Hydrocarbon Resource Studies in the Southwest Pacific, 1982

By H. Gary Greene, Florence L. Wong, and the scientific staff of the 1982 CCOP/SOPAC cruise

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PREFACE

This report summarizes the investigation conducted aboard the U.S. Geological Survey's Research Vessel *S.P. Lee* in 1982 under the terms of an agreement between Australia, New Zealand, and the United States (ANZUS Tripartite Agreement) in association with the United Nations Committee for the Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas. Data collected on the cruise were first presented at the *S.P. Lee* postcruise meeting in Honolulu, Hawaii on August 19 and 20, 1982, and further discussed at a meeting cosponsored by the U.S. Geological Survey and the Circum-Pacific Council for Energy and Mineral Resources, a section of the American Association of Petroleum Geologists, in Menlo Park, California, on April 5, 1983.

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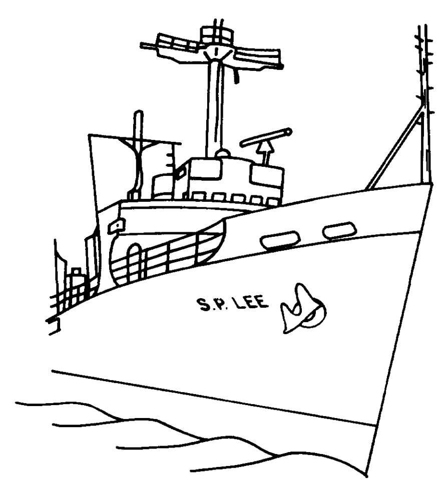

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INTRODUCTION

From April 2 to June 11, 1982, the USGS (U.S. Geological Survey) conducted a hydrocarbon resource investigation in the offshore areas of Tonga, Vanuatu, and the Solomon Islands (fig.1). The work was arranged under the ANZUS (Australia, New Zealand, and United States) Tripartite Agreement in association with CCOP/SOPAC (United Nations Committee for the Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas), as part of a program of marine geoscientific research and mineral resource studies in the South Pacific region.

The U.S. Department of State was instrumental in negotiating the agreement and establishing the framework for the cooperative research. The USGS provided instruments and scientific and technical personnel. The Office of Energy of the United States Agency for International Development (AID) provided funding for the implementation and operation of the investigation. Funds were also provided by the government of Australia. CCOP/SOPAC in Fiji served as the basic coordinator and provided, along with Australia, New Zealand, and CCOP/SOPAC member nations, some of the scientific staff.

The data collection phase of the joint program was a three-leg, 60-day resources survey by the Research Vessel *S.P. Lee*. This report summarizes that investigation, gives tentative results, outlines the future work schedule, and proposes significant work to be continued.

ACKNOWLEDGMENTS

This report required the devotion and labor of many to meet the publication deadline. We are grateful to Tom Chase for his efforts in supplying us with bathymetric and navigation charts, and to Phyllis Swenson who spent many hours drafting the illustrations for this report. David Scholl and

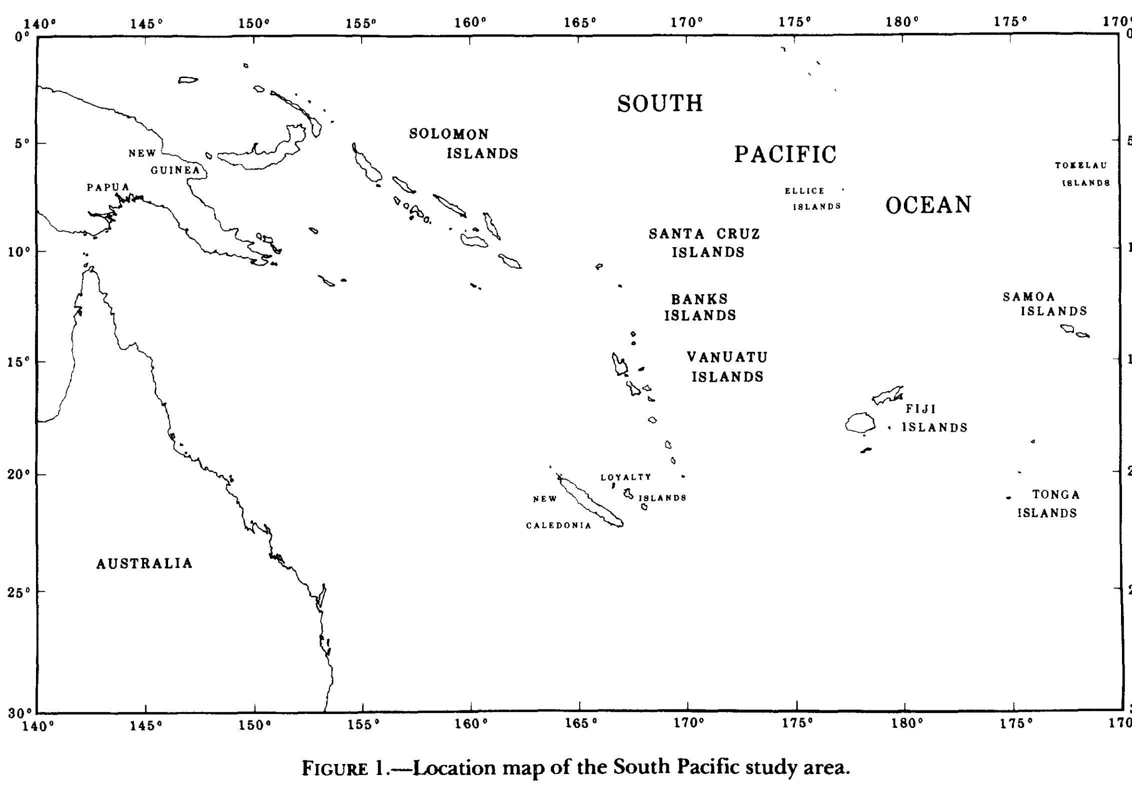

FIGURE 1.—Location map of the South Pacific study area.

Jack Vedder reviewed the manuscript and contributed significantly to the improvement of the text. We also appreciate the encouragement and support from the ANZUS Tripartite and CCOP/SOPAC scientific participants. The studies were funded by the U.S. Agency for International Development, the government of Australia, and the U.S. Geological Survey and were conducted in cooperation with the governments of Australia, New Zealand, and the United States.

LEG 1, TONGA RIDGE

Departed Pago Pago, American Samoa, March 28
Arrived Nuku'alofa, Tonga, March 31; departed, April 2
Arrived Suva, Fiji, April 20; departed, April 23
Arrived Port Vila, Efate, Vanuatu, April 26

METHODS

Leg 1, conducted mainly on the southern Tonga platform up to 250 km south of Tongatapu, Tonga, included over 5,700 km (3,078 n. mi.) of 12 kHz, 3.5 kHz, gravity, and magnetic profiles (fig. 2). In the area, 2,421 km (1,307 n. mi.) of 24-fold, CDP seismic-reflection profiles, and 54 sonobuoy wide-angle reflection-refraction profiles were obtained (fig. 3). Also, at 13 sampling stations 9 dredge hauls and 4 gravity cores were taken. A brief (12-hr) sampling visit was included at Ata Island during data collection in the platform area (Scholl and others, 1982).

Geophysical data were also gathered offshore of the western margin of the island of Viti Levu, Fiji and over Baravi Basin at the request of the Fiji Mineral Resources Department, and along the *Lee's* virtual due-west track from Suva to Port Vila (fig.2).

GENERAL RESULTS

Initial results include the following data taken from Maung and others (1982) and Scholl and others (1983): (1) acoustical resolution of a westward-thickening, extensionally deformed platform section (<4.5 km/s; 2-3 km thick) of chiefly Neogene and younger volcaniclastic and limestone beds overlying a basement of arc-type igneous rocks (>5 km/s) (figs. 4, 6); (2) identification of a regional unconformity of late Miocene age in the upper part of the platform section that possibly reflects thermal uplift of the ridge just prior to the opening of the Lau Basin; (3) identification of large, moundlike buildups in the lower part of the platform section that may be reefal or possibly igneous masses (fig. 4); (4) recognition of evidence that the forearc area, most of which is deeply submerged, may have been a source terrane for some of the volcaniclastic deposits of the platform section; (5) southwestward tracing (at least 250 km) of an axis of early Tertiary volcanism that is situated along the Pacific side of the platform and passes beneath or close to Eua Island; (6) acoustical tracking of the subducted surface of the Pacific plate 25-30 km landward of the inner trench wall (fig. 5); this slope is not underlain by offscraped, low-velocity oceanic pelagic deposits; and (7) the probable detection of a magma chamber 3-4 km below a spreading axis in Lau Basin (fig. 5).

