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INITIAL REPORT ON 1984 R/V. S.P. LEE CRUISE L6-84-SP

IN WESTERN SOLOMON ISLANDS AND

EASTERN PAPUA NEW GUINEA

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United States, Australia, and
New Zealand in co-operation
with CCOP/SOPAC

INITIAL REPORT ON 1984 R/V S.P. LEE CRUISE L6-84-SP IN
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INTRODUCTION

Purpose and Scope

Under the auspices of the ANZUS Tripartite 2 Agreement, the U.S. Geological Survey research vessel S.P. LEE made a reconnaissance survey in the western Solomon Islands and the Bougainville-Buka-Green Island region of Papua New Guinea during June 1984. The agreement specified that the acquisition and interpretation of geoscience data by the Tripartite group would be used as a means of assessing the offshore petroleum and mineral resource potential for member nations of CCOP/SOPAC. The S.P. LEE Cruise L6-84-SP departed on June 9 from Honiara, Solomon Islands and arrived on June 26 at Kieta, Bougainville. On board were scientific personnel from the Solomon Islands, Australia, and the United States (Table 1). Docking of the ship at Kieta concluded the third of four cruise legs that began in Tonga in March 1984.

Regional Setting

As outlined by Coleman and Packham (1976) and Kroenke (1984), the central and western Solomon Islands together with their geologic counterparts, Bougainville and Buka, form a segment of the Melanesian Borderlands. Because the region straddles the boundary between the convergent Pacific and Australia-India plates, it has had a Cenozoic history of complex tectonism and repeated volcanism. At present, the central and western Solomon Islands

TABLE 1. LIST OF SHIPBOARD PARTICIPANTS

Scientific Party

J. G. Vedder	Co-chief scientists	USGS
J. B. Colwell	Co-chief scientist	BMR, Australia
A. K. Cooper	Geophysicist	USGS
T. R. Bruns	Geophysicist	USGS
S. Shafik	Micropalaeontologist	BMR, Australia
H. J. Ryan	Geophysicist	USGS
D. A. Dinter	Geologist	USGS
R. E. Wells	Geologist	USGS
A. R. Niem	Geologist	Oregon State University
C. Midobatu	Geochemist	Solomon Is. Geol.Survey
J.A. Fife	Geophysicist	USGS
K. L. Kinoshita	Navigator	USGS
B.J. Blubaugh	Navigator	USGS
C. R. Wilson	Navigator	USGS
J. R. Vaughn	Electronics technician	USGS
R. W. Vaill	Electronics technician	USGS
J. C. Erikson	Marine technician	USGS
G. E. O'Brien	Marine technician	USGS

Ship's Crew

A. McClenaghan	Captain
J. Dobranski	Chief Engineer
O.Lovett	
G. Wynn	
C.Satchwell	
M. Spruill	
S. Raine	
P.Erickson	
J. Sheehan	
S. Slade	
C. Poppe	
L.Prantner	
M. Wilson	
J.Harkness	
W. Lafleur	
J. Pryor	
J.Williams	
J. Morris	
A. Nye	

consist principally of a double chain of islands that is separated by an intra-arc basin, the central Solomons Trough of Katz (1980). Coleman (1966) divided the region into three geologic provinces: the Pacific Province consisting of Malaita and the northeastern part of Santa Isabel; the Central Province of San Cristobal, Guadalcanal, Florida Islands, southwestern Santa Isabel and Choiseul; and the Volcanic Province of the Russell Islands, Savo, the New Georgia Group, Shortland Islands and northwestern Guadalcanal. Bougainville and Buka form the northwestward continuation of the Central and Volcanic Provinces.

The Pacific Province is generally regarded as an overthrust and folded portion of the southwestern margin of the Ontong Java Plateau, an anomalously thick piece of Pacific Ocean crust (Kroenke, 1972). The Central Province consists of the remnants of a late Eocene-late Oligocene island-arc sequence, apparently a segment of a northeastward-facing arc over a southwestward-dipping subduction zone. In the Miocene, arrival of the Ontong Java Plateau at the trench caused cessation of volcanism and the widespread deposition of reef limestone, calcarenite and foram-rich marl in the San Cristobal, Guadalcanal and Bougainville-Buka areas. From the late Miocene onward, north-eastward subduction along the New Britain and San Cristobal Trenches led to the development of the Volcanic Province to the southwest of, or superimposed on, the older arc. The late Miocene change in subduction direction and consequent development of the New Georgia volcanoes resulted in the change of the area now occupied by the Central Solomons Trough from a back-arc basin to an intra-arc basin. The absence of a well-defined trench south of the New Georgia island group and the anomalous proximity of volcanism to the inferred position of subduction are thought by most workers (e.g. Coleman, 1976; Weissel et al., 1982) to be the result of the subduction of the Woodlark Basin spreading ridge beneath the New Georgia island group.

Previous Work

Solomon Islands

During the 1960's and 1970's a number of reconnaissance offshore surveys were made in the Central Solomons Trough and adjacent areas by exploration companies and institutions. These surveys included Magellan Petroleum Ltd. (1969), Shell Oil Co. and Teledyne (1971), Gulf and Mobil (1972), Western Geophysical (1973), Pacific Energy and Minerals (1978), and CCOP/SOPAC (1979). Reports based upon an analysis of the results of these surveys were prepared by CCOP/SOPAC for the Solomon Islands Government by Katz (1980) and Maung and Coulson (1983).

In 1982, two cruises were made by U.S. ships under the terms of the ANZUS Tripartite 1 Agreement. The first, by the Hawaii Institute of Geophysics research vessel KANA KEOKI, involved the collection of approximately 3700 nmi of underway geophysical data and substantial geological data from the Woodlark Basin - New Georgia area (Taylor and Exon, 1984). Supplemental data were acquired in the Central Solomons Trough by the same ship. The second, by the u.S. Geological Survey research vessel S.P. LEE, consisted of seafloor sampling and recording of approximately 2000 nmi of geophysical data from the Central Solomons Trough and adjacent areas (Vedder and Pound, 1984). Both cruises provided significant new data on the structure, tectonic history and resource potential of the area.

Bougainville-Buka area

Prior knowledge in this area was limited to data collected along reconnaissance geophysical lines by Gulf, ORSTOM (Austradec), and the Australian Bureau of Mineral Resources in the early to mid-1970's.

