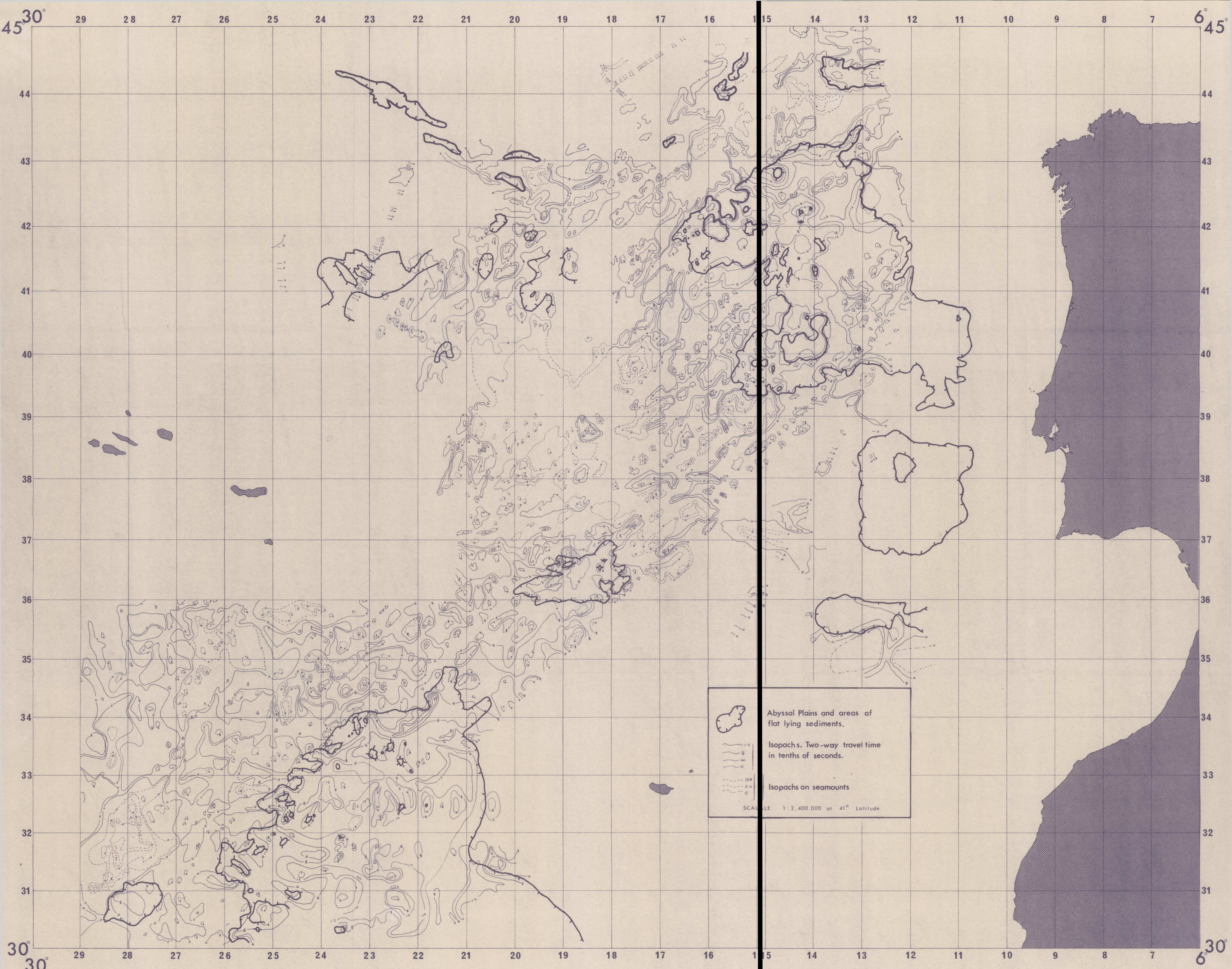
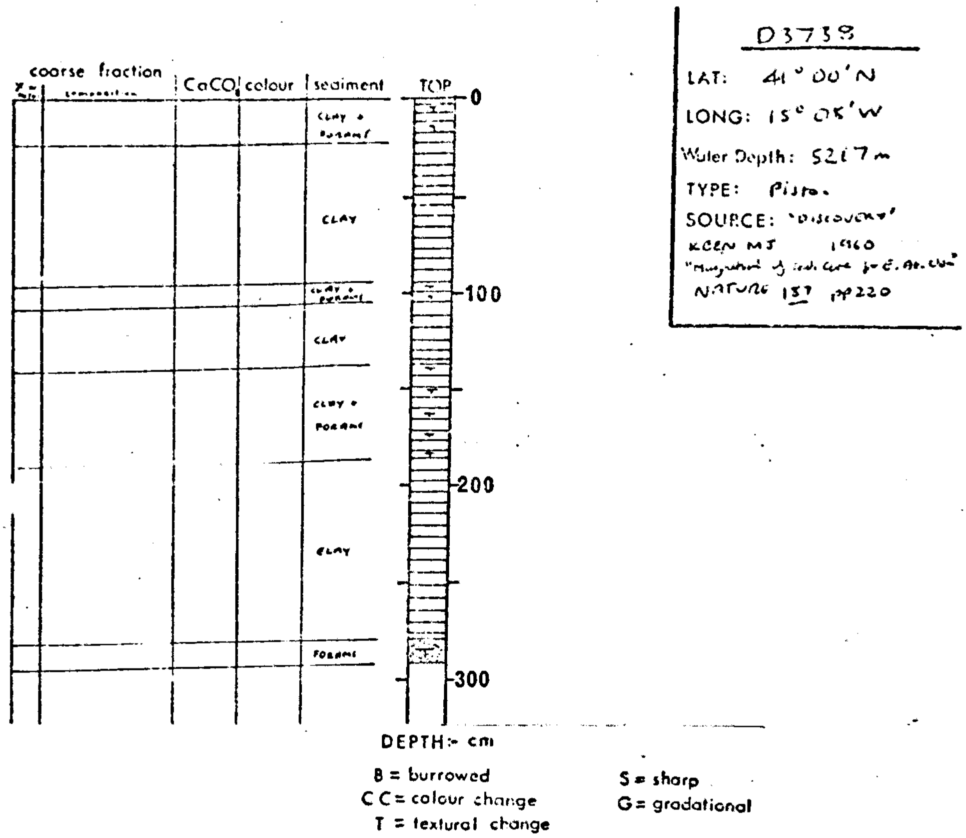
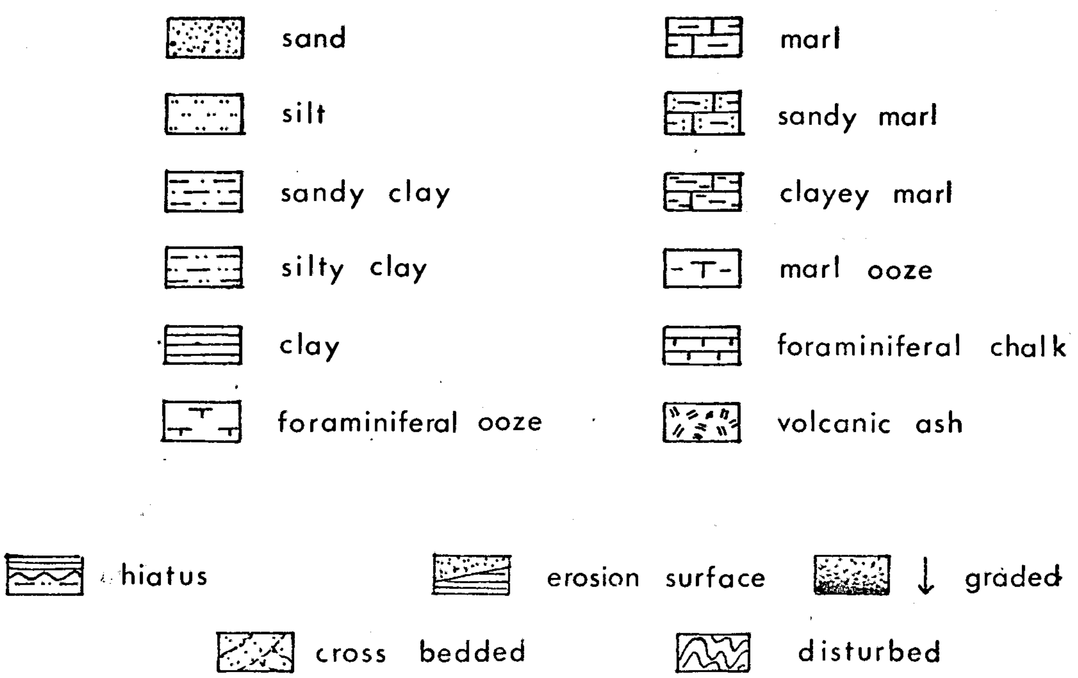

Abyssal Plains and areas of flat lying sediments.
Isopachs, Two-way travel time in tenths of seconds.
Isopachs on seamounts
SCALE 1:2,400,000 at 41° Latitude

FIGURE 2

EXAMPLE OF CORE LOG FORMAT



KEY TO CORE SYMBOLS



10/02/80 1207
MERCATOR PROJECTION.   SCALE=1/ 2400000.00 AT   41.00 DEG LAT
PARAMAT1   NORTH-EAST ATLANTIC - 30-45N, 0-36W - CORE & DRILL STATIONS