A comprehensive evaluation of the petroleum potential of the Tonga platform area must await the results of laboratory analysis of rocks dredged from the sea floor and sampled on land, and the interpretation of the fully processed multifold reflection profiles.

LEG 2, CENTRAL BASIN OF VANUATU

Departed Port Vila, Efate, Vanuatu, April 28
Arrived Honiara, Guadalcanal, Solomon Islands, May 16

METHODS

Leg 2, conducted in the Central Basin of Vanuatu, included 2,520 km (1,361 n. mi.) of 24-fold, CDP multi-channel seismic-reflection profiles (fig. 7). In addition, 622 km (336 n. mi.) of high-resolution Uniboom seismic-reflection profiles and nearly 4,500 km (2,430 n. mi.) of 3.5 kHz very high resolution seismic-reflection, 12 kHz bathymetric, magnetic, and gravity profiles were collected, and 33 sonobuoy wide-angle reflection refraction profiles were obtained (Greene and others, 1982, 1983; fig. 2). Three sampling stations comprised one dredge station and two gravity core stations. Geophysical trackline spacing was generally 5-10 km (2.7-5.4 n. mi.) apart, and in some localities spacing was as close as 1 km (0.5 n. mi.) apart (fig. 7).

GENERAL RESULTS

Preliminary onboard data reduction and interpretation resulted in (1) the delineation of three small shelf sedimentary basins east of Malekula and Espiritu Santo; (2) estimation of minimum sedimentary thickness in the intra-arc Central Basin; and (3) the discovery of the northward continuation of the southern New Hebrides

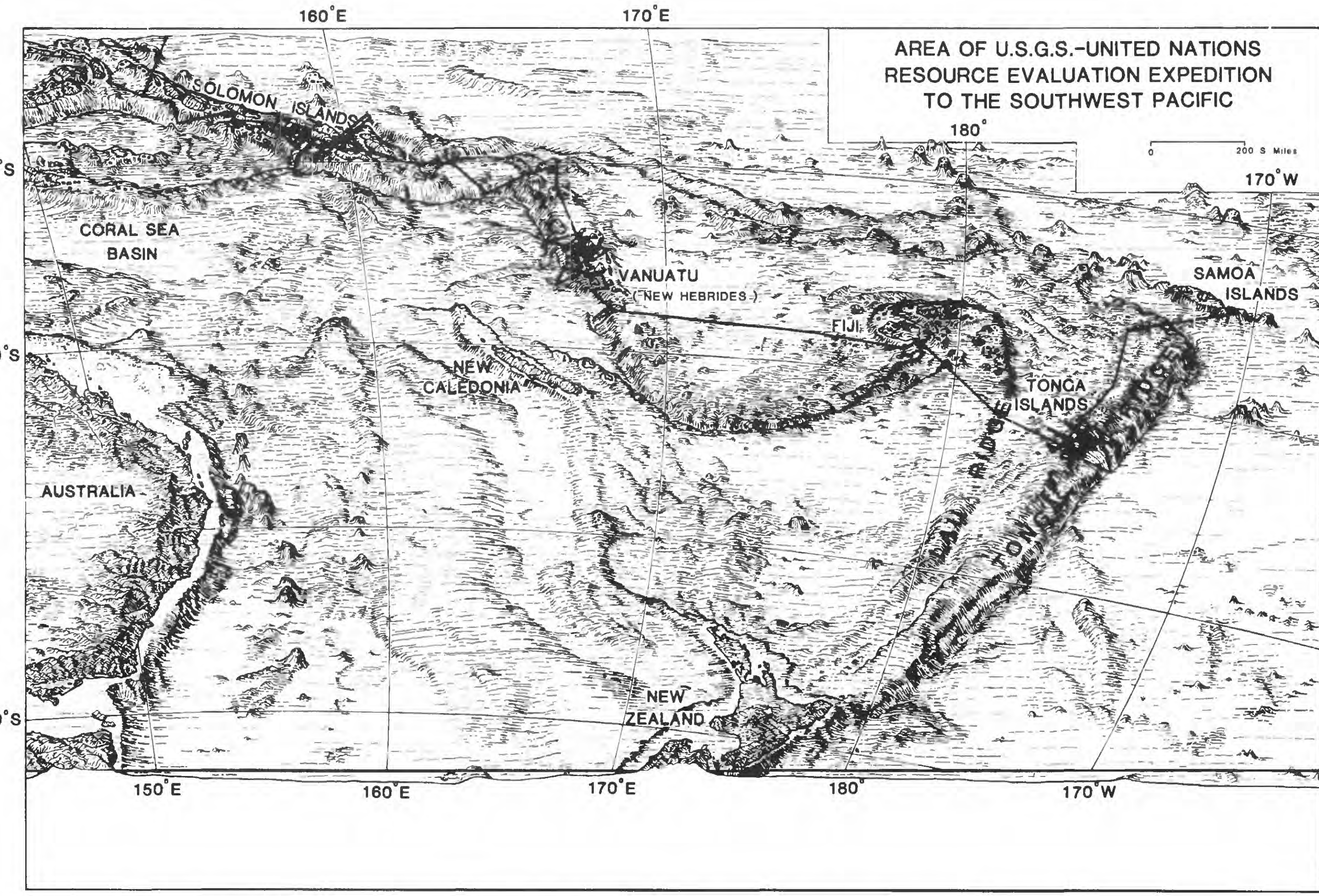

FIGURE 2.—Physiographic map with tracklines covered by Research Vessel *S.P.Lee* during the 1982 South Pacific surveys. Physiography by Tau R. Alpha.