OBJECTIVES

As outlined in the ANZUS Tripartite 2 Agreement, the general objectives of the cruise were to find geologic features and relationships that are directly applicable to exploration for hydrocarbons. Chief among these objectives were:

1. - identification of potential structural and stratigraphic traps for
petroleum
2. - location of deeply buried reef build-ups
3. - detection and analysis of shallowly buried gas accumulations
4. - assessment of geologic hazards
5. - correlation of onshore geology with offshore seismic stratigraphy.

Other objectives and problems that were not conclusively resolved by earlier cruises included:

1. - definition and delineation of the southern and western margins of the
Shortland Basin
2. - structure and composition of the crust beneath the Central Solomons
Trough and bordering ridges
3. - configuration and structure of the southern terminus of the New Ireland
forearc basin
4. - composition and origin of shallow gas pockets beneath the Central
Solomon Trough.

OPERATIONS

Equipment

Geophysical and sampling equipment used on R/V S.P. LEE Cruise L6-84-SP are listed in Table 2.

In general, the equipment worked well except for problems in the GUS multichannel data-acquisition system which periodically resulted in the loss of small amounts of data. A significant amount of data was lost because of malfunctions of the gravity meter which was replaced after 12 days at sea. The Uniboom system did not perform satisfactorily and was used sporadically only in shallow-water areas. Five out of the ten sections of seismic cable, which had been damaged during the previous leg of the Tripartite cruise, were replaced with available spares before starting the multichannel work. Because of a lack of repair facilities, the remaining five damaged sections were removed from the cable, reducing its capacity from 24 to 22 channels.

TABLE 2. GEOPHYSICAL AND SAMPLING EQUIPMENT

1. Integrated Magnavox MX702A dual-channel satellite navigation system, supplemented on a few occasions by Radar ranges and visual bearings,*
2. La Coste and Romberg S-53 gravimeter*,
3. Geometrics proton-precession magnetometer*,
4. 12 kHz echo sounder, with a Raytheon CESP III correlator*,
5. 3.5 kHz high-resolution sub-bottom profiles with a Raytheon CESP III correlator*,
6. EG&G Uniboom high-resolution seismic profiler with hull-mounted transducer array,
7. Single-channel seismic-reflection system,
8. Multichannel seismic-reflection system consisting of five Bolt airguns with a combined capacity of approximately 1200 cu. in., a 22-group SEI streamer, a Litton air-gun triggering system, four air compressors and a GUS 4300 digital recording system,
9. 6 Raytheon line-scan recorders (two as single-channel monitors),
10. Fairfield sonobuoy refraction/wide-angle reflection system
11. Cesium clock and NBS synchronizing digital timing equipment
12. Deep-sea winch with approximately 7000 m of 1/2" wire,
13. Chain-bag dredges,
14. Time-depth recorders,
15. Three-metre gravity corer,
16. 30-cm long dart corers, and
17. Carle Model 311 gas chromatograph.

*Routine recording

Cruise Chronology

- Day 1 (9 June) Departed from Honiara at 1000 hrs.
- Days 2-7 Geological sampling and refraction profiling in the Central Solomons Trough.
- Day 7 Twelve-hour streamer party to make the multichannel cable operational.
- Days 8-10 Multichannel-seismic and sonobuoy-refraction profiling in the Shortland Basin area. Retrieved streamer in order to go through shallow Bougainville Strait.
- Days 11-15 Multichannel-seismic and sonobuoy-refraction profiling along the northeastern side of Bougainville, in the Buka-Green Island area, and between Bougainville and New Ireland.
- Days 16-17 Geological sampling in the Buka-Green Island area. Single-channel seismic-reflection and sonobuoy-refraction profiling from Green Island to Kieta.
- Day 18 (26 June) Arrived in Kieta at 1000 hrs.

RESULTS

Summary

A summary of the quantity of data acquired during the survey is given in Table 3. Geophysical tracklines and sampling stations are shown in Figure 1.

TABLE 3. SUMMARY OF ACQUIRED DATA

Multichannel seismic data	968 nmi (1792 km)
Single-channel seismic data	155 nmi (287 km)
Sonobuoy refraction lines	40
Gravity	1620 nmi (3000 km)
Magnetic	1250 nmi (2315 km)
Bathymetry, 3.5 kHz	2088 nmi (3868 km)
Bathymetry, 12 kHz	2127 nmi (3940 km)
Uniboom	324 nmi (600 km)
Gravity cores	6
Dart cores (3 lines)	19
Gas samples from gravity cores	16
Dredge hauls (19 stations)	12

Geological Sampling

Bedrock sampling was attempted using chain-bag dredges and dart corers. Soft-sediment sampling was by means of a gravity corer. Sampling targets were selected on the basis of both 1982 and 1984 LEE multichannel and high-resolution seismic data. Because of a lack of exposure of bedrock, dredging was concentrated mainly along the eastern margin of the Guadalcanal-Santa Isabel platform, west of Vella Lavella, and north of Buka (Fig. 1). Results of the dredging and other sampling are summarized in Table 4.

Dredges

Nineteen dredge stations were occupied, 12 successfully. Two proposed stations (4 and 20) were not occupied because of unfavorable conditions. The rocks recovered range in lithology from well-rounded volcanic and metavolcanic cobble conglomerate (Station 1) to foram- and pteropod-rich calcilutite

(Station 29). Preliminary identifications of calcareous nannofossils suggest that most of the samples are of Quaternary age except the calcilutite at Station 29, which is Pliocene (Shafik, pers. comm., 1984).

Several dredge sites yielded particularly significant rocks. Among these are the moderately-indurated pebbly conglomerate from Station 1 that possibly represents an offshore continuation of the Plio-Pleistocene Vatumbulu Beds of eastern Guadalcanal and the calcareous sandy mudstone from Station 2 that displays unusual cementation and borings. Pliocene (?) calcilutite from Station 29 apparently is sheared suggesting late tectonism in that area. The shallow water reef limestone and volcanoclastic sandstone collected from 620 to 900 m water depths at Stations 22 and 23 confirm the conclusion that the region west of Vella Lavella underwent substantial uplift and subsidence during part of the Quaternary (Resig, 1984; Colwell and Vedder, 1984).

Dart Cores

Results of the dart coring were disappointing because a widespread thin veneer of Holocene mud apparently mantles the bedrock even where slopes are steep and currents are strong. Up to 52 cm of hemipelagic muddy sand and sandy mud were obtained in 18 out of the 19 drops along three dart-core lines. One drop (9I) was unsuccessful.