+ Cores   × Cores with pebbles

FIGURE 4

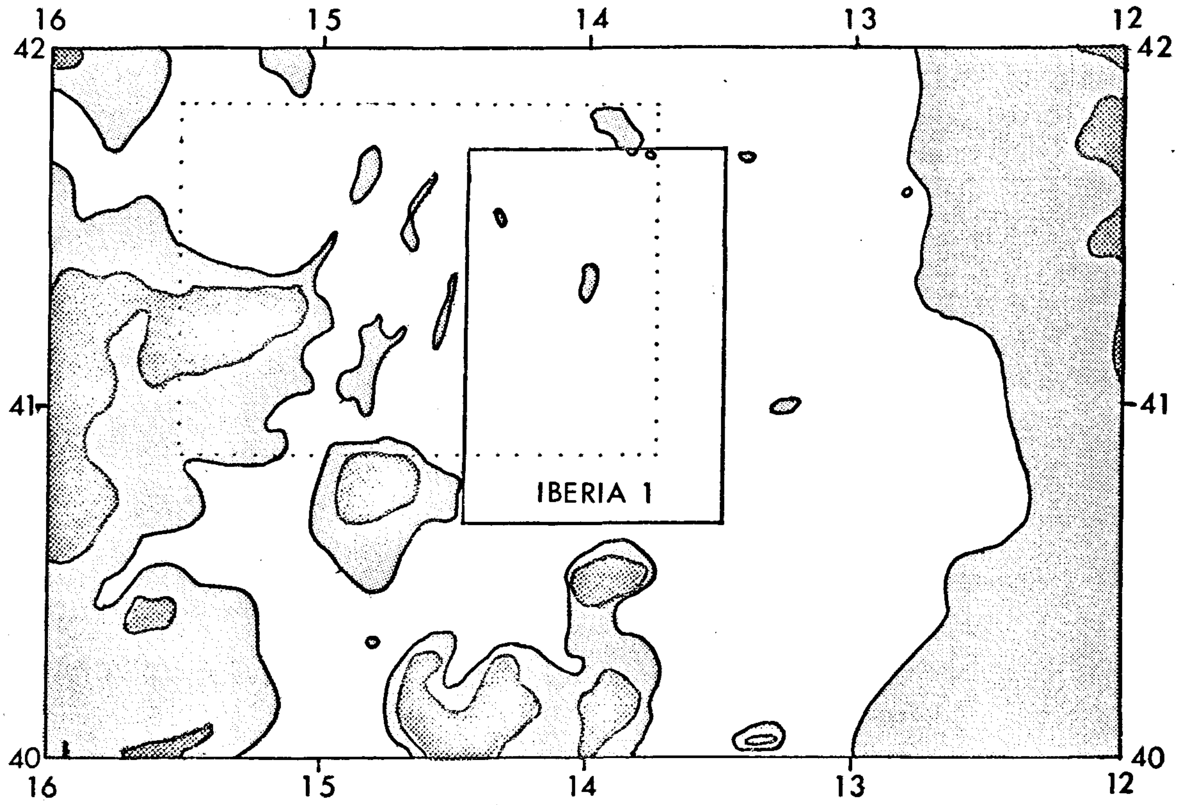


Figure 5 BATHYMETRY IBERIA 1

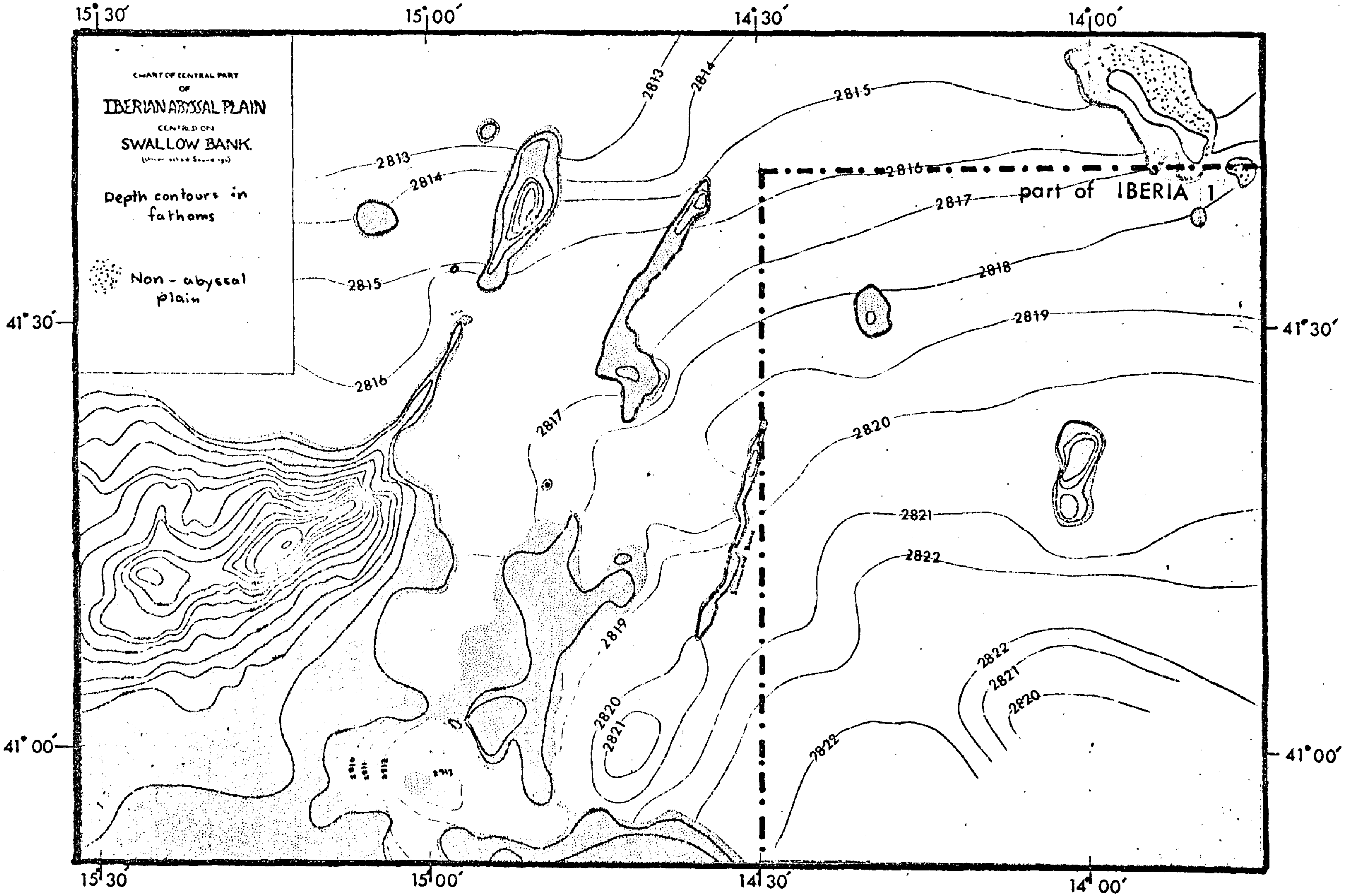
< 2500 fathoms

2500 – 2900 fathoms

2900 – 3000 fathoms

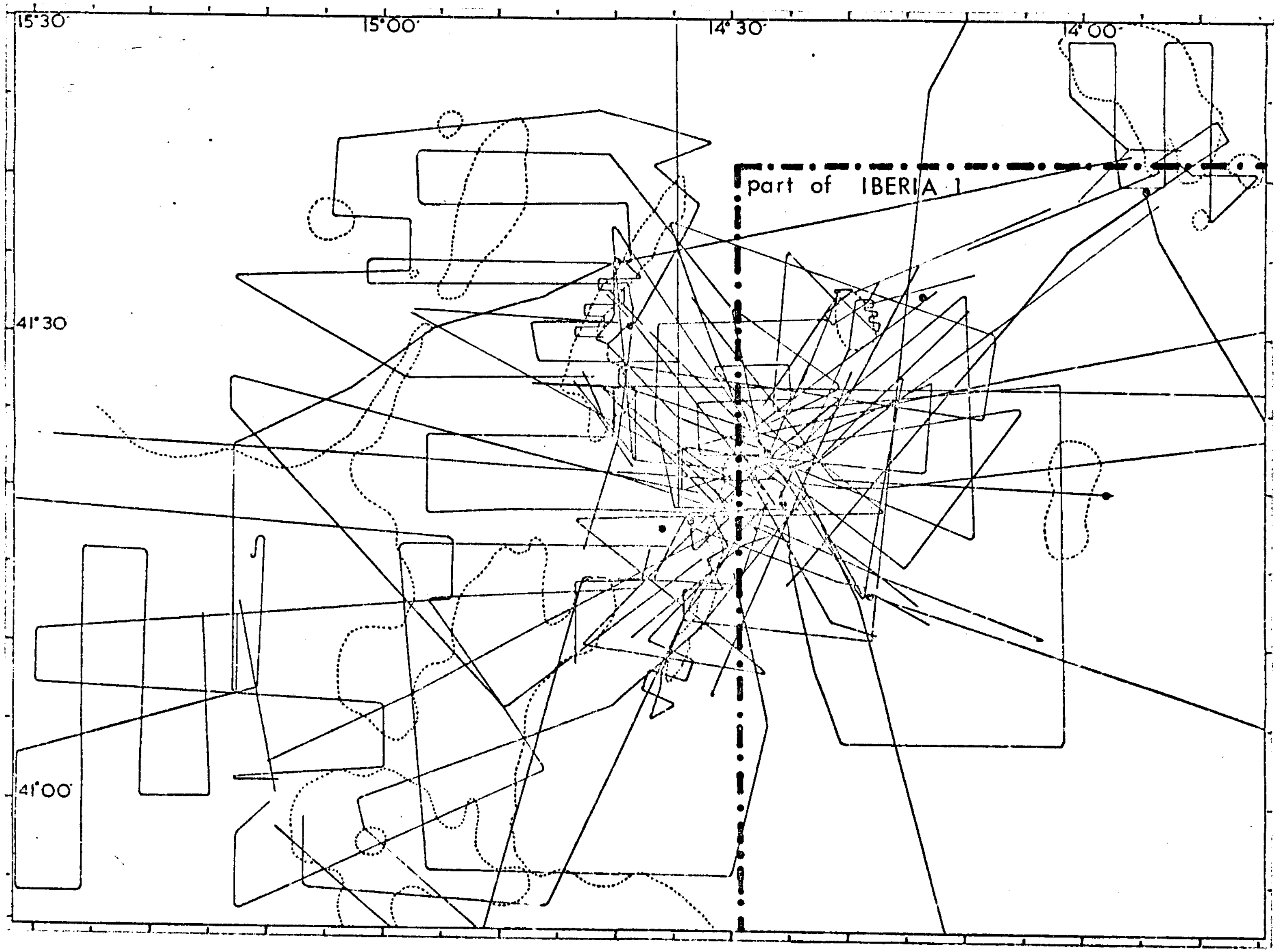
Scale 1 : 2,400,000 at 41° latitude

Figure 6



R.R.S. 'DISCOVERY II' 1958 Unpublished Survey

BATHYMETRY



R.R.S. 'DISCOVERY II' Unpublished Survey 1958