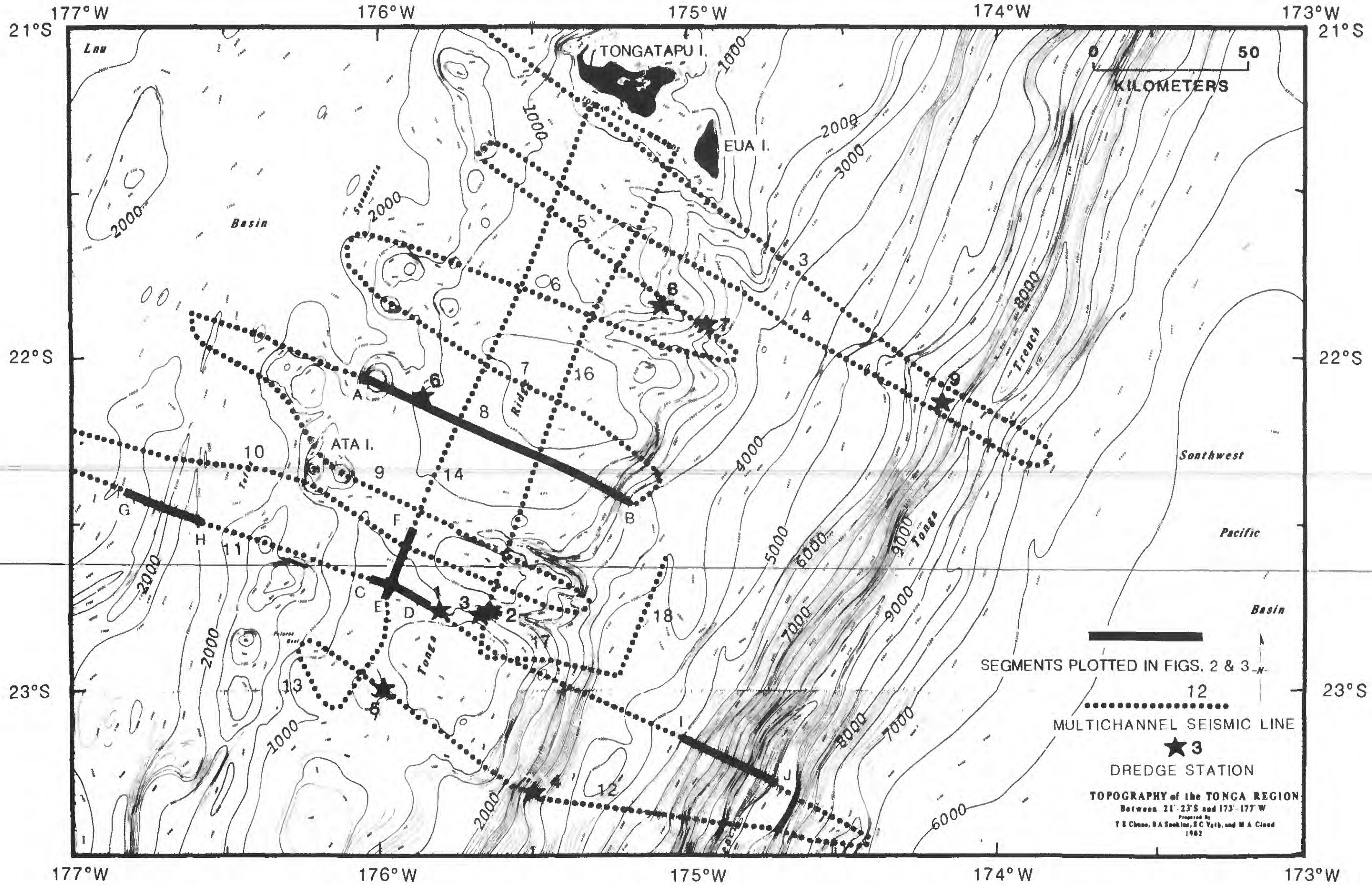

FIGURE 3.—Index map of southern Tonga platform showing tracklines of 24-fold multichannel data, locations of profile segments (that is, A-B through I-J) displayed on figures 4 and 5, positions of dredge stations where submarine outcrops were sampled, and depth contours in meters (based on velocity-corrected soundings).

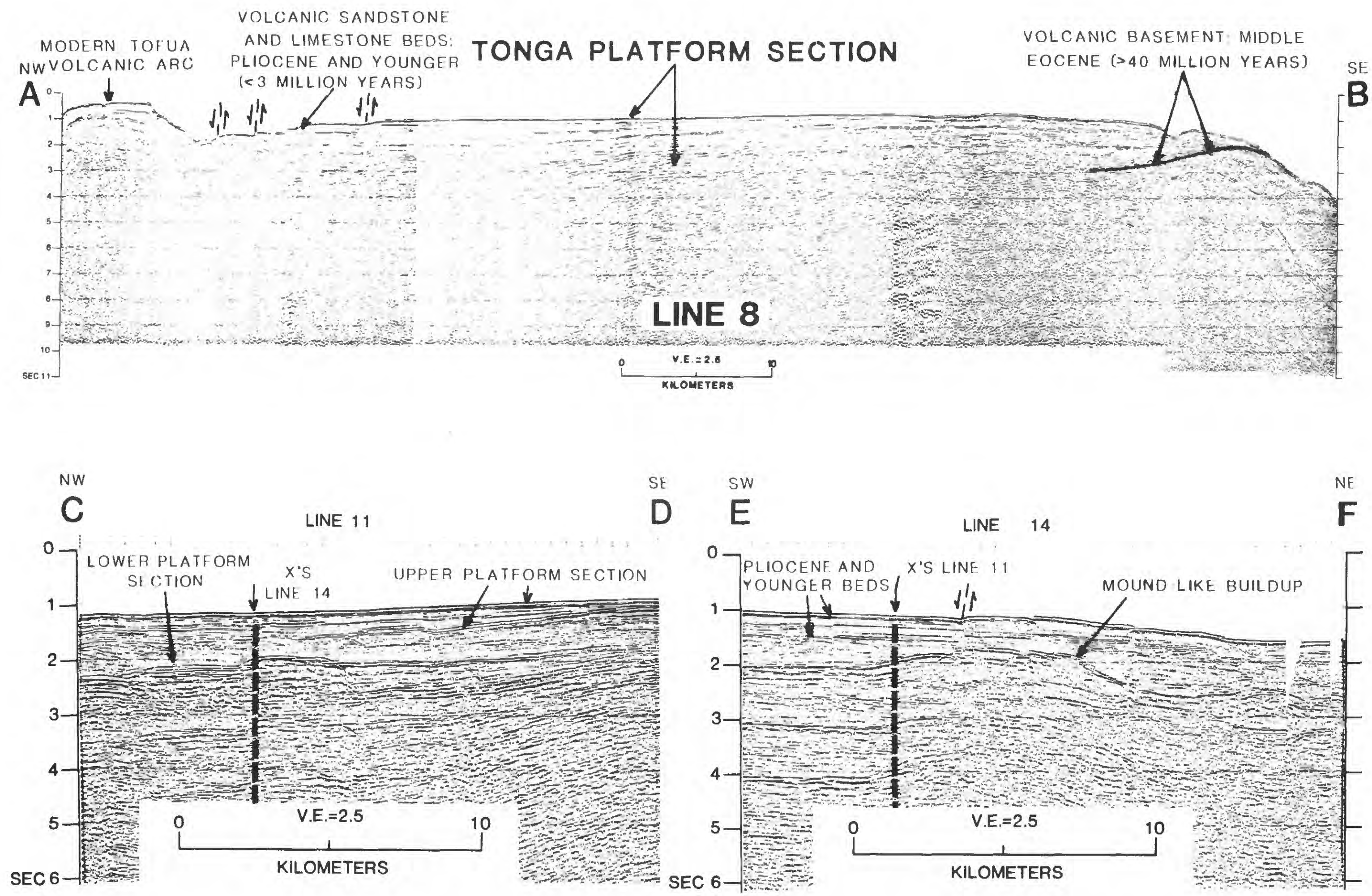

FIGURE 4.—Annotated segment of multichannel line 8 (A-B), which traverses the crestal platform of the Tonga Ridge, and mutually crossing segments of lines 11 and 14, which reveal a subsurface moundlike structure of possible igneous or reefal origin (see figure 3 for locations). The platform section noted along line 8 is constructed of volcaniclastic and limestone beds of post-Eocene age that, in general, are characterized by acoustic velocities less than about 4.5 km/s. The section's underlying acoustic basement is presumably arc-type volcanic and intrusive rocks of Eocene and older age. The upper, more coherently layered strata of the platform section is composed of Pliocene and younger beds; the underlying moundlike buildup within the lower platform section is probably associated with Tertiary beds of Miocene age.