Variations in the amount of mud in the cored sediment seem to reflect the degree of winnowing. For example, the line of cores at Station 15 show that the amount of mud in the sediment decreases with decreasing water depth, i.e. with increasing current action. The sand fraction at all sites consists of a mixture of biogenic (mainly foram and pteropod) and volcanogenic (mainly lithic and feldspar) components.

Gravity Cores

Six gravity cores varying in length from 125 to 295 cm were taken in water depths ranging from 913 to 1682 m (Table 4; Fig. 1). All of the cores appear to be of Quaternary age (Shafik, pers. comm., 1984).

At Station 7 (1290 m of water), 125 cm of olive-grey hemipelagic mud was recovered. A thin (3 cm thick) yellowish olive-brown oxidation zone is present at the top of the core. Thin (1 cm and less) ash layers are present in two zones, from 9-16 cm and 79-86 cm.

The core from Station 12 consists of 295 cm of light olive-grey, bioturbated (mottled) hemipelagic mud containing minor sand-size foram and pteropod debris. The core was recovered in 1612 m of water. Volcanic-rich sand and mud layers are common between 160 and 170 cm, and 200 and 235 cm. Quaternary nannofossils occur at the base of the core (Shafik, pers. comm., 1984).

At Station 13 (1682 m of water), 169 cm of pale olive to light olivegrey, bioturbated, slightly sandy hemipelagic mud containing planktonic forams and some pteropods was recovered. Thin, dark olive-grey, fine-grained, probable turbidite volcaniclastic sand layers occur at 73-75 cm and 133-136 cm. These layers have a sharp lower contact and a gradational upper contact. A 7cm thick dark yellowish-brown to greyish-orange oxidation layer occurs at the top of the core.

The cores recovered at Stations 16 and 16A (Fig. 1) consist of 219 and 266 cm, respectively, of predominantly yellowish-grey to light olive-grey, slightly sandy, hemipelagic mud. Water depths vary from 1672 m at Station 16 to 1444 m at Station 16A. The mud is typically bioturbated and contains minor sand, mainly foram and pteropod debris. A foram-rich turbidite layer occurs in core 16 between 70 and 85 cm. Dark olive-grey to black volcanic-rich sandy layers also occur in this core. Both cores have a 5- to 10-cm thick oxidation layer on their upper surface.

The core from Station 18 (913 m of water) consists of 264 cm of pale olive to light olive-grey, bioturbated, slightly sandy hemipelagic mud containing foram and pteropod fragments. A thin (3 cm) oxidation zone is present at the top of the core. Minor volcanogenic material also is present.

In general, the gravity cores confirm that hemipelagic sedimentation is widespread in the Russell basin. Unfortunately, because of their short lengths, cores taken at Stations 7 and 13 failed to penetrate the targeted slumped sediments.

Gas Analyses

Small concentrations of hydrocarbon gases occur in the fifteen sediment samples extracted for gas analysis from the six gravity cores taken during the cruise. Except for Station 7, these cores were taken over or adjacent to areas interpreted by Colwell and Tiffin (1984) to contain shallow-depth gas produced seismic features such as transparent layers and lenses.

K. Kvenvolden, A. Niem and E. Frankel (pers. comm., 1984) determined that methane is the most abundant hydrocarbon gas analyzed in the samples and that it ranged in concentration from 240 to 2600 nanolitres/litre of wet sediment (NL/L). Ethane, which they measured in only three samples, ranges from 8 to 60 NL/L, whereas propane, measured in six samples, ranges from 4 to 80 NL/L. Unsaturated hydrocarbon gases are present in most samples. Butanes as well as a small amount of heavier hydrocarbons occur in one sample from 16A with the exception of this one sample, the remaining samples contain a background of hydrocarbon gases which appear to be ubiquitous in oceanic sediment (Kvenvolden, pers. comm., 1984). This background results from gases in seawater incorporated during sedimentation and from low-level, microbiological activity. The single anomalous sample hints at the presence of thermogenic

hydrocarbons; however, the relatively low concentrations and the occurrence of the sample stratigraphically between samples having background values reduce the significance of this anomaly with regard to possible hydrocarbon seepage from deeply buried petroleum deposits.

Seismic-Reflection

In general, the seismic system worked well and records showing as much as 4 seconds of penetration were obtained. To date, interpretations are based only upon an initial shipboard examination of the single-channel monitor records taken off the multichannel streamer. They are, therefore, subject to change when the multichannel data have been fully processed, hopefully by the end of 1984.

The seismic-reflection results are described in three main geographic areas: 1) in the Shortland Basin, 2) along the northeast side of the Bougainville-Green Island area, i.e. in the Kilinailau Trench, and 3) west of Buka.

Shortland Basin

Seven lines, 401-407, were run over the southern and western parts of the Shortland Basin (Fig. 1). The purpose of these lines was to define the extent of sedimentary fill within the basin and to determine the configuration and structural nature of the southern and western margins.

In general, sedimentary fill is confined largely to the area northwest of Vella Lavella, south of Choiseul and east of the Shortland Islands as was suggested by the 1982 survey lines. The ridge of acoustic basement extends from the western side of Vella Lavella extends to Treasury (Mono) Island in the Shortland Islands group (Fig. 2). Sedimentary sequences similar to those

recorded in 1982 occur on the eastern end of Line 406 and on Line 407. The Shortland basin does not extend westward beneath the bathymetric saddle north of Treasury Island.

Northeast side of Bougainville-Green Island Area

Eight multichannel lines (408-413, 417 and 418) were run over the axis and southwestern (inner) wall of the Kilinailau Trench (Fig. 1). In addition, one single-channel line was run from the last dredge station (Station 29) back to Kieta.

The results of this profiling clearly indicate that the Kilinailau Trench is a partly-filled former subduction zone. Dipping reflectors above the acoustic basement of Ontong Java Plateau are overlain by slightly deformed sediments that abut the inner trench wall (Fig. 3). Folded and upfaulted(?) blocks of trench(?) sediment are present at the base of the inner trench wall, and small ponded basins occur higher on the slope.

West of Buka

Five lines (414-416, 419-420) and parts of two lines (413 and 417) transect this area. These lines were run in order to determine the extent and structure of the sedimentary sequence that forms the southeastern end of the New Ireland basin as well as to define the trend of the late Eocene and Oligocene arc between Bougainville and New Ireland.