TRACK CHART

Figure 7

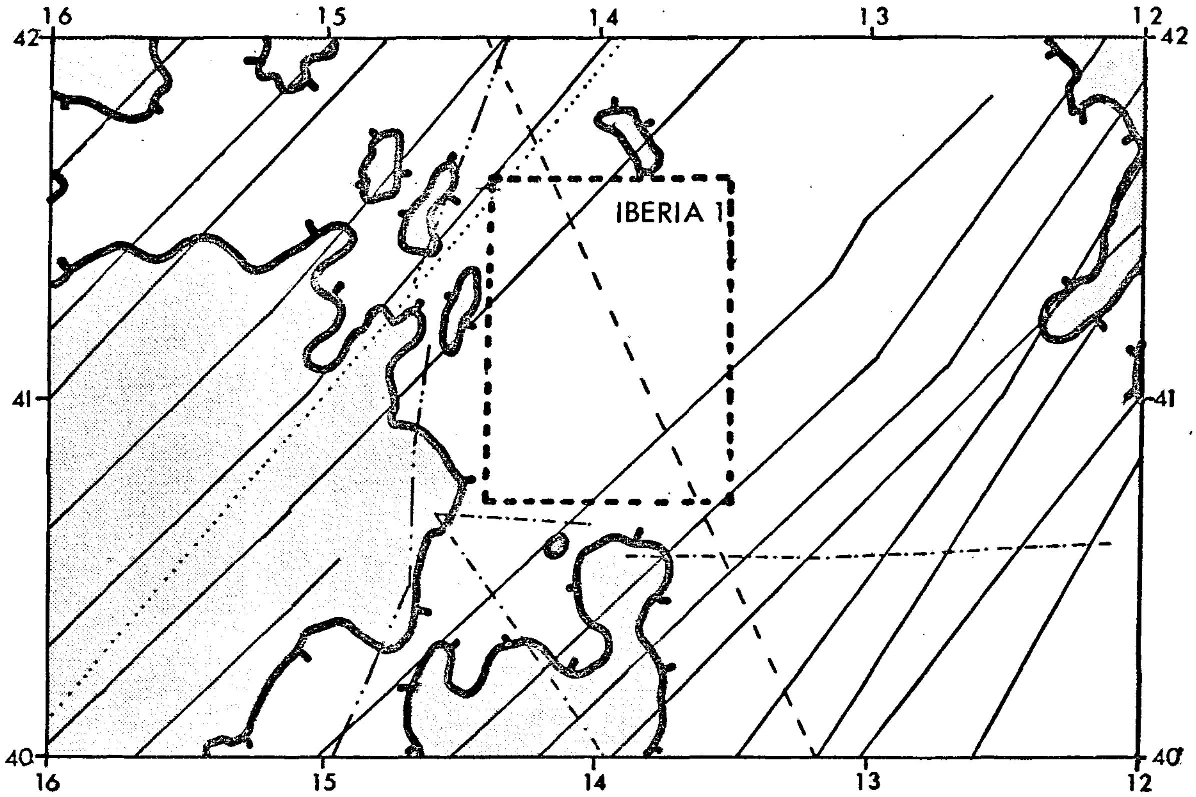


Figure 8 IBERIA 1 - S.R.P. TRACKS

- Vening Meinesz Laboratorium
- Glomar Challonger Leg 39
- Vema 27
- Conrad 9
- Vema 23
- Non-Abyssal Plain

SCALE 1 : 2,400,000 at 41° Latitude

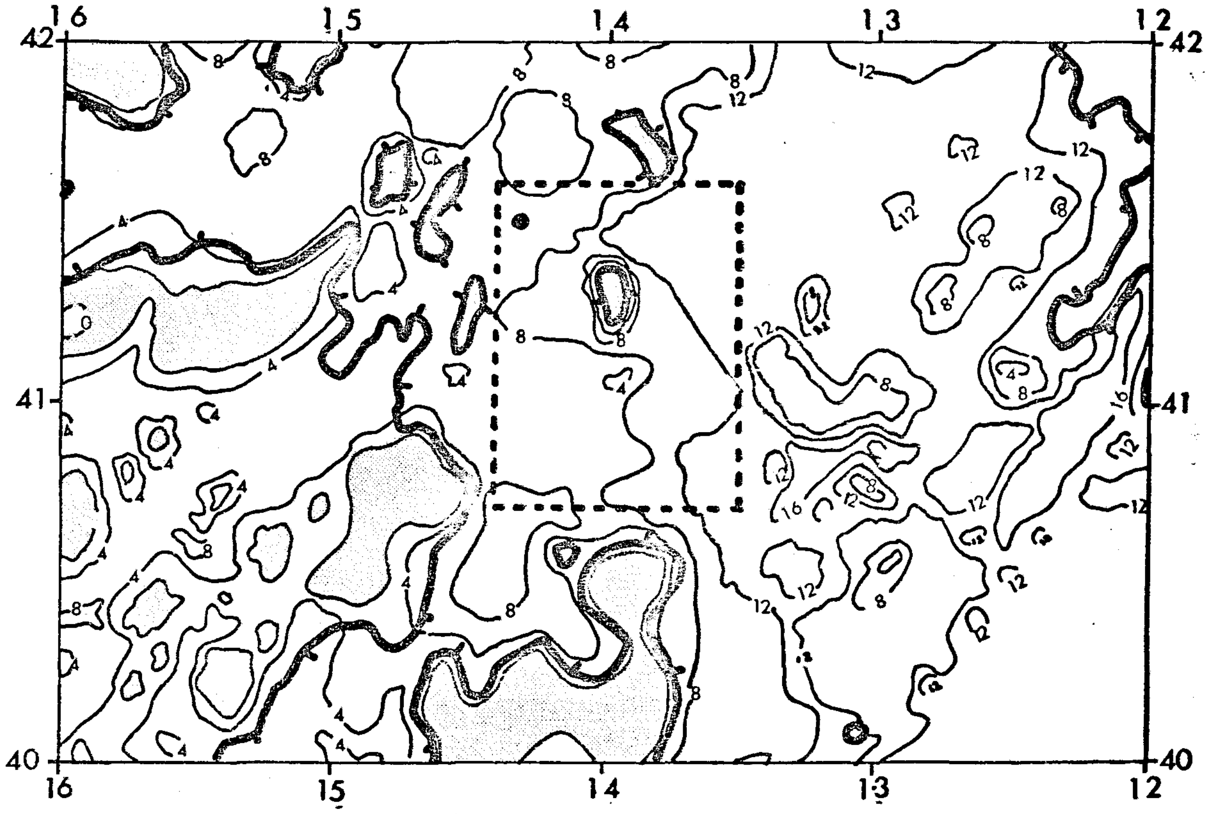


Figure 9. IBERIA 1 - ISOPACHS

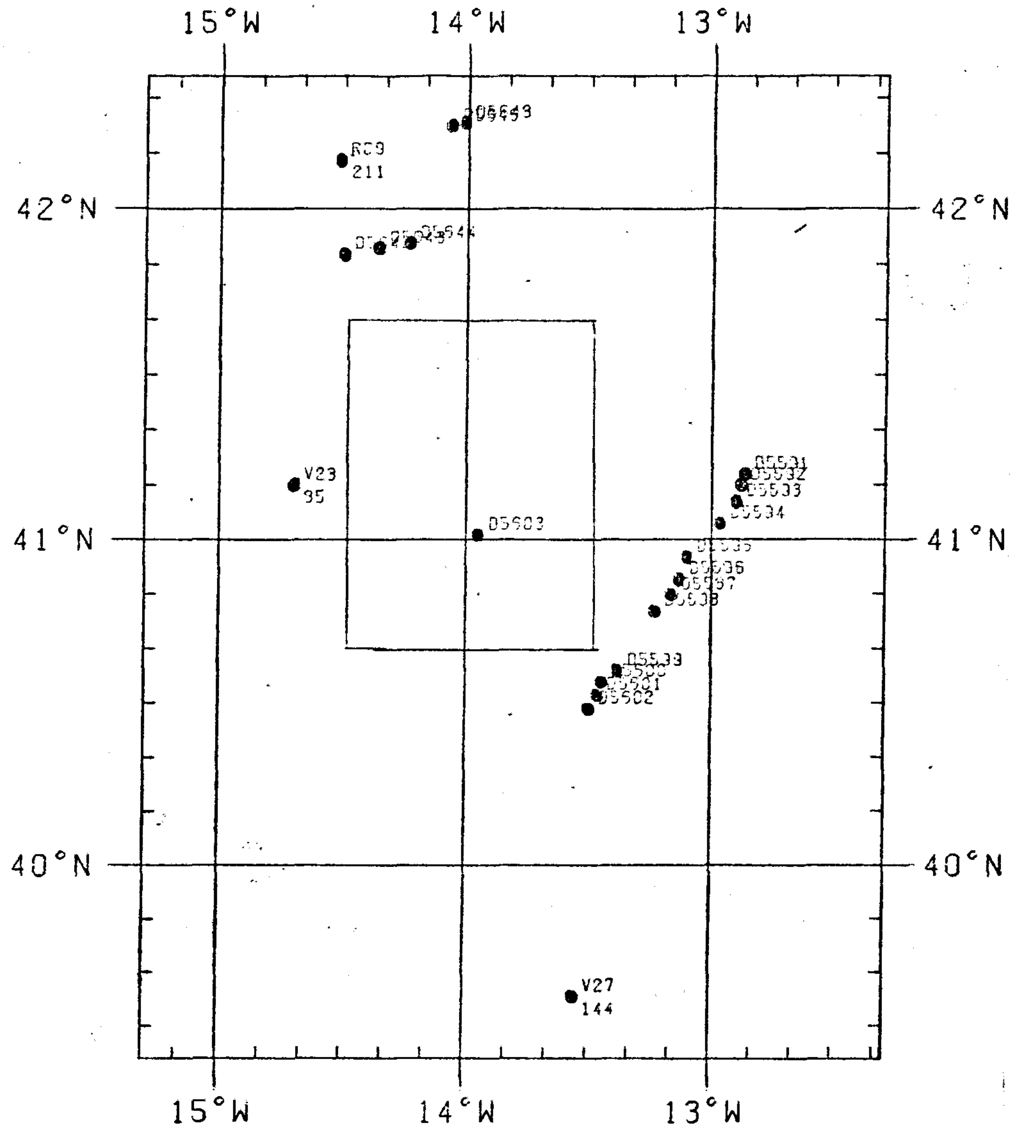
Contoured every 0·4 seconds two-way time