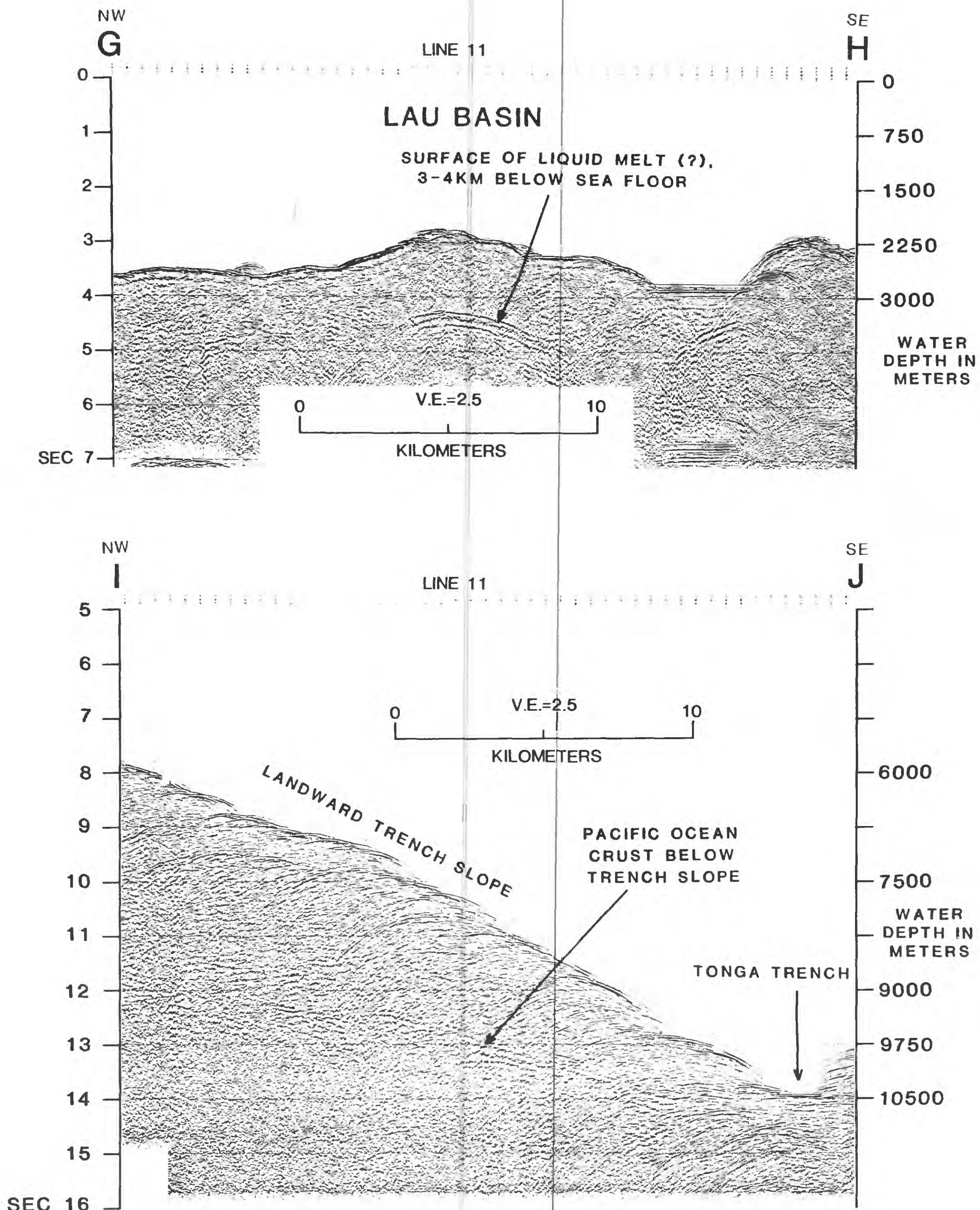

FIGURE 5.—Annotated segments of multichannel line 11. Segment G-H reveals a subsurface upper crustal reflection horizon near the eastern side of Lau Basin that may be the top of a magma chamber underlying a spreading center. Segment I-J, recorded over the lower part of the landward slope of the Tonga Trench, reveals a deep, subsurface reflection horizon that is presumed to be the top of subducted Pacific oceanic crust. On a true-depth section, the horizon actually dips downward beneath the Tonga Ridge, but a prominent velocity pull-up effect induced by high-velocity rocks underlying the lower slope causes the horizon to ascend to the west on this reflection-time section.

Trench (fig. 8). Tentative interpretation of the single-channel seismic-reflection data indicates that regionally the islands are deformed in a complex structural pattern. These structures may be related to the complex tectonic evolution of the arc that involves orthogonal subduction, oblique subduction, and arc reversal through middle and late Miocene times.

Multichannel seismic data from this investigation indicate that the trench near the central part of this arc is nearly devoid of sediment and that the accretionary wedge is covered by only a veneer of sediment (Fisher and others, 1982; fig. 9). Rocks within this wedge have high acoustic velocities (4-5 km/s), and these rocks cause faint reflections that dip arcward. Oceanic crust can be traced beneath this wedge for 30 km.

The three shelf or shelf-edge sedimentary basins that were mapped all lie in water depths of less than 1,000 m and have sediment thicknesses

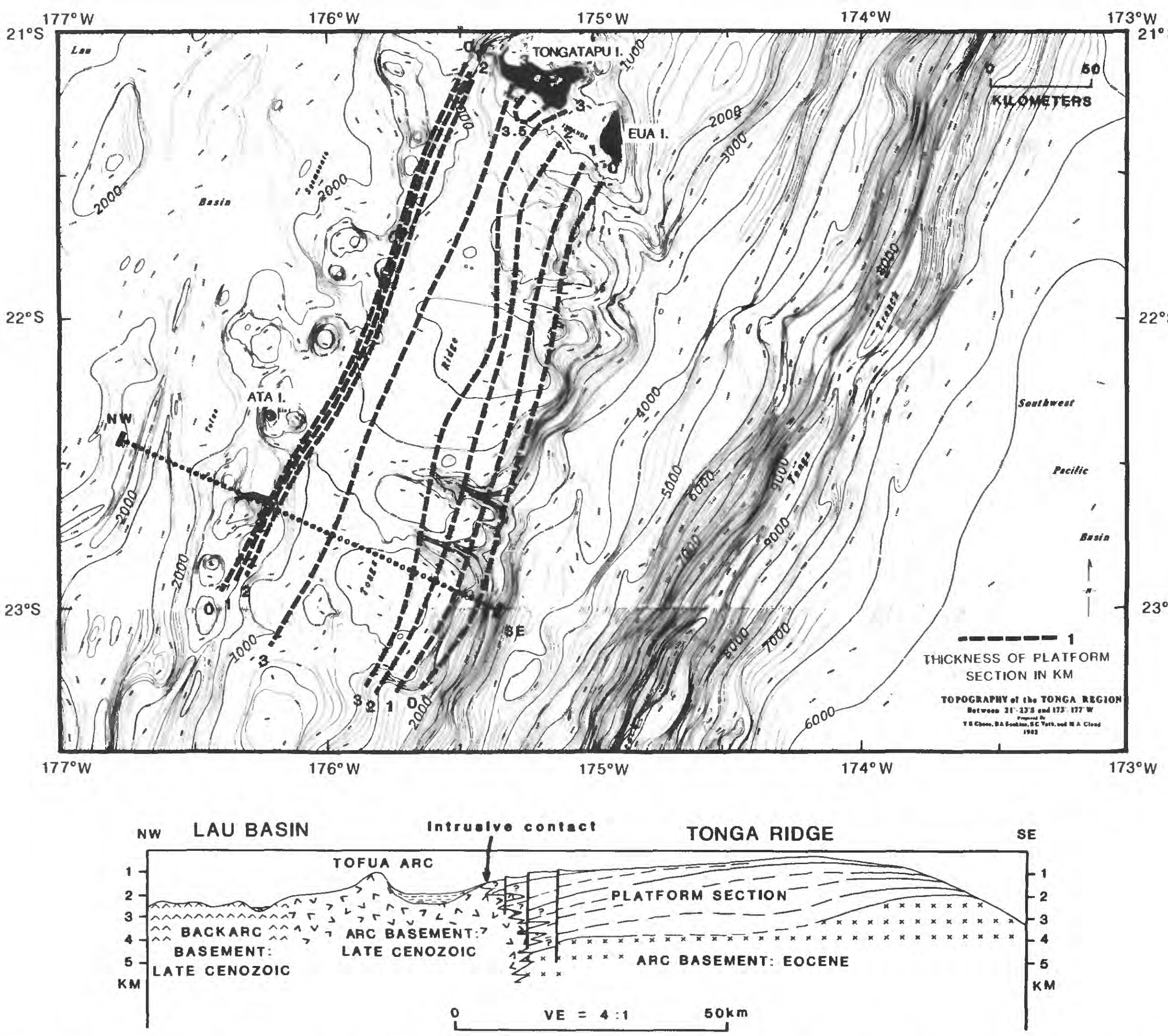

FIGURE 6.—Diagrammatic representation of isopach contours, based on multichannel and sonobuoy refraction velocities and depth calculations, showing the thickness of the platform section in kilometers. Lower cross-section, from Lau Basin to the eastern edge of the southern Tonga platform, is a cartoon or schematic drawing illustrating presumed structural and stratigraphic relations of regional importance (based on sonobuoy refraction data and multichannel reflection profile 11; see figure 3). Platform section has presumably been truncated by extensional rifting along western side of ridge. Young arc basement is shown intruding the truncated edge of the section. The missing or western part of the section presumably underlies Lau Ridge, approximately 300 km to the west.