A thick sequence of sediments overlies acoustic basement in the trough directly west of Buka (Lines 413 and 414) and extends (Lines 417 and 419) northwestward toward the main axis of the New Ireland forearc basin. The basement presumably is continuous with Pliocene(?) to Holocene volcanic rocks that form northwestern Bougainville and that are believed to underlie the

Feni-Green Island ridge. Westward-dipping reflectors in the lower part of the basin sequence just west of Buka probably include the Oligocene(?) Buka Formation.

The broad bathymetric salient that extends westward from the Bougainville island platform (Fig. 1) is underlain by acoustic basement (Fig. 4). Thin, Pleistocene(?) reef sequences appear to be present on the highest parts of the ridge. The basement rocks possibly are island-arc volcanics that correlate with the Oligocene Kieta Volcanics on Bougainville. The same ridge extends northwestward farther than indicated by the bathymetry on Figure 1 and seems to join the western side of Bougainville to the southern end of New Ireland, which is underlain by the Oligocene Jaulu Volcanics.

Sonobuoy Refraction

Forty sonobuoy refraction profiles were recorded along the lines shown on Figure 1. Preliminary interpretations in general corroborate those made from the 1982 profiles. Significant new interpretations, which are supported by gravity and magnetics data, cover areas in the northwestern part of the Central Solomons Trough and the Bougainville-Buka-Green Island ridge and adjoining Kilinailau Trench.

The southwestern shelf of Choiseul, which is marked by a striking gravity high, probably is underlain by mafic intrusions (gabbroic?) rather than ultramafic rocks as previously suspected. Fatu O Moana, the horst-like feature between Choiseul and Kolombangara, is an uplifted block that is underlain by high-density rocks.

The northeast slopes of Bougainville and Buka and the ridge that connects Buka and Green Islands are formed by volcanic rocks at or near the surface. We assume that these volcanic rocks correlate with the Pliocene to Holocene

Bougainville Volcanics based upon seismic-reflection data. The inner wall of the Kilinailau Trench is composed of volcanic rocks and strata that apparently are underridden by high-velocity oceanic rocks of the Ontong Java Plateau.

SUMMARY AND CONCLUSIONS

The geological and geophysical data collected during this survey are a valuable supplement to those collected during the 1982 LEE cruise. They provide additional knowledge on the nature of the rocks that occur at the eastern end of the Russell basin, west of Vella Lavella, and in the vicinity of Buka and Green Islands. The new data furnish detailed information on the configuration and structural nature of the southern and western margins of the Shortland Basin. Furthermore, the new data afford a means of understanding the character and deformational history of trench-fill sediments northeast of Bougainville and the tectonic relation of the oceanic basement of Ontong Java Plateau to the inner wall of the Kilinailau Trench. Moreover, the sedimentary sequences present at the southeasternmost end of the New Ireland forearc basin, and their underpinnings can be delineated and explained.

Because little processing, analysis and interpretation of the data have been undertaken in the two months since the cruise, no new assessment of the hydrocarbon potential of the areas surveyed has been made. However, reevaluations of the potential will be undertaken in the next few months as processing of the multichannel seismic data continues. Final results of the survey will be reported about 18 months to 2 years after the completion of the cruise, presumably at the end of 1985 or in the first half of 1986.

TABLE 4

STATION SUMMARY

STATION	EQUIPMENT*	TDR ^Ø	LAT.(S)	LONG.(E)	APPROX. W.D. (m) OF ROCKS RECOVERED	AMOUNT RECOVERED	WHAT WAS RECOVERED [†]
1.	D	Y	09°27.927' 09°28.83'	160°45.780' 160°42.67'	700	~10 kg	1. 60%. Well-rounded, meta-volcanic(?) and volcanic cobbles up to 15 cm in length & small piece of poorly-sorted, moderately-indurated, pebbly conglomerate. 2. 40%. High-weathered, bored, calcareous volcaniclastic(?) sandstone (& some pieces of wood).
2.	D	Y	09°17.616'	160°35.242'	750-800	~100 kg (Full bag)	1. Toroid (doughnut & elongate, hollow, cylinder), hollow-cone, and plate-shaped pieces of sandy mudstone with abundant claystone fragments. Well-indurated, highly calcareous matrix. Cementation commonly centred around (?worm) tubes. 2. Medium grey, poorly-indurated, highly fossiliferous, muddy, volcaniclastic sandstone.
3.	D	N	09°09.320'	160°34.535'	-	0	Few pieces of wood.
4.	-	-	-	-	-	(NO ATTEMPT)	
5.	D	N	08°46.234'	160°07.624'	-	0	(Lost dredge at weak link)
6.	D	Y	08°38.445'	160°05.123'	500-900	20 kg	1. 50%. Light-yellowish grey, soft claystone. Scattered forams and pteropod fragments. Has a surface oxidised layer. Rare Gastropods. 2. 15%. Dark-medium-grey-chocolate, foram & pteropod rich, soft mudstone. 3. 5%. Surface oxidation layer of type 2. Foram & pteropod-rich mudstone. 4. 30%. Iron and manganese oxide-stained reef debris.

*D : Small chain-bag dredge
GC : Gravity corer
DC : Datt Corer

Ø : Time/depth recorder
Y : Used
N : Not used

† Initial, shipboard description

TABLE 4 (CONT'D.)