Outcrop

Limit IBERIA 1

Limit of abyssal plain

SCALE 1 2,400,000 at 41° Latitude

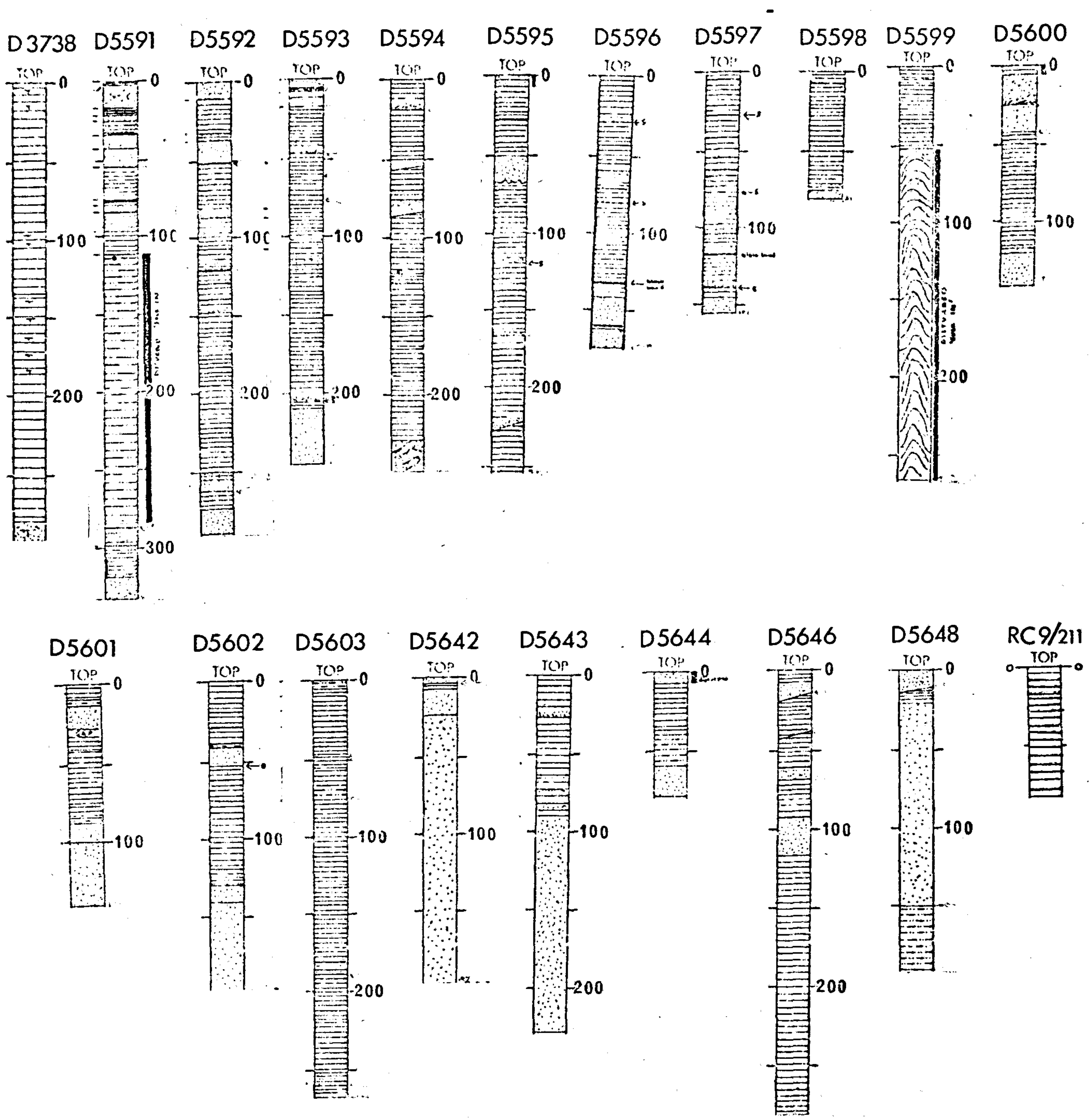


IBERIA 1 - CORE POSITIONS

MERCATOR PROJECTION.

SCALE=1/ 2400000.00 AT 46.00 DEG LAT

Figure 10



D3738		41 0. N	15 8.00W
D5591		41 12.00N	12 52.00W
D5592		41 10.00N	12 53.00W
D5593		41 7.00N	12 54.00W
D5594		41 3.00N	12 58.00W
D5595		40 57.00N	13 6.00W
D5596		40 53.00N	13 8.00W
D5597		40 50.00N	13 10.00W
D5598		40 47.00N	13 14.00W
D5599		40 36.00N	13 23.00W
D5600		40 34.00N	13 27.00W
D5601		40 31.50N	13 28.00W
D5602		40 29.00N	13 30.00W
D5603		41 1.00N	13 57.00W
D5642		41 52.00N	14 30.00W
D5643		41 53.00N	14 21.50W
D5644		41 54.00N	14 14.00W
D5646		42 15.00N	14 4.00W
D5648		42 15.50N	14 1.00W
RC9	211	42 9.00N	14 31.00W
V23	85	41 9.90N	14 42.20W

Figure 11

IBERIA 1 - CORES

V 23/85

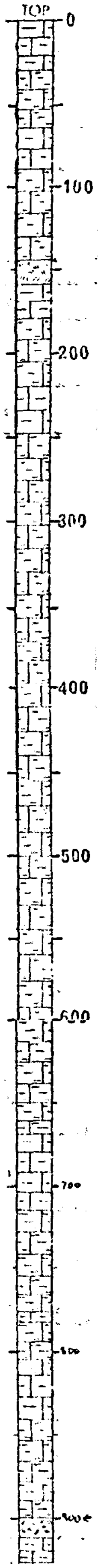


Figure 11 (cont)