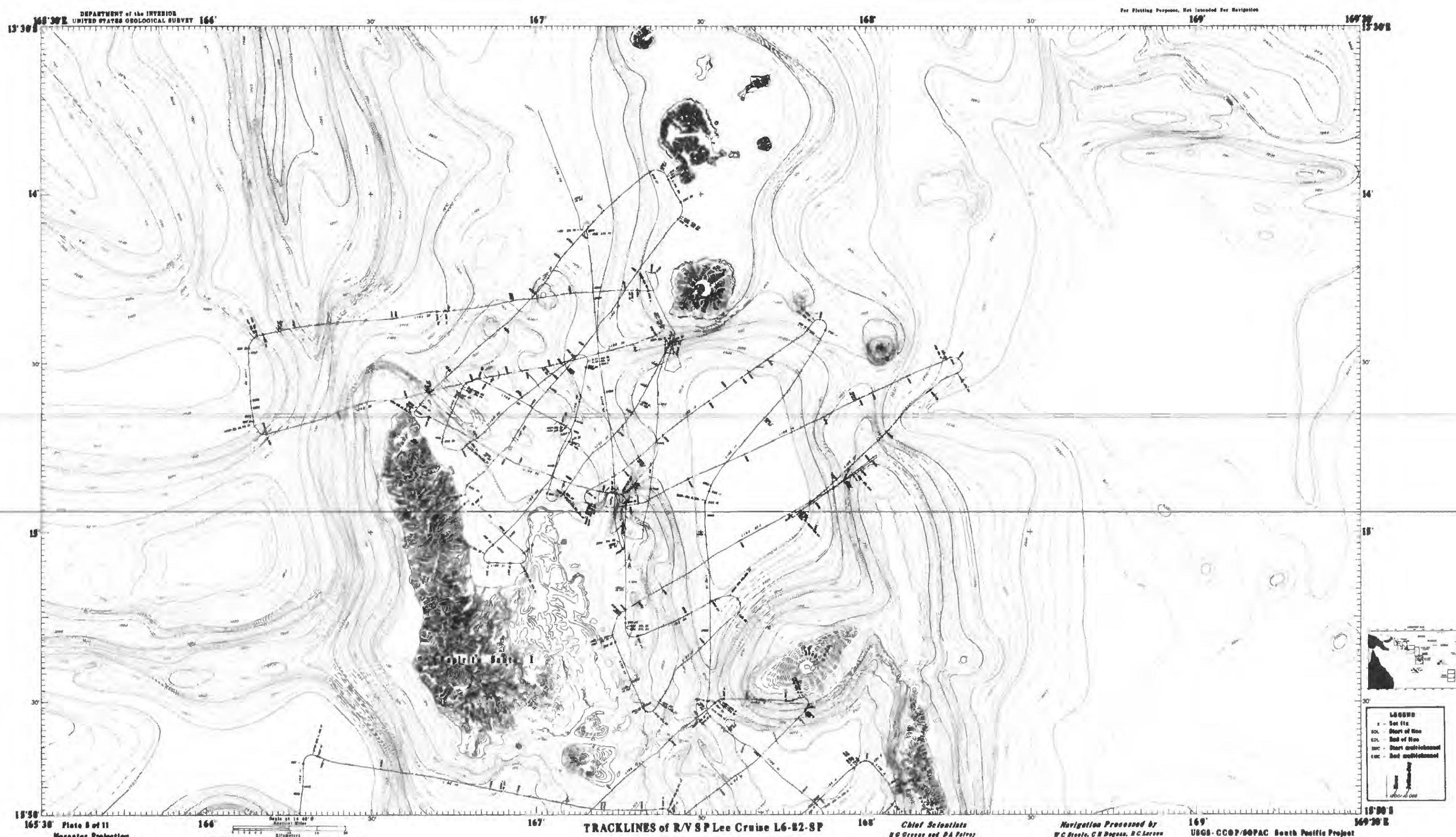

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Plate 8 of 11
Mercator Projection
TRACKLINES of R/V S P Lee Cruise L6-82-SP
Chief Scientists
H G Greene and D A Falvey
Navigation Processed by
W C Steele, C H Dugan, R C Larson
USGS - CCOP/SOPAC South Pacific Project
Kilometers
LEGEND
x - Sat fix
SOL - Start of line
EOL - End of line
SMC - Start multichannel
EMC - End multichannel

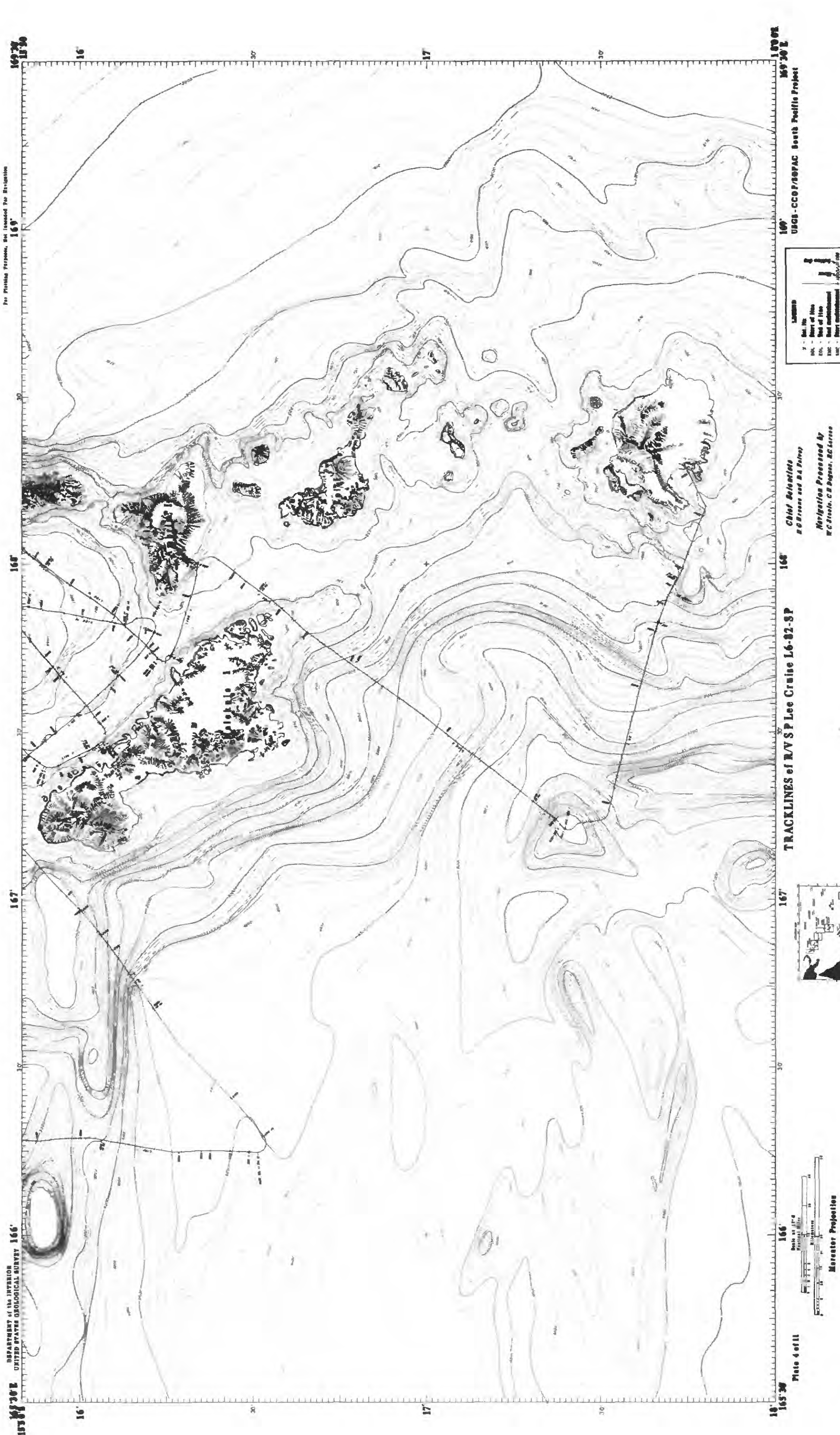


FIGURE 7.—Trackline map and bathymetry, Leg 2, Vanuatu.