STATION SUMMARY

STATION	EQUIPMENT*	TDR	LAT.(S)	LONG.(E)	APPROX. W.D. (m) OF ROCKS RECOVERED	AMOUNT RECOVERED	WHAT WAS RECOVERED†
7.	GC	-	09°01.735'	159°41.246'	1290	125 cm	Bioturbated (burrowed), hemipelagic muds containing thin ash layers at 10 and 80 cm.
8.	D	Y	09°02.44'	150°30.30'	-	0	
9A.	DC	-	09°12.118'	159°32.378'	893	45 cm	Slightly-sandy, hemipelagic mud.
9B.	DC	-	09°12.837'	159°32.155'	718	25 cm	"
9C.	DC	-	09°12.987'	159°32.169'	685	38 cm	"
9D.	DC	-	09°12.734'	159°31.677'	642	38 cm	Sandy, hemipelagic mud.
9E.	DC	-	09°12.739'	159°31.561'	582	43 cm	Hemipelagic muddy sands/sandy muds.
9F.	DC	-	09°12.767'	159°31.463'	525	26 cm	Slightly-muddy sands. Volcanic-rich.
9G.	DC	-	09°12.725'	159°31.294'	420	23 cm	Hemipelagic muddy sand.
9H.	DC	-	09°12.680'	159°31.213'	399	52 cm	Hemipelagic muddy sands/sandy muds.
9I(1)	DC	-	09°12.786'	159°31.054'	362	0	-
9I(2)	DC	-	09°12.710'	159°31.098'	369	0	-
10.	D	Y	09°32.55'	159°08.95'	-	0	-
11.	D	Y	09°12.55'	158°48.66'	1200-1350	4 Kg	Blocks of partly manganese-oxide-coated, non-calcareous siltstone and fine-grained sandstone.
12.	GC	-	08°52.01'	159°13.86'	1612	295 cm	Bioturbated (burrowed), very slightly sandy, hemipelagic muds. Thin, interbedded(?), volcanoclastic muds at ~200 and 235 cm.
13.	GC	-	08°47.789'	159°13.586'	1682	169 cm	Bioturbated (burrowed), slightly sandy, hemipelagic mud containing sandy turbidite layers at 75 and 135 cm.

TABLE 4 (CONTD.)

STATION SUMMARY

STATION	EQUIPMENT*	TDR	LAT.(S)	LONG.(E)	APPROX. W.D. (m) OF ROCKS RECOVERED	AMOUNT RECOVERED	WHAT WAS RECOVERED †
14.	D	N	08°25.608'	159°27.932'	700-500	6 kg	All scree (no fresh surfaces). 1. 70%. Iron and manganese-oxide-stained coralline limestone. (Reef). 2. 35%. (?Calcareous) volcanoclastic mudstone/sandy mudstone. 3. 5%. Dark grey, sandy, volcanoclastic mudstone.
15A.	DC	-	08°07.293'	159°02.358'	778	30 cm	Greyish olive, slightly-sandy mud.
15B.	DC	-	08°06.978'	159°02.261'	614	39 cm	"
15C.	DC	-	08°06.664'	159°01.891'	456	32 cm	Slightly-sandy mud grading into sandy muds.
15D.	DC	-	08°06.8'	159°01.15' (RADAR)	458	37 cm	Olive-grey, fine-grained, slightly sandy mud.
15E.	DC	-	08°06.4'	158°58.1' (RADAR)	895	25 cm	"
15F.	DC	-	08°05.55'	158°56.7' (RADAR)	819	29 cm	"
15G.	DC	-	08°04.5'	158°54.9' (RADAR)	752	33 cm	"
16.	GC	-	08°07.149'	158°09.310'	1672	219 cm	Bioturbated (burrowed), very slightly sandy, hemipelagic muds containing volcanic-rich, sandy turbidite layers at 70, 120 and 190 cm.
16A.	GC	-	08°04.350'	157°58.156'	1444	266 cm	Bioturbated (burrowed), slightly-sandy hemipelagic muds.
17A.	DC	-	07°47.717'	157°55.817'	735	31 cm	Olive grey, muddy sand.
17B.	DC	-	07°46.553'	157°54.589'	701	34 cm	"
17C.	DC	-	07°46.219'	157°54.911'	764	36 cm	"
17D.	DC	-	07°45.482'	157°54.937'	737	48 cm	"
18	GC	-	07°40.564'	157°17.455'	913	264 cm	Bioturbated (burrowed), very slightly sandy, hemipelagic muds containing a sandy turbidite layer at 110 cm.

TABLE 4 (CONTD.)
STATION SUMMARY

STATION	EQUIPMENT*	TDR [†]	LAT.(S)	LONG.(E)	APPROX. W.D. (m) OF ROCKS RECOVERED	AMOUNT RECOVERED	WHAT WAS RECOVERED [†]
19.	D	N	07°36.982'	157°15.183'	700-750	50 kg	All samples partly coated in manganese oxides and bored. 1. 60%. Moderately-indurated, burrowed, v.f. grained, volcaniclastic (?), muddy sandstone. 2. 30%. Similar to type 1 but containing in part very coarse-grained, angular, poorly-sorted, volcanic rock fragments. 3. 10%. Volcanic-rich muddy sandstone.
20.	-	-	-	-	(NO ATTEMPT)		
21.	D	Y	07°48.659'	156°06.937'	3100-3900	1 kg	Probably all scree - coated with manganese oxides. Olive grey, muddy, volcaniclastic (feldspathic) sandstone. Some coarse-grained shelly sand scraped off dredge wire.
22.	D	N	07°34.886'	156°07.633'	850	~50 kg (Full bag)	(?Pleistocene) reef limestone rubble.
23.	D	N	07°31.916'	156°10.319'	620-900	3 kg	1. 70%. Clean, well-cemented (?calcite), feldspathic sandstone containing articulated pelecypods. 2. 30%. Dark, bioturbated, foram-rich, volcaniclastic muddy sandstone.
24.	D	Y	07°01.429'	156°24.627'	1200	1 kg	Light olive grey, hemipelagic, slightly-sandy mud.
25.	D	N	07°04.813'	156°39.750'	600-850	1 kg	1. Coral limestone fragments. 2. Well-rounded andesite (?) cobble. 3. Pale olive, very fine grained, bioturbated, muddy sandstone/sandy sandstone.

TABLE 4 (CONT'D.)

STATION	EQUIPMENT*	TDR	LAT.(S)	LONG.(E)	STATION SUMMARY		WHAT WAS RECOVERED†
					APPROX. W.D. (m) OF ROCKS RECOVERED	AMOUNT RECOVERED	
26.	D	Y	05° 13.336'	153° 52.706'	-	0	except for some white carbonate sand scraped off dredge wire.
27.	D	Y	04° 46.887'	154° 14.498'	-	0	
28.	D	Y	04° 54.621'	154° 41.531'	-	0	
29.	D	Y	04° 17.542'	154° 35.293'	1500-2000	40 kg	Buff, foram - and nanno-rich, calcilutite (chalk). Sheared.