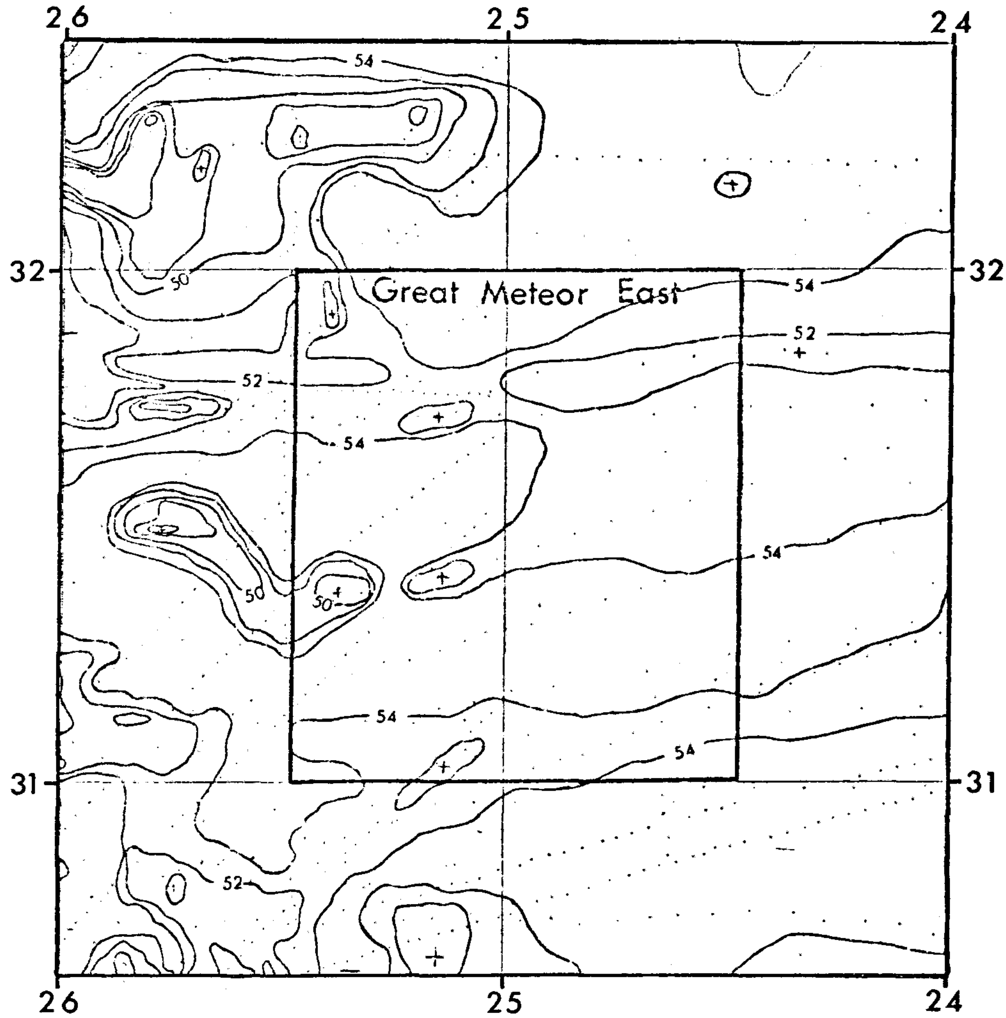


Figure 12 GREAT METEOR EAST

BATHYMETRY

Contour Interval 200 metres

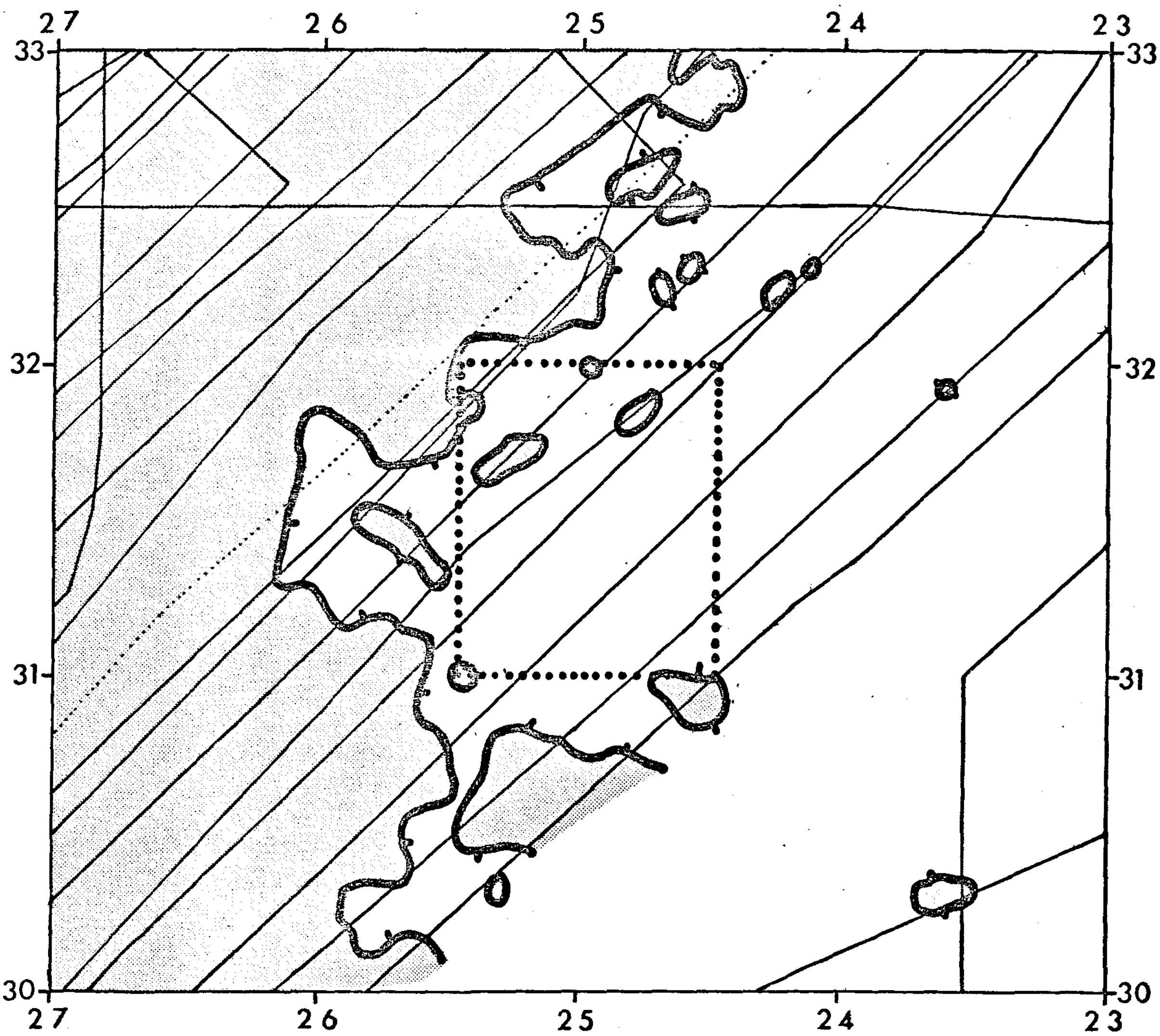


Figure 13 GREAT METEOR EAST S.R.P. TRACKS

Limit of Gt. Meteor East

Vening Meinesz Laboratorium

Glomar Challanger Leg 39

Non - Abyssal Plain

SCALE 1:2,400,000 at 41° Latitude

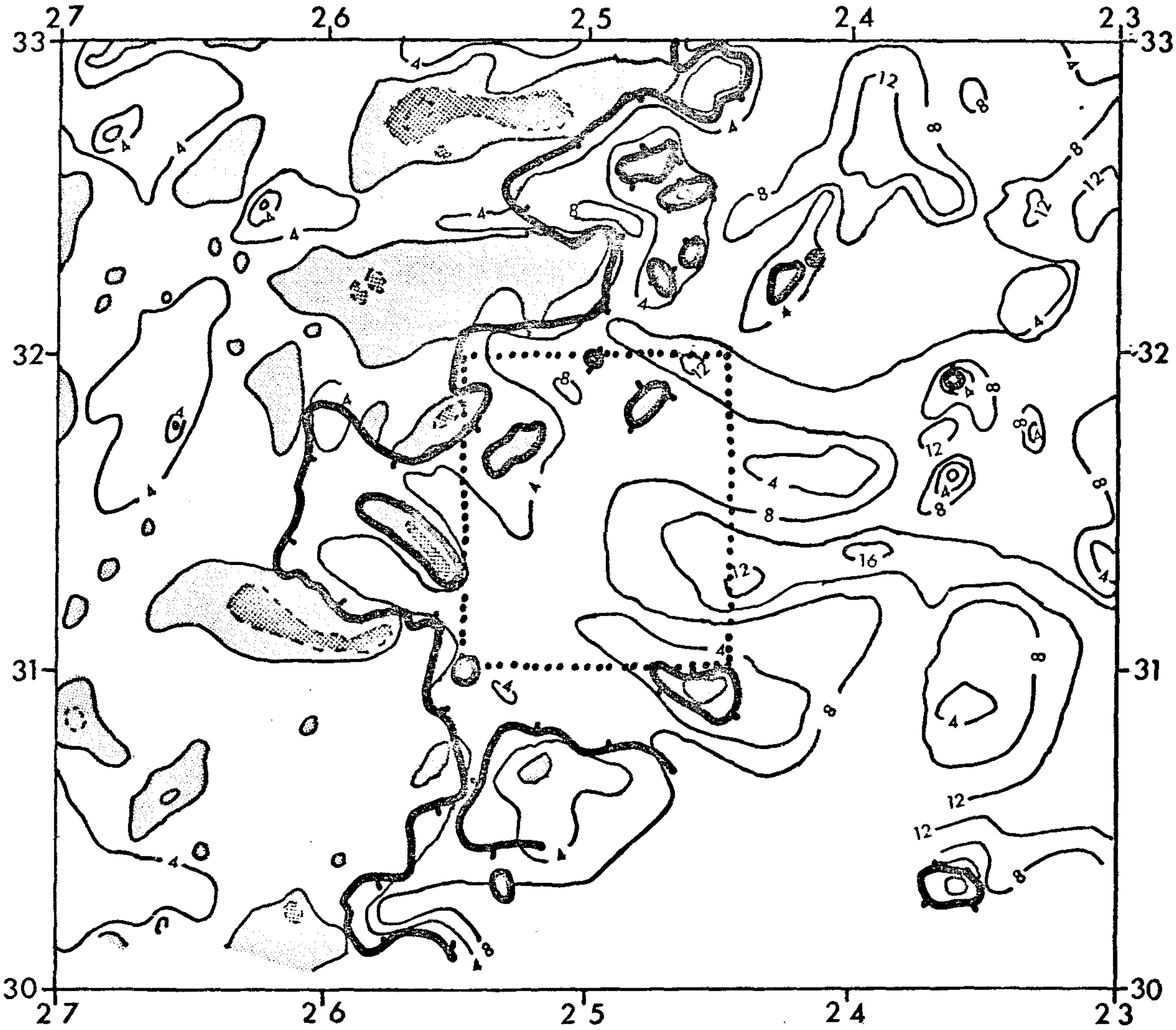


Figure 14 GREAT METEOR EAST - ISOPACHS

Contoured every 0·4 seconds two-way time