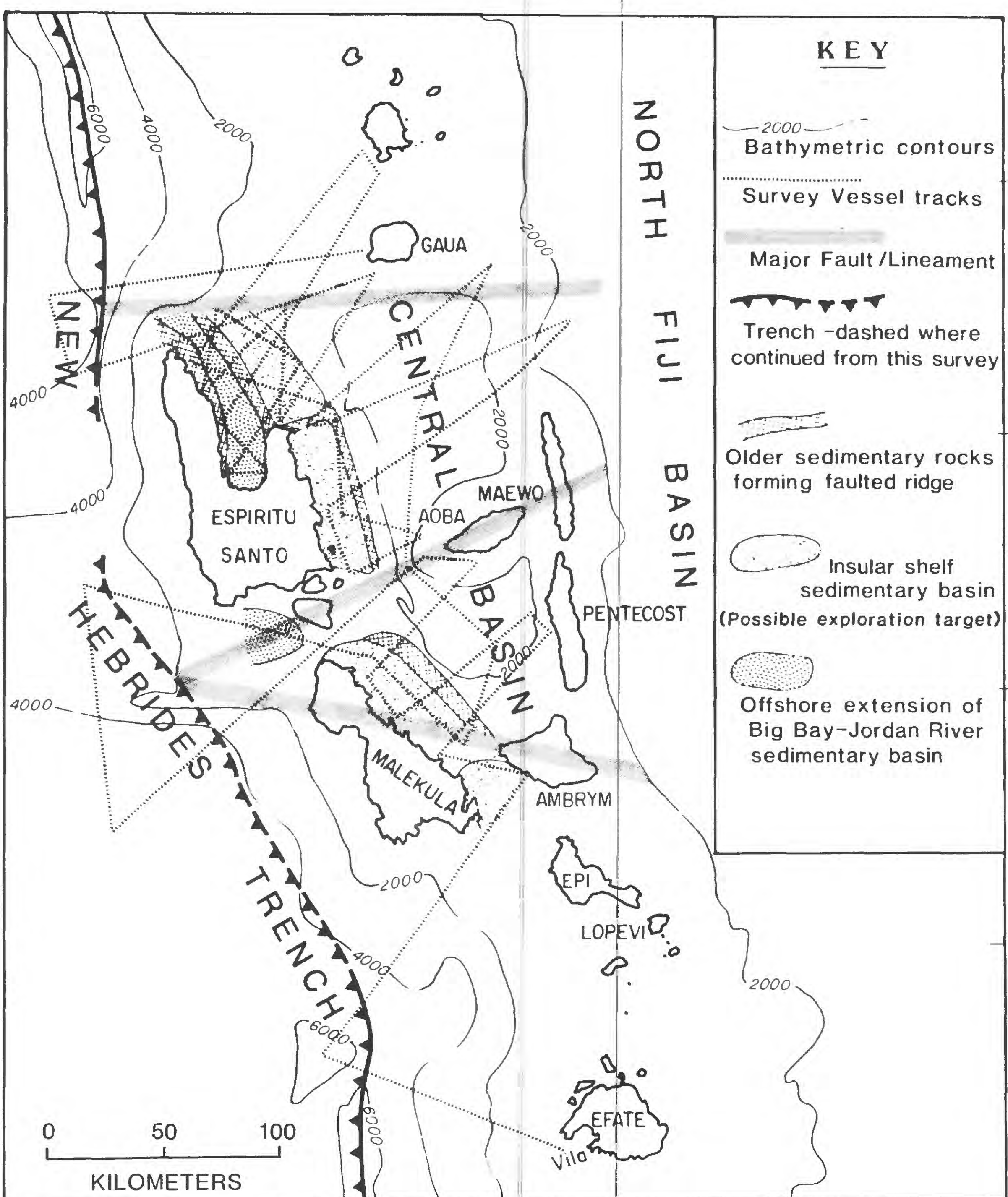


FIGURE 8.—Generalized outline of shelf or shelf-edge sedimentary basins and primary structural features delineated during Leg 2. Bathymetry in meters.

greater than 2 km (fig. 10). Structures capable of trapping oil and gas are present in all three basins. Sedimentary rocks identified within these smaller shelf-edge basins appear to be locally connected with the deeper intra-arc basin (that is, the Central Basin), thereby forming potential pathways for petroleum migration from thick sedimentary sections in deep-water marine source beds to shallow-water reservoir beds and traps (fig. 11).

The main part of Central Basin contains about 5 km of rocks that have velocities less than 5 km/s (fig. 10). Preliminarily processed multichannel seismic data indicate that three main seismic-stratigraphic units compose the basin fill, all separated by unconformities. They consist from oldest to youngest of an older, poorly bedded sedimentary unit resting on acoustic basement along the margins of the basin and everywhere overlain by a well-layered sedimentary unit that is in turn overlain by a thin layer of well-bedded unconsolidated sediments (fig. 12). Several large structures deform the youngest units of this fill; these structures do not appear to have igneous rocks at their core.

The three shelf-edge basins identified in the survey are considered promising sites for further investigations of hydrocarbon potential. They are equal in size and sediment thickness to some of the smaller hydrocarbon producing basins found elsewhere in the world (for example, western coast of the United States). The water depths overlying all of these shelf-edge basins are shallow enough for drilling with current technology.

LEG 3, CENTRAL SOLOMONS TROUGH

Departed Honiara, Guadalcanal, Solomon Islands, May 19
Arrived Rabaul, New Britain, Papua New Guinea, June 11

METHODS

Leg 3, conducted in the Solomon Islands trough area, included approximately 3,700 km (1,998 n. mi.) of 24-fold, CDP multichannel and about 3,200 km (1,728 n. mi.) of high-resolution Uniboom seismic-reflection profiles in the central and western Solomon Islands area (fig. 13). For the entire leg, including transit lines, about 5,500 km (2,970 n. mi.) of 3.5 kHz high-resolution, seismic-reflection, magnetic, gravity, and 12 kHz bathymetric profiles were collected. In addition 36 wide-angle seismic reflection-refraction sonobuoy profiles were obtained. Nine dredge hauls were made, and two gravity cores were taken. Dredge hauls ranged in water depths from approximately 1,200 m to 300 m. Trackline spacing was generally between 5 and 10 km (2.7 and 5.4 n. mi.).

In addition to the resource survey specified in the ANZUS Tripartite Agreement, the USGS made an 8-hour survey in Rabaul harbor, New Britain, on June 11 at the request of CCOP/SOPAC and the Rabaul Volcanological Institute (fig. 14). Reconnaissance bathymetric data were acquired, and the Rabaul seismograph network was tested using the airgun system aboard the *Lee* as an artificial seismic source. Also, a sonobuoy refraction profile was recorded, and intermediate penetration and high-resolution Uniboom seismic-reflection profiles were collected.

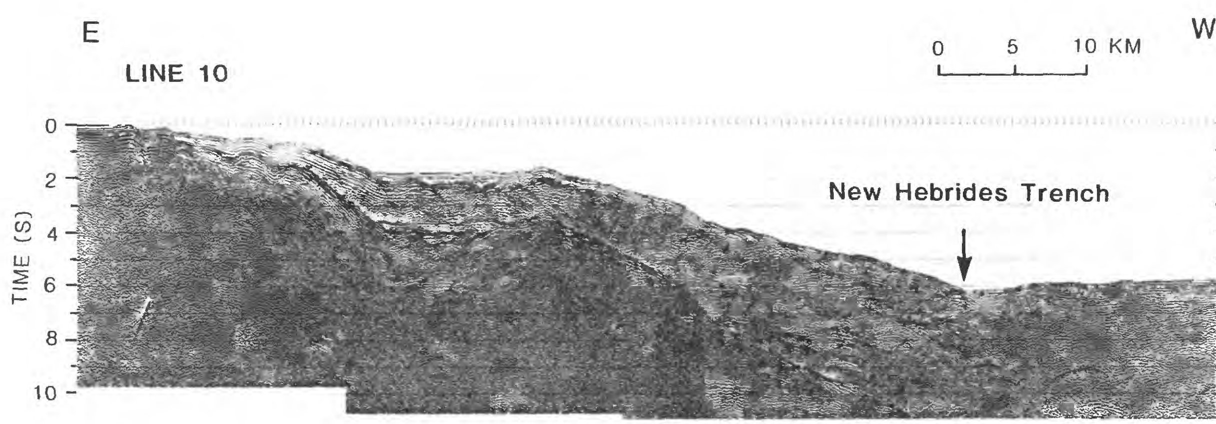


FIGURE 9.—Uninterpreted multichannel record of line 10, Leg 2, across the New Hebrides Trench.