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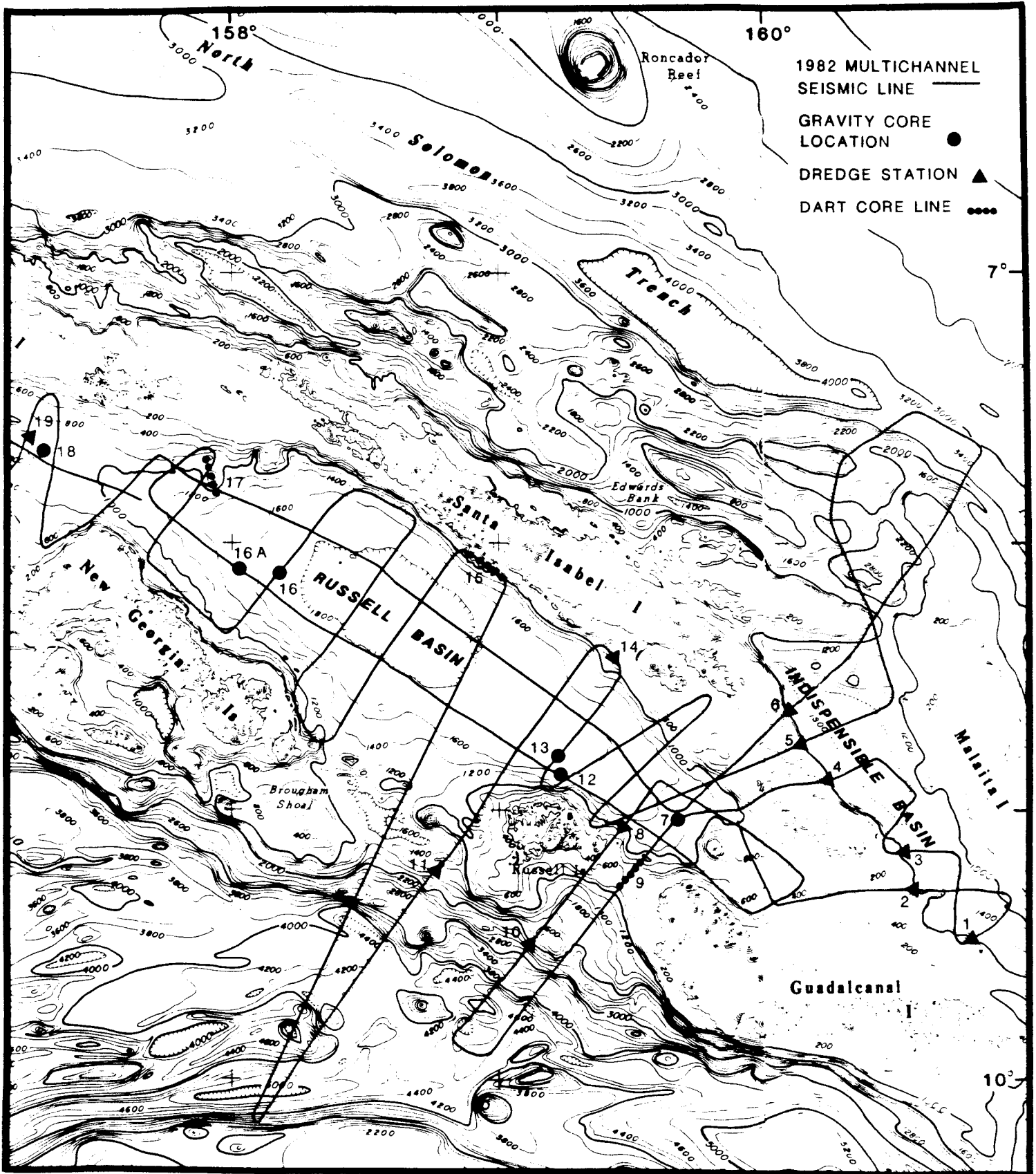


Figure 1A Index map, eastern half. Western half on following page.