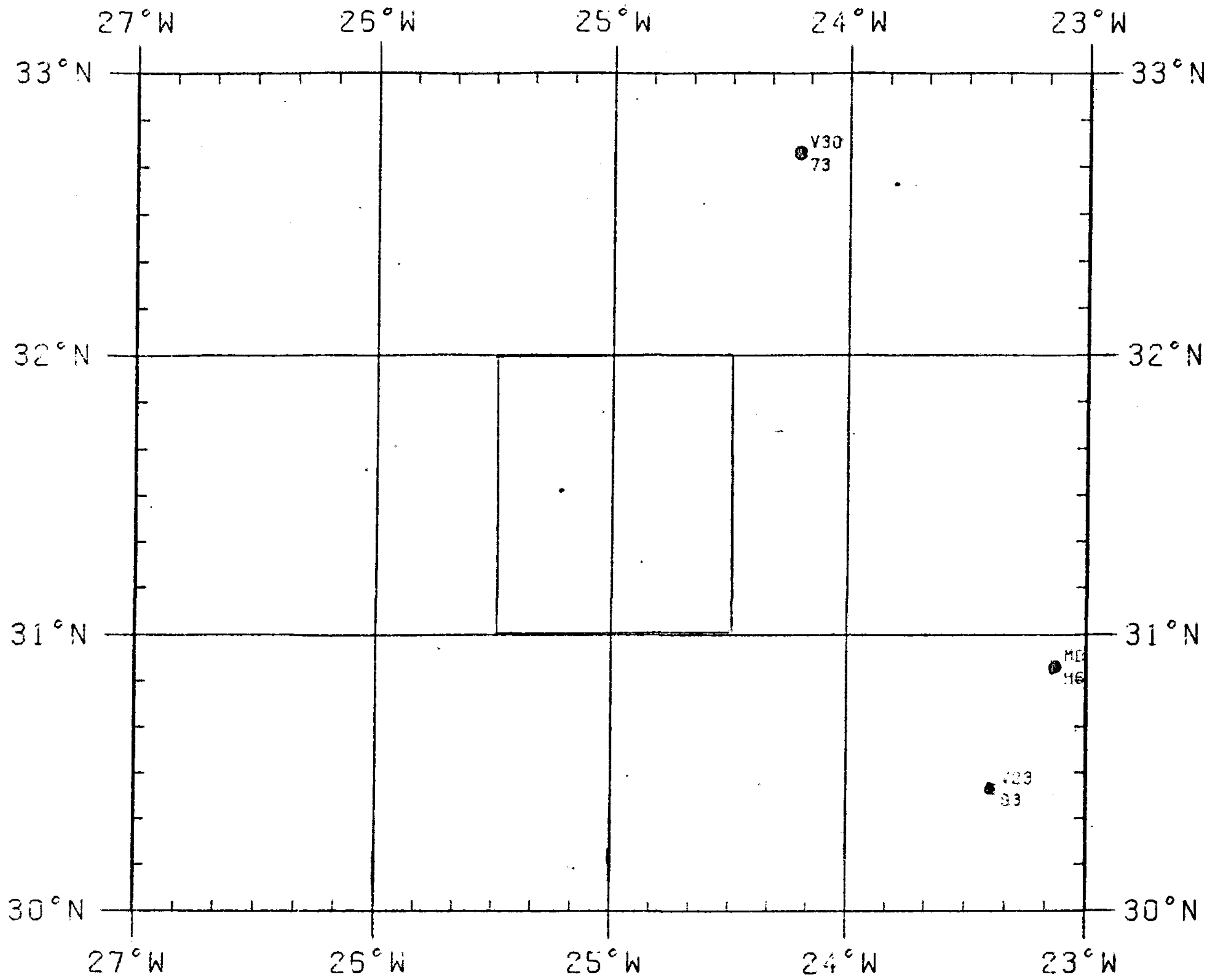
Outcrop

Sediment capping

Limit Gt. Meteor East

Limit abyssal plain

SCALE 1 : 2,400,000 at 41° Latitude



GREAT METEOR EAST - CORE POSITIONS

MERCATOR PROJECTION,

SCALE=1/ 2400000.00 AT 45.00 DEG LAT

Figure 15

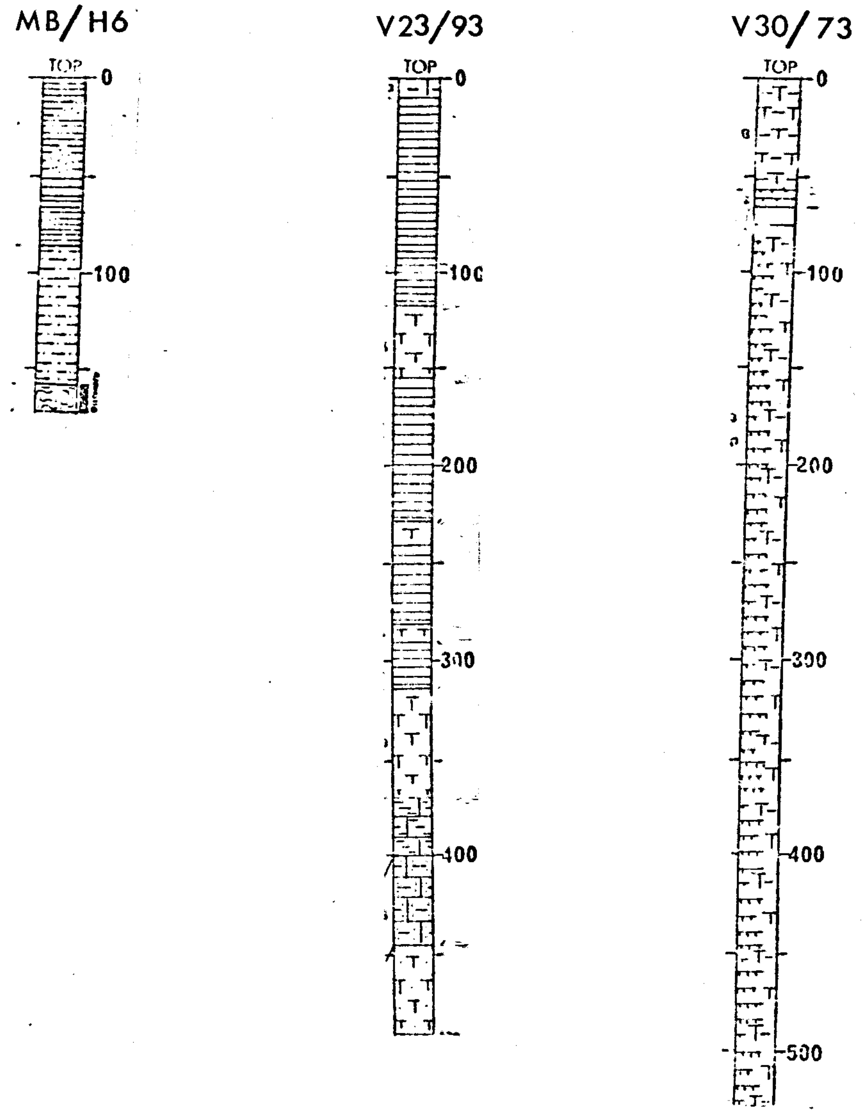
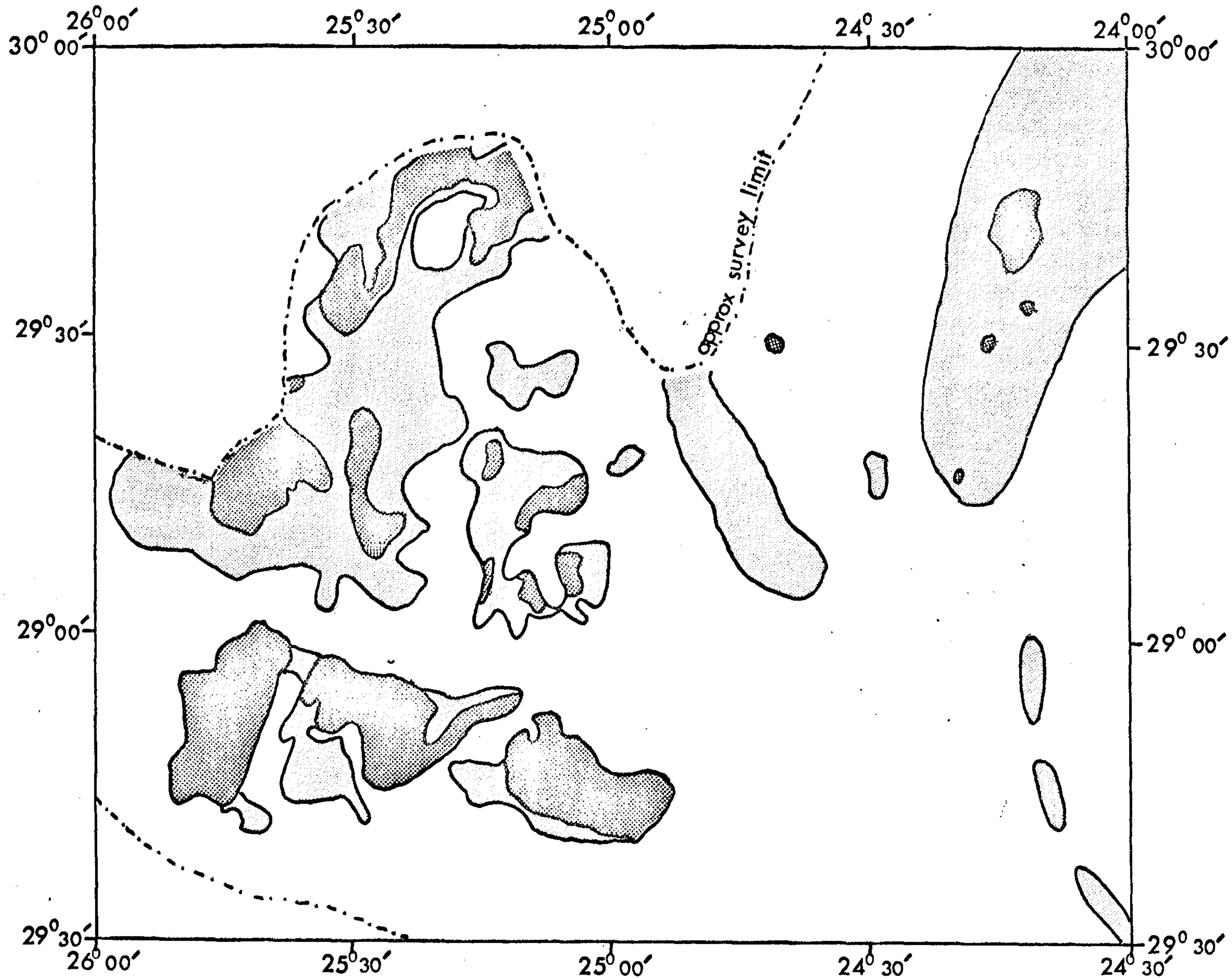


Figure 16 GREAT METEOR EAST - CORES

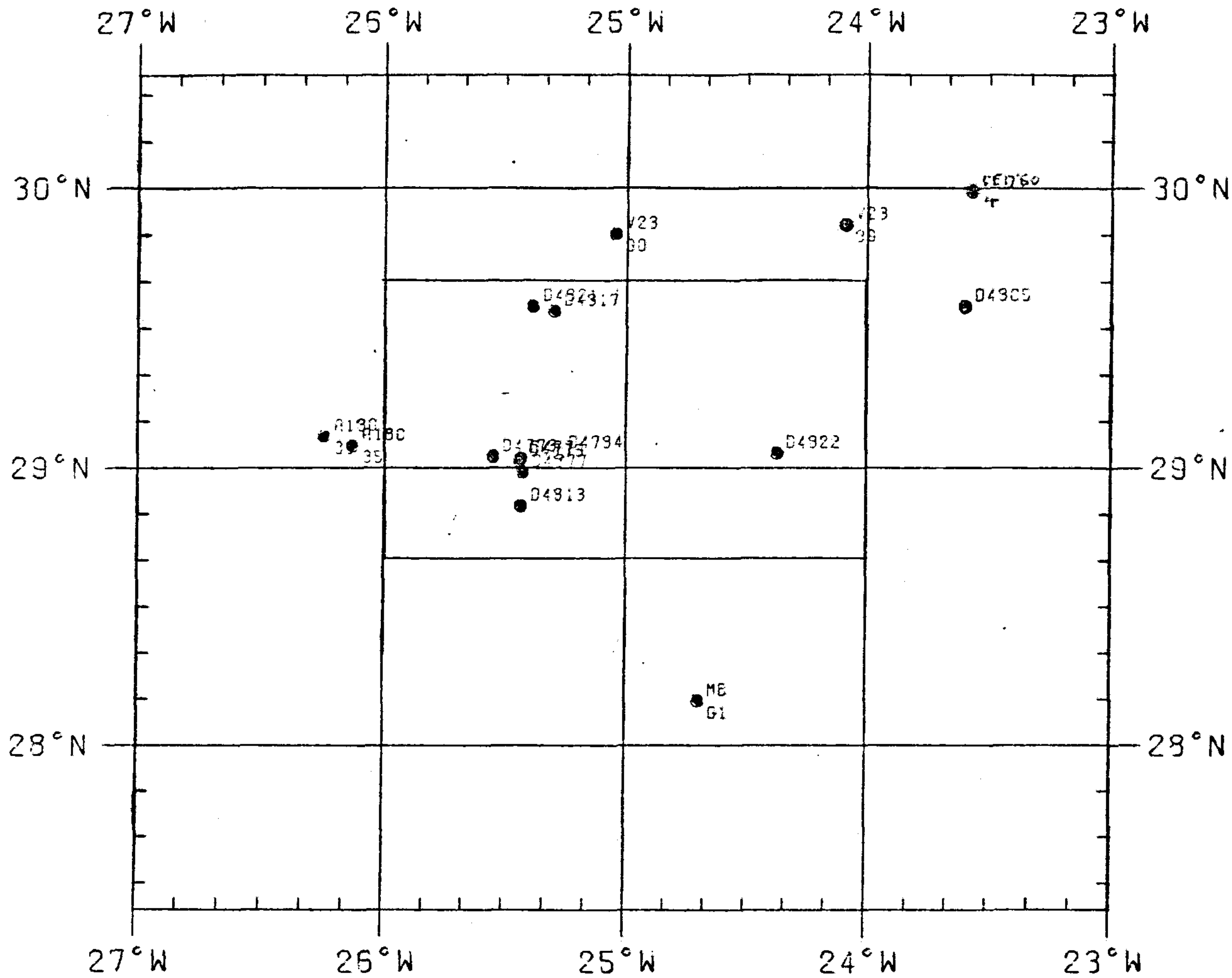
MB	H6	30 53.00N	23 8.00W
V23	93	30 26.50N	23 23.50W
V30	73	32 43.00N	24 13.00W