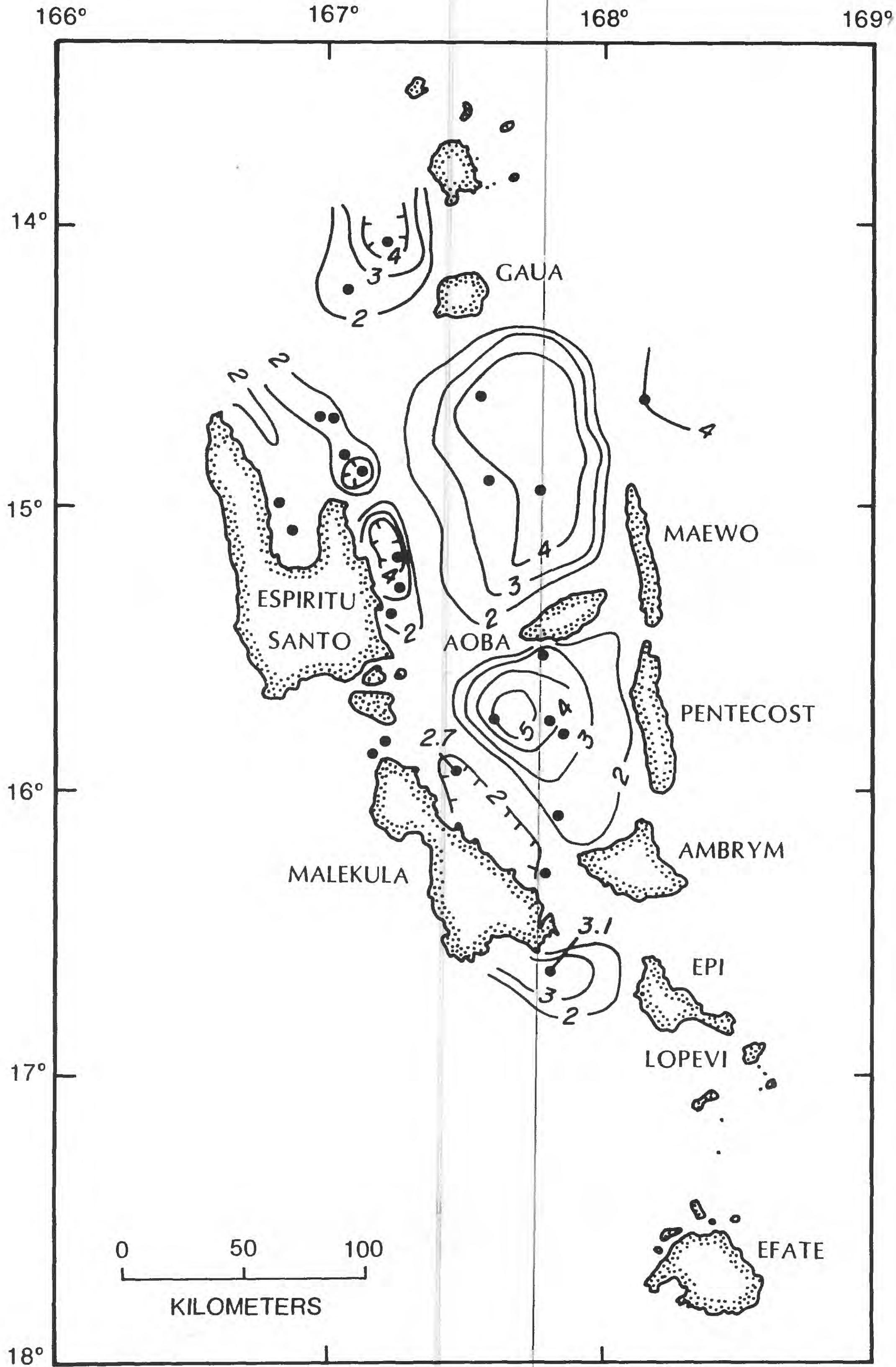


FIGURE 10.—Preliminary isopach map of sediments overlying acoustic basement rocks of 5 km/s seismic velocity in the Central Basin of Vanuatu. Dots are approximate sonobuoy locations where basement reflectors were recorded. Contours are sediment thickness in kilometers; numbered dots indicate deepest recorded sediment thickness.

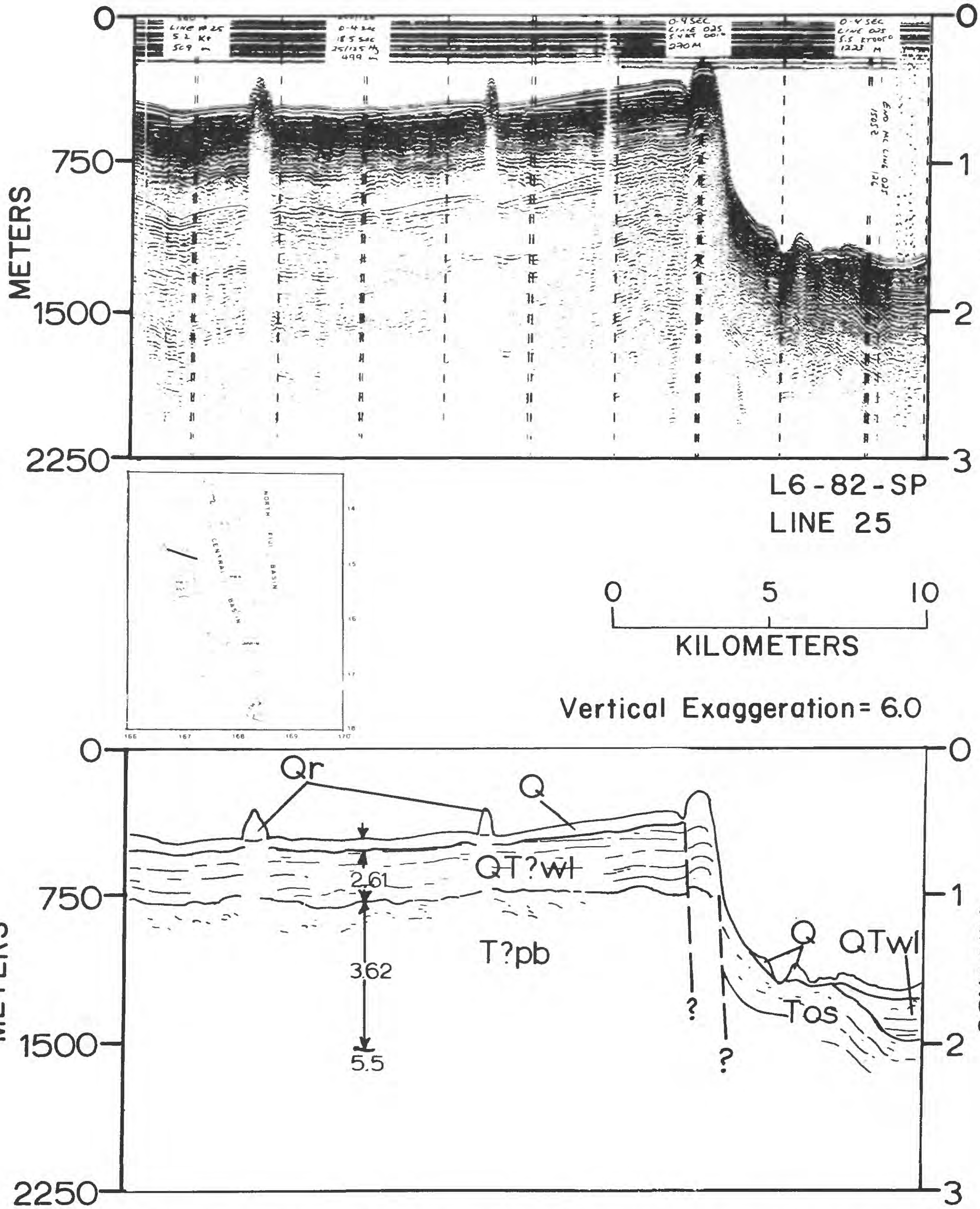
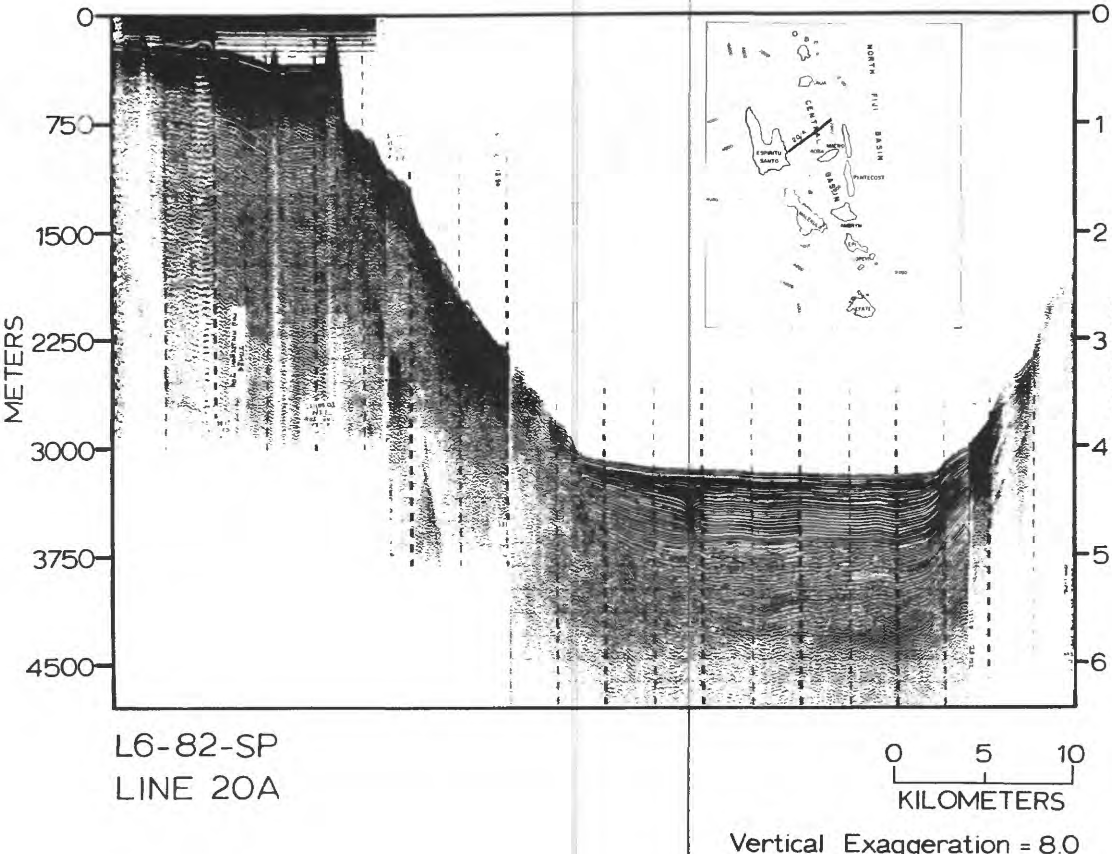