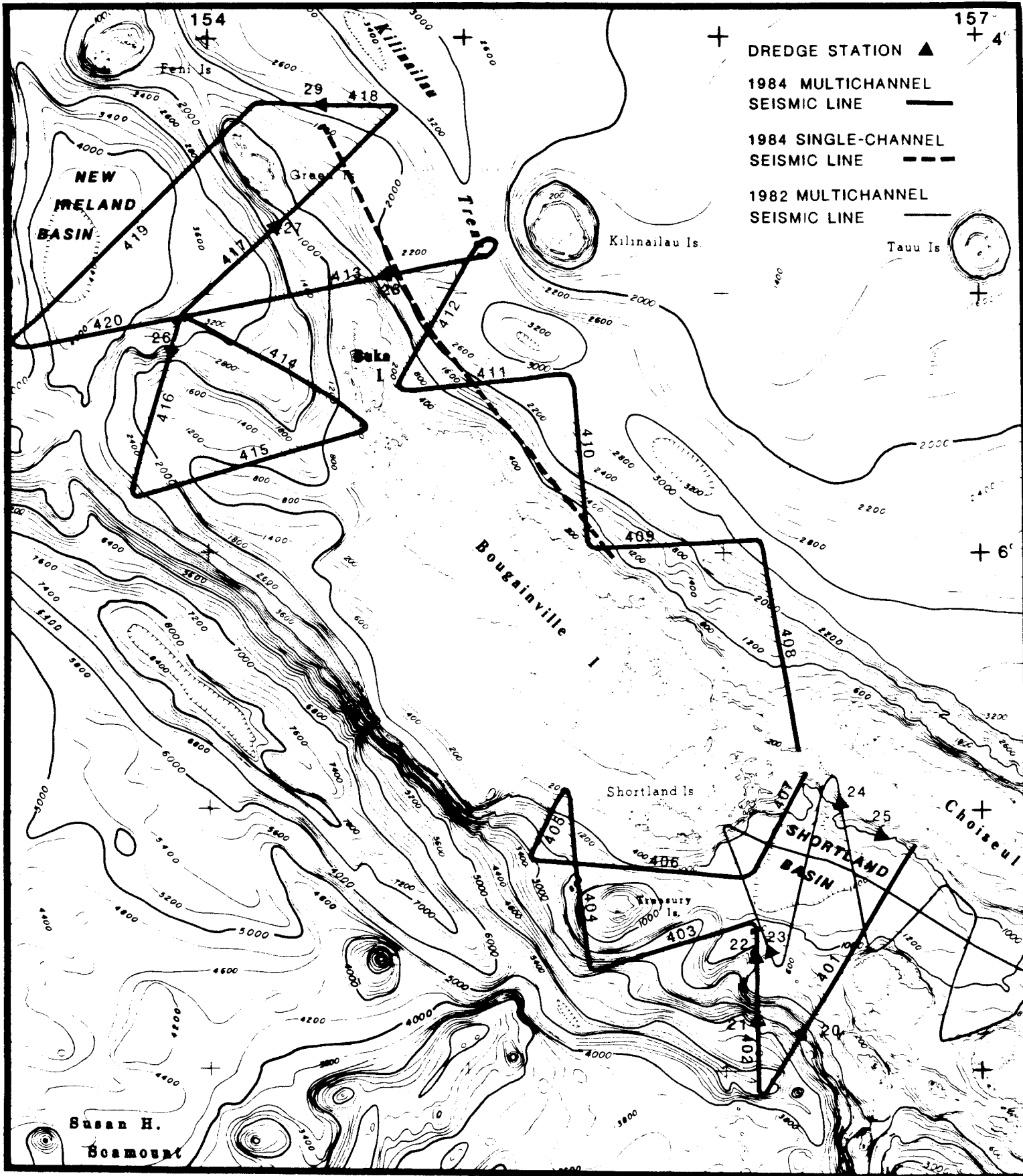


Figure 1B Index map, western half. Eastern half on preceding page.

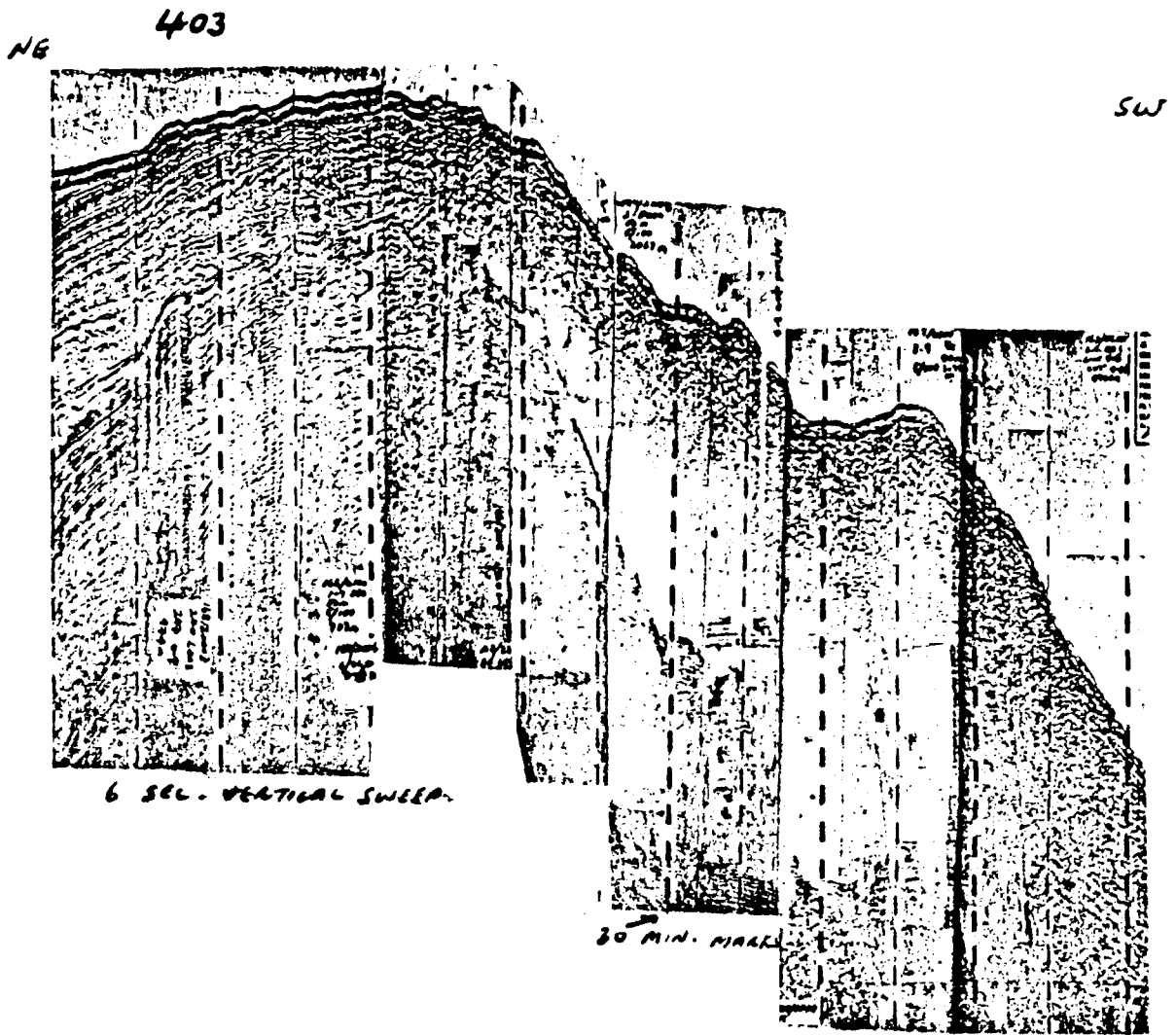


Figure 2. Single-channel monitor record of Line 403.