Figure 17



MADCAP TOPOGRAPHY (after Belderson & Laughton 1965)

rough, mountainous   undulating   abyssal plain



MADCAP - CORE POSITIONS

MERCATOR PROJECTION,

SCALE=1/ 2400000.00 AT 45.00 DEG LAT

Figure 18

A180	33	29	7.00N	26	15.00W
A180	35	29	5.00N	26	8.00W
D4774		29	2.25N	25	26.00W
D4775		29	1.75N	25	26.50W
D4777		28	59.50N	25	25.75W
D4778		29	2.75N	25	33.00W
D4784		29	3.50N	25	16.75W
D4805		29	35.00N	23	36.00W
D4813		28	52.25N	25	26.00W
D4817		29	34.00N	25	18.00W
D4821		29	35.00N	25	23.50W
D4822		29	3.50N	24	22.50W
MB	G1	28	10.00N	24	42.00W
SED'60	4	29	59.80N	23	35.10W
V23	89	29	52.40N	24	5.70W
V23	90	29	50.50N	25	3.00W
V23	93	30	26.50N	23	23.50W

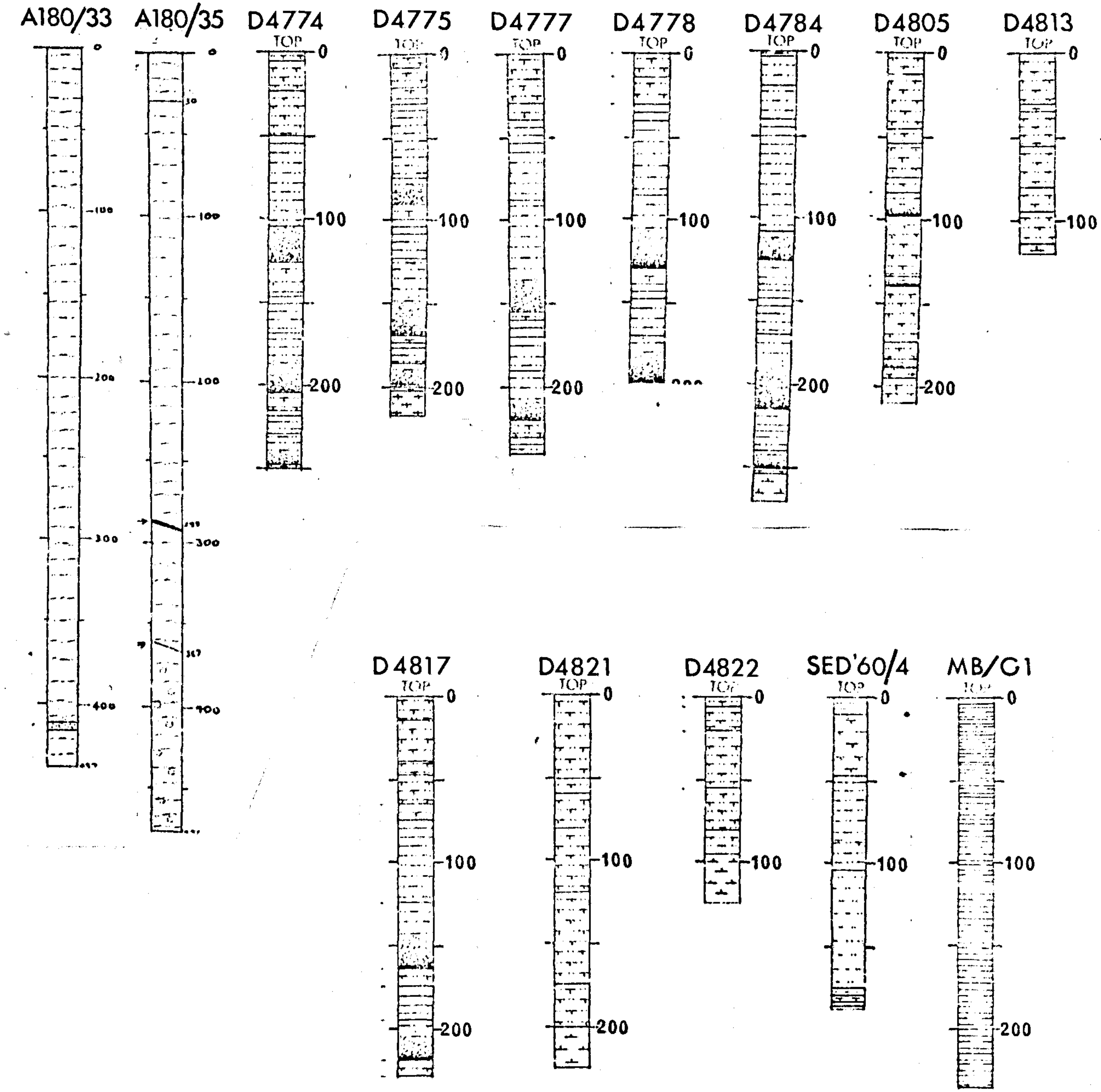


Figure 19

MADCAP - CORES

APPENDIX A

KEY TO ABBREVIATIONS USED IN CORE LISTINGS

CODE	VESSEL	SOURCE
A	ATLANTIS	WOODS HOLE OCEANOGRAPHIC INSTITUTE
ALB	ALBATROSS	SWEDISH DEEP SEA EXPEDITION
CA	CARYN	WOODS HOLE OCEANOGRAPHIC INSTITUTE
CHN	CHAIN	STN/CORE NO. WOODS HOLE OCEANOGRAPHIC INSTITUTE
D	DISCOVERY	STATION NO. INSTITUTE OCEANOGRAPHIC SCIENCES, ENGLAND
DSDP	GLOMAR CHALLANGER [SITE]	DEEP SEA DRILLING PROJECT
EKV	EKVATOR	USSR HYDROGRAPHICAL SERVICE
K	KANE	U.S. NAVAL HYDROGRAPHIC OFFICE
KNR	KNORR	STN/CORE NO. WOODS HOLE OCEANOGRAPHIC INSTITUTE
LK	LORD KELVIN	(CABLE-LAYING SHIP)
MB	MENAI BRIDGE	UNIVERSITY COLLEGE OF NORTH WALES - NAVADO COLLECTION
ML	MICHAIL LOMONOJOV	USSR MARINE HYDROGRAPHIC INSTITUTE
PL	PETER LEBEDEV	USSR ACADAMY OF SCIENCE
REH	REHOBATH	U.S. NAVAL HYDROGRAPHIC OFFICE
RC	ROBERT D CONRAD	LAMONT GEOLOGICAL OBSERVATORY
S	SHACKLETON	INSTITUTE OCEANOGRAPHIC SCIENCES, ENGLAND
SED	SEDOV	USSR HYDROGRAPHIC SERVICE
SP	SAN PABLO	U.S. NAVAL HYDROGRAPHIC OFFICE
TRI	TRIDENT	UNIVERSITY OF RHODE ISLAND
V	VEMA	LAMONT GEOLOGICAL OBSERVATORY

A152	88	39 5.00N	23 25.00W
ALB	289	41 12.00N	31 30.00W
ALB	290	41 35.00N	29 37.00W
ALB	292	42 16.00N	26 36.00W
ALB	293	42 23.00N	26 2.00W
ALB	296	42 27.00N	21 8.00W
ALB	297	43 4.00N	19 40.00W
CA	10	37 57.00N	24 15.00W
CA	15	37 6.00N	11 37.00W
CHN21	14/14G	33 32.00N	18 11.00W
CHN21	15/15G	34 0. N	15 51.00W
CHN43	106/30	44 36.00N	28 10.00W
CHN43	109/32	42 37.10N	28 44.80W
CHN43	115/33	42 38.10N	28 48.40W
CHN82	21/1PG	36 9.50N	7 16.30W
CHN82	22/2PG	35 39.00N	13 42.00W
CHN82	23/3PG	41 38.00N	27 20.00W
CHN82	24/4PG	41 42.50N	32 51.00W
CHN82	25/5PG	42 18.70N	28 34.50W
CHN82	26/6PG	42 10.00N	31 38.00W
CHN82	27/7PG	42 6.00N	28 16.00W
CHN82	28/8PG	42 0. N	29 57.00W
CHN82	30-1/9	41 50.60N	26 27.00W
CHN82	30-2/1	40 48.20N	26 27.00W
CHN82	31/11P	42 23.00N	31 47.50W
CHN82	32/12P	43 45.00N	27 46.50W
CHN82	33/13P	42 28.50N	28 40.00W
CHN82	36/14P	42 33.30N	29 18.50W
CHN82	41/15P	43 22.30N	28 13.90W
CHN82	42/16P	43 19.60N	28 4.60W
CHN82	44/17P	40 57.70N	27 12.50W
CHN82	45/18P	41 35.90N	27 27.80W
CHN82	49/19P	43 29.30N	29 34.40W
CHN82	50/20P	43 29.90N	29 52.00W
CHN82	51/21P	43 17.30N	29 49.80W
CHN82	54/22P	43 50.00N	27 57.90W
CHN82	56/23P	43 35.10N	31 37.50W
CHN82	57/24P	43 27.90N	30 37.80W
CHN82	58/25P	43 29.50N	30 13.00W
CHN82	59/26P	43 20.10N	30 0. W
CHN96	98/8G	30 31.30N	20 19.70W
CHN96	6-10/1	32 36.10N	21 26.20W
D3738		41 0. N	15 8.00W
D3815		43 43.00N	12 39.00W
D3816		43 42.00N	12 39.30W
D3817		43 41.50N	12 39.40W
D3819		43 35.00N	12 47.00W
D3820		43 37.00N	12 49.50W
D4824		43 3.00N	19 48.00W
D5591		41 12.00N	12 52.00W
D5592		41 10.00N	12 53.00W
D5593		41 7.00N	12 54.00W