FIGURE 11.—Single-channel record and line drawing of line 25, Leg 2, which crosses the shelf basin off northern Espiritu Santo. Symbols: Q, Quaternary; Qr, reef deposits; T?pb, poorly bedded Tertiary strata, age uncertain; QTwl, well-bedded Tertiary strata, ?, age uncertain; Tos, older sediment.



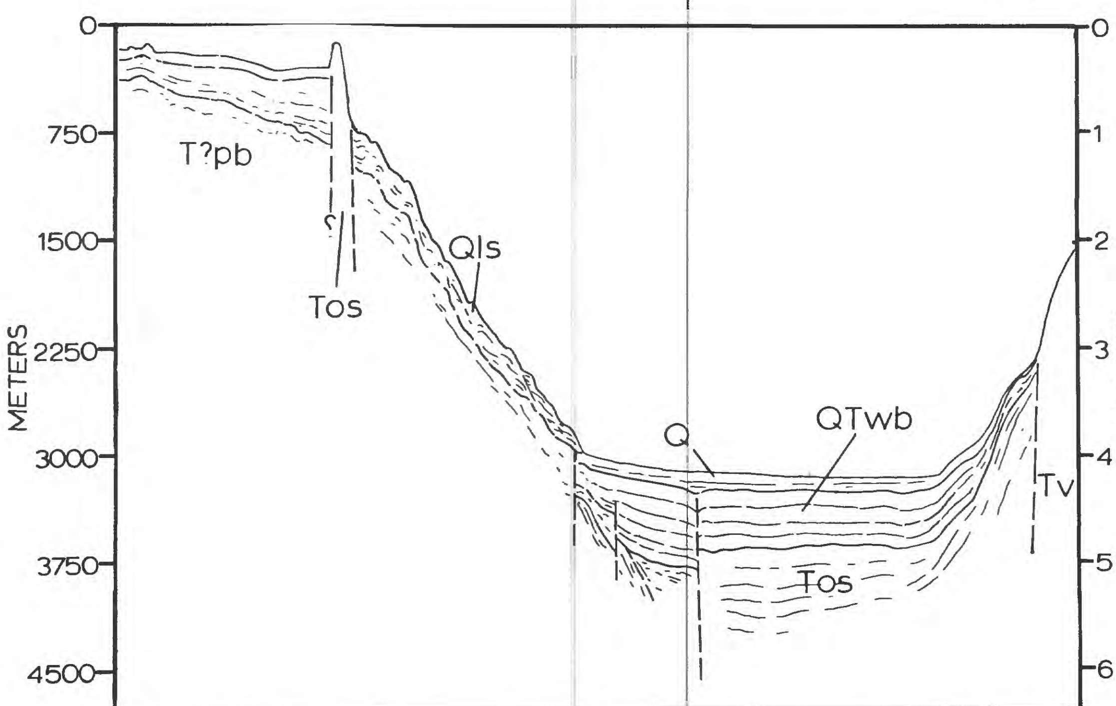


Figure 12.—Single-channel record and line drawing of line 20A, Leg 2, across the northern Central Basin of Vanuatu. Profile shows ponded sediment behind a faulted ridge of older sedimentary rocks located on the eastern shelf of Espiritu Santo. Symbols: Qls, landslide deposits; QTwb, well-bedded Tertiary strata; Tv, Tertiary volcanic rocks; others as in figure 11.

The purpose of the harbor survey was to (1) determine if local uplift is taking place in the harbor, (2) test the sensitivity of the Rabaul seismograph network, and (3) obtain refraction velocities of the rocks in the harbor area to calibrate the seismograph network. Upon completion of the harbor survey, the *Lee* docked at Rabaul and thus ended the USGS-CCOP/SOPAC survey.

GENERAL RESULTS

The Solomon Islands region encompasses three geologic provinces (Coleman, 1976): the Pacific province, which is underlain by obducted portions of the Ontong-Java Plateau on the northeast flank; the Central province, which is largely underlain by early Tertiary volcanic and volcaniclastic rocks; and the Volcanic province, which includes the late Cenozoic volcanic island arc on the southwest flank. The structure of the Solomon Island region is believed to consist of a volcanic ridge underlain by shallow, high-velocity rocks and incised by a deep intra-arc basin known as the central Solomons Trough (Katz, 1980; fig. 15). The ridge is flanked by oceanic crustal rocks of the Woodlark Basin on the southwest and thickened transitional crustal rocks of the Ontong-Java Plateau on the northeast. The deep-water (800-1,800 m), intra-arc sedimentary basin lies between the Volcanic and Central provinces and may contain more than 5 km of sedimentary section at places (fig. 15).

Both wide-angle sonobuoy reflection and refraction data were recorded, and velocity profiles for the sedimentary section and crustal layers were computed from these data. Seismic refraction arrivals, routinely recorded to a range of 37-45 km, provided maximum sedimentary layer depth estimates of 10-12 km beneath the island arc and adjacent ocean basins (Cooper and others, 1982; fig. 16).

Two subsidiary basins separated by a horst-like feature constitute the central Solomons Trough. These newly named structural basins are the Shortland Basin and the Russell Basin (fig. 15). The late Cenozoic Russell Basin is an elongate (60 × 250 km) asymmetrical crustal depression that contains a 1-5 km sedimentary section (fig. 15). Velocities of the crustal rocks beneath the sedimentary section range from 4.8-7.5 km/s. The acoustic basement, thought to be volcanic and volcaniclastic rocks that are partly metamorphosed, has velocities of 4.8-5.8 km/s; a deeper layer, which has a velocity of 6.4-7.5 km/s, is 3-5 km below the acoustic basement. These higher velocity rocks may include deeper crustal igneous rocks similar to those observed in island outcrops in the Central province.

In addition to the Russell and Shortland Basins, two other sedimentary basins have been defined and named in the region (fig. 15). Offshore from northern Guadalcanal, the basin previously identified in Iron Bottom Sound (newly named Iron Bottom Basin) is bounded by Savo Island to the northwest, Guadalcanal to the south, and the Nggela Sule Island platform to the northeast. Another sedimentary basin (newly named the Indispensable Basin) lies in Indispensable Strait and is separated from Iron Bottom Basin by the Nggela Sule Island platform; it is bounded to the northeast by Malaita and the Malaita anticlinorium.

The samples dredged from the perimeter of the Russell and Shortland Basins consist principally of volcaniclastic rocks and reef-detritus limestone (Vedder and others, 1983). In general, the volcaniclastic rocks include poorly sorted foraminiferal sandstone, sandy calcilutite, lapilli tuff, and ashy mudstone that range from indurated to friable. The limestone is largely recemented and partly recrystallized coralline and algal reef detritus that suggests downslope transport as well as submergence since deposition. Both the volcaniclastic rocks and the limestones have low porosity. Calcareous nannofossils in selected samples from each of the dredge stations indicate Quaternary ages, chiefly in the range 0.2 to 1.6 million years before present (David Bukry, written commun., 1982). Radiocarbon ages on two limestone samples are >31,000 years before present (J. B. Colwell, written commun., 1982).

The two gravity cores from water depths of 1,810 and 1,279 m in the central Russell Basin recovered 192 and 262 cm, respectively, of Holocene laminated to bioturbated foraminifer-rich mud. Thin layers of ashy material occur at intervals in both cores.

RECOMMENDATIONS

To assist CCOP/SOPAC in further evaluation of hydrocarbon, as well as mineral, resources, future studies in the region of this recent survey are recommended (fig. 17). These recommendations