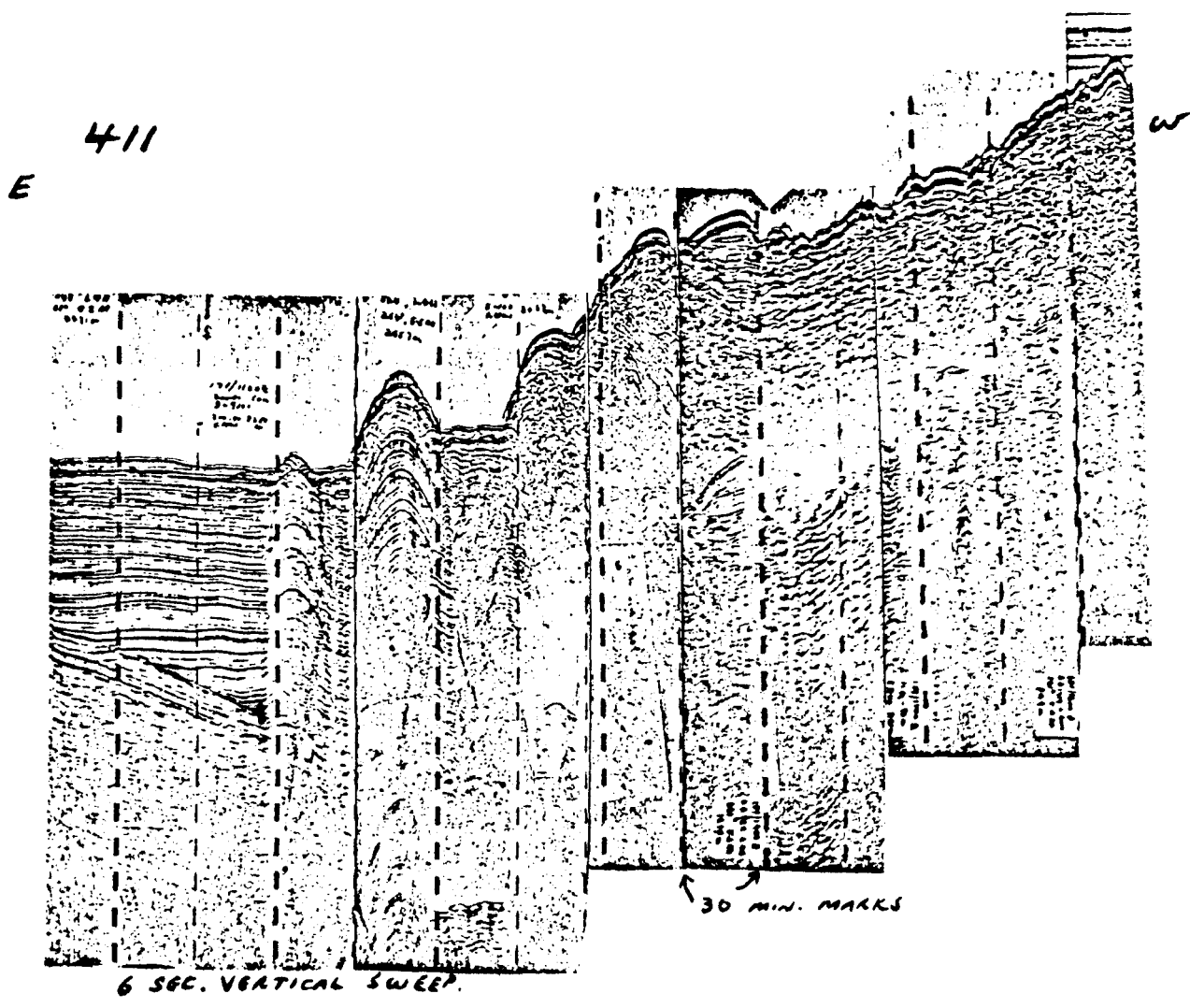


Figure 3. Single-channel monitor record of Line 411.

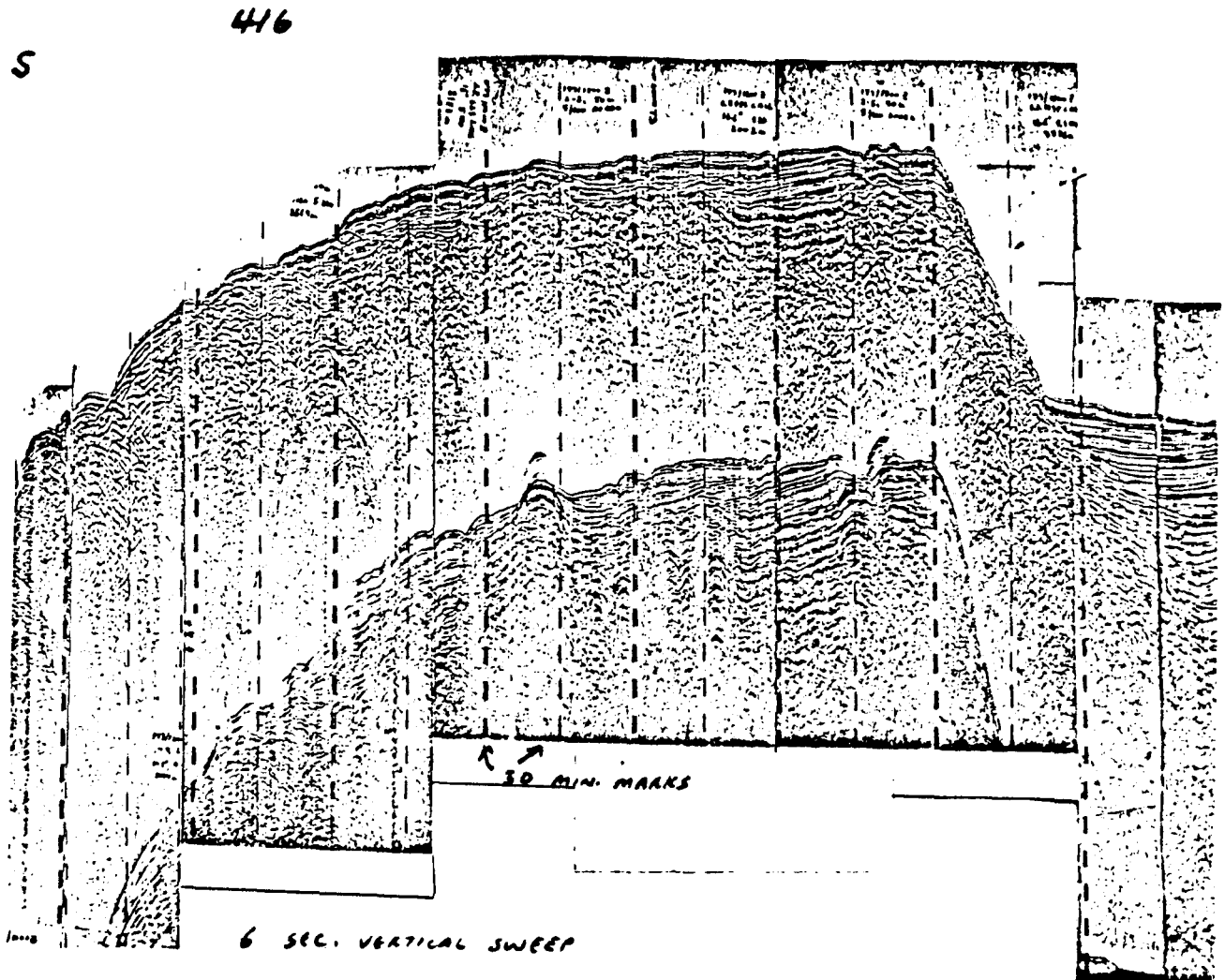


Figure 4. Single-channel monitor record of Line 416.