D5594		41 3.00N	12 58.00W
D5595		40 57.00N	13 6.00W
D5596		40 53.00N	13 8.00W
D5587		40 50.00N	13 10.00W
D5598		40 47.00N	13 14.00W
D5599		40 36.00N	13 23.00W
D5600		40 34.00N	13 27.00W
D5601		40 31.50N	13 28.00W
D5602		40 29.00N	13 30.00W
D5603		41 1.00N	13 57.00W
D5613		42 47.50N	20 17.00W
D5615		43 6.00N	20 7.00W
D5620		42 49.50N	20 16.00W
D5621		42 46.50N	20 17.00W
D5622		42 50.00N	20 17.00W
D5635		42 50.50N	20 15.00W
D5638		42 26.00N	20 28.00W
D5642		41 52.00N	14 30.00W
D5643		41 53.00N	14 21.50W
D5644		41 54.00N	14 14.00W
D5646		42 15.00N	14 4.00W
D5648		42 15.50N	14 1.00W
D5980		42 48.20N	20 14.30W
D9567		44 2.12N	21 48.79W
D9571		44 2.80N	21 47.03W
D9574		43 33.50N	22 23.90W
D9806		43 32.50N	17 53.30W
DSDP	120	36 41.19N	11 25.94W
DSDP	135	35 20.80N	10 25.46W
DSDP	136	34 10.13N	16 18.19W
DSDP	332	36 52.72N	33 38.46W
DSDP	333	36 50.45N	33 40.05W
DSDP	334	37 2.13N	34 24.87W
DSDP	370	32 50.20N	10 46.60W
DSDP	411	36 45.97N	33 23.30W
DSDP	412 &	36 33.74N	33 9.96W
DSDP	413	36 32.59N	33 10.50W
K5	50	34 58.00N	13 0. W
K28	C5	37 8.00N	30 15.00W
K28	07	37 42.00N	30 35.00W
KNR31	1/1PG	36 26.50N	32 0. W
MB	H6	30 53.00N	23 8.00W
MB	I1	33 52.00N	12 56.00W
MB	I2	33 52.00N	19 17.00W
MB	J5	37 15.00N	27 40.00W
MB	J6B	37 9.00N	14 23.00W
MB	K1A	39 57.00N	10 33.00W
MB	K1	40 2.00N	10 52.00W
MB	K2	40 1.00N	22 54.00W
MB	L3	43 4.00N	32 35.00W
MB	L4	43 4.00N	23 16.00W
MB	L5	43 1.00N	17 14.00W
MB	BALEN	34 56.00N	8 9.00W
MB	PALMAS	30 17.00N	14 33.00W
ML4	218	43 14.60N	9 51.20W
ML4	254	43 47.30N	22 36.00W
ML4	255	43 4.50N	21 40.20W
ML4	257	41 28.50N	21 23.20W
ML4	260	40 13.80N	24 22.30W

ML4	263B	38 55.60N	28 34.30W
ML4	265	39 59.30N	30 59.00W
ML4	270	44 26.80N	34 7.00W
R5	50	34 58.00N	13 11.00W
RC9	211	42 9.00N	14 31.00W
RC9	212	44 12.00N	14 55.00W
RC9	213	43 34.00N	15 47.00W
RC9	214	43 47.00N	15 44.00W
RC9	215	44 16.00N	15 47.00W
RC9	216	44 21.00N	15 25.00W
RC9	217	44 31.00N	15 28.00W
S8	79-1	41 4.30N	21 44.20W
S8	79-2	41 28.50N	21 41.40W
S8	79-3	42 8.70N	21 23.60W
S8	79-4	42 22.60N	22 3.10W
S8	79-5	42 13.50N	22 33.90W
S8	79-6	41 51.90N	22 44.20W
S8	79-7	42 19.90N	23 3.50W
S8	79-8	42 49.60N	23 3.80W
SED'59	30	44 2.00N	23 9.50W
SED'59	35	39 4.80N	13 15.70W
SED'59	37	37 40.10N	10 20.50W
SED'59	38	37 17.50N	9 38.20W
SED'59	39	36 44.90N	8 49.90W
SED'59	40	36 23.20N	7 55.60W
SED'60	7	30 10.70N	30 35.00W
SED'60	8	30 13.80N	32 48.20W
SP8	3	30 24.00N	30 47.00W
TR121	2	38 28.20N	26 22.80W
TR121	6	38 47.40N	23 59.40W
TR121	7	39 53.70N	23 20.30W
TR121	9	38 53.00N	22 44.00W
TR121	10	39 18.00N	20 34.20W
TR121	12	39 33.00N	19 19.80W
TR121	13	39 39.00N	18 42.60W
TR121	14	38 53.00N	17 53.10W
TR121	15	38 57.00N	17 58.80W
TR121	17	32 24.00N	20 1.80W
TR121	18	38 24.00N	20 34.80W
TR121	19	38 15.60N	21 18.00W
TR121	21	38 10.20N	22 16.80W
TR121	22	38 6.90N	22 48.60W
TR121	24	38 1.00N	23 19.00W
TR121	26	37 53.40N	23 51.00W
TR121	30	38 19.90N	25 18.00W
TR121	31	38 14.60N	25 42.10W
V4	8	37 13.50N	33 8.20W
V4	13	36 36.00N	18 34.50W
V4	14	35 43.20N	17 21.00W
V4	15	35 11.00N	15 20.50W
V4	19	34 14.00N	15 12.00W
V4	20	35 7.50N	13 4.00W
V4	22	35 8.00N	13 0. W
V4	23	35 0.50N	12 57.00W
V4	24	35 0. N	12 57.00W
V4	25	35 1.00N	12 57.00W
V4	27	35 3.00N	12 57.50W
V4	32	35 3.00N	11 37.00W
V4	33	34 35.00N	8 41.00W

V4	34	34	10.00N	8	16.00W
V4	35	34	4.00N	8	2.50W
V4	39	38	12.30N	9	23.80W
V4	40	38	17.40N	9	23.00W
V4	41	38	12.00N	9	45.00W
V4	42	38	12.00N	10	5.00W
V4	44	37	40.00N	11	7.50W
V4	46	38	5.00N	11	54.00W
V4	47	37	13.90N	12	16.00W
V4	48	37	2.00N	12	36.20W
V4	51	33	9.00N	28	49.00W
V4	53	33	5.00N	29	18.50W
V4	54	33	13.80N	29	31.00W
V14	149	35	57.00N	7	30.00W
V14	151	38	36.50N	28	50.50W
V23	85	41	9.90N	14	42.20W
V23	86	37	23.70N	17	2.00W
V23	87	34	4.50N	19	42.00W
V23	88	31	6.50N	21	57.50W
V23	92	30	3.50N	28	15.00W
V23	93	30	26.50N	23	23.50W
V23	94	30	37.30N	20	8.60W
V23	95	30	24.20N	18	23.00W
V27	124	44	22.90N	16	26.90W
V27	125	43	22.10N	15	40.50W
V27	126	43	47.90N	14	41.20W
V27	127	44	37.30N	14	57.60W
V27	136	43	58.10N	15	48.70W
V27	137	42	41.50N	17	4.10W
V27	138	42	56.70N	25	4.40W
V27	139	42	2.70N	27	17.00W
V27	140	41	3.80N	24	49.80W
V27	141	35	28.70N	24	56.40W
V27	142	36	59.90N	22	54.10W
V27	143	39	42.80N	20	9.40W
V27	144	39	35.60N	13	33.40W
V27	145	39	2.60N	11	59.20W
V27	146	38	9.20N	11	42.30W
V27	147	37	1.90N	11	14.70W
V27	148	35	45.60N	13	26.70W
V27	149	35	20.00N	14	1.90W
V27	150	36	26.90N	12	59.20W
V27	151	35	52.90N	12	23.30W
V27	152	35	32.00N	12	4.40W
V27	153	35	50.90N	11	38.00W
V27	154	35	37.20N	10	50.60W
V27	157	34	15.00N	10	40.20W
V27	155	36	3.20N	10	33.70W
V27	156	36	7.70N	10	13.30W
V27	158	34	16.70N	11	46.40W
V27	159	33	58.90N	13	19.60W
V27	160	33	26.30N	12	53.40W
V27	161	33	34.70N	13	58.30W
V27	162	34	11.90N	16	51.50W
V27	163	31	29.70N	17	21.80W
V28	85	44	55.00N	17	2.00W
V28	89	44	32.00N	32	35.00W
V29	172	33	42.00N	29	23.00W

V29	173K	33 42.00N	29 23.00W
V29	174	36 17.80N	29 21.70W
V29	175	37 30.00N	28 17.00W
V29	176	40 33.30N	26 0.30W
V29	177	41 32.20N	25 42.50W
V29	178	42 50.90N	25 9.10W
V29	179	44 0.60N	24 32.40W
V30	69	32 12.00N	18 49.00W
V30	70	32 19.00N	19 55.00W
V30	71	32 18.00N	19 50.00W
V30	72	34 8.00N	22 19.00W
V30	73	32 43.00N	24 13.00W
V30	74	33 53.00N	25 34.00W
V30	75	32 58.00N	29 8.00W
V30	76	33 36.00N	31 29.00W
V30	77	35 4.20N	34 26.40W
V30	78	34 59.00N	34 9.00W
V30	82	35 8.50N	34 32.20W
V30	83	34 56.00N	34 19.00W
V30	84	35 20.10N	34 21.50W
V30	85	35 11.00N	34 28.50W
V30	86	35 7.00N	34 1.50W
V30	96	39 56.00N	33 8.00W
V30	98	42 2.00N	32 48.00W
V30	99	43 9.00N	32 27.00W
V30	100	44 6.00N	32 30.00W
V30	101K	44 6.00N	32 30.00W
V30	186	41 1.00N	18 4.00W
V30	187	41 7.00N	10 4.00W
V30	188	39 54.00N	10 33.00W
V30	189	38 25.00N	11 29.00W
V30	190	37 55.00N	14 6.00W
V30	191	36 59.00N	15 43.00W
V30	192	35 21.00N	17 7.00W
V30	193	35 7.00N	16 34.00W
V30	194	34 2.00N	13 57.00W
V30	195	33 22.00N	12 1.00W
V30	196	32 57.00N	11 7.00W
V30	197	32 38.00N	10 12.00W
V30	198	33 8.00N	9 33.00W
V30	199	33 56.00N	9 55.00W
V30	200	34 18.00N	9 25.00W
V30	201	34 43.00N	7 53.00W
V30	202	35 33.00N	7 59.00W
V30	203	36 7.00N	8 10.00W
V30	204	36 19.00N	8 6.00W
V30	205	36 18.00N	8 49.00W
V30	206	36 2.00N	9 2.00W
V30	207	36 28.00N	9 8.00W
V30	208	34 36.00N	8 17.00W
V30	210	36 39.00N	7 43.00W
V30	211	36 24.00N	7 26.00W
V30	216	35 26.00N	7 7.00W
V30	217	34 42.00N	7 19.00W
V30	218	34 36.00N	9 2.00W
V30	219	34 27.00N	10 16.00W
V30	220	33 36.00N	9 31.00W
V30	221	33 28.00N	9 19.00W
V30	222	33 28.00N	9 18.00W

V30	223	33 36.00N	9 25.00W
V30	224	33 36.00N	9 33.00W
V30	225	33 46.00N	9 25.00W
V30	226	33 46.00N	9 24.00W
V30	228	31 51.00N	12 26.00W
V30	229	31 8.00N	11 38.00W
V30	230	31 8.00N	11 38.00W
V30	231	30 18.00N	10 52.00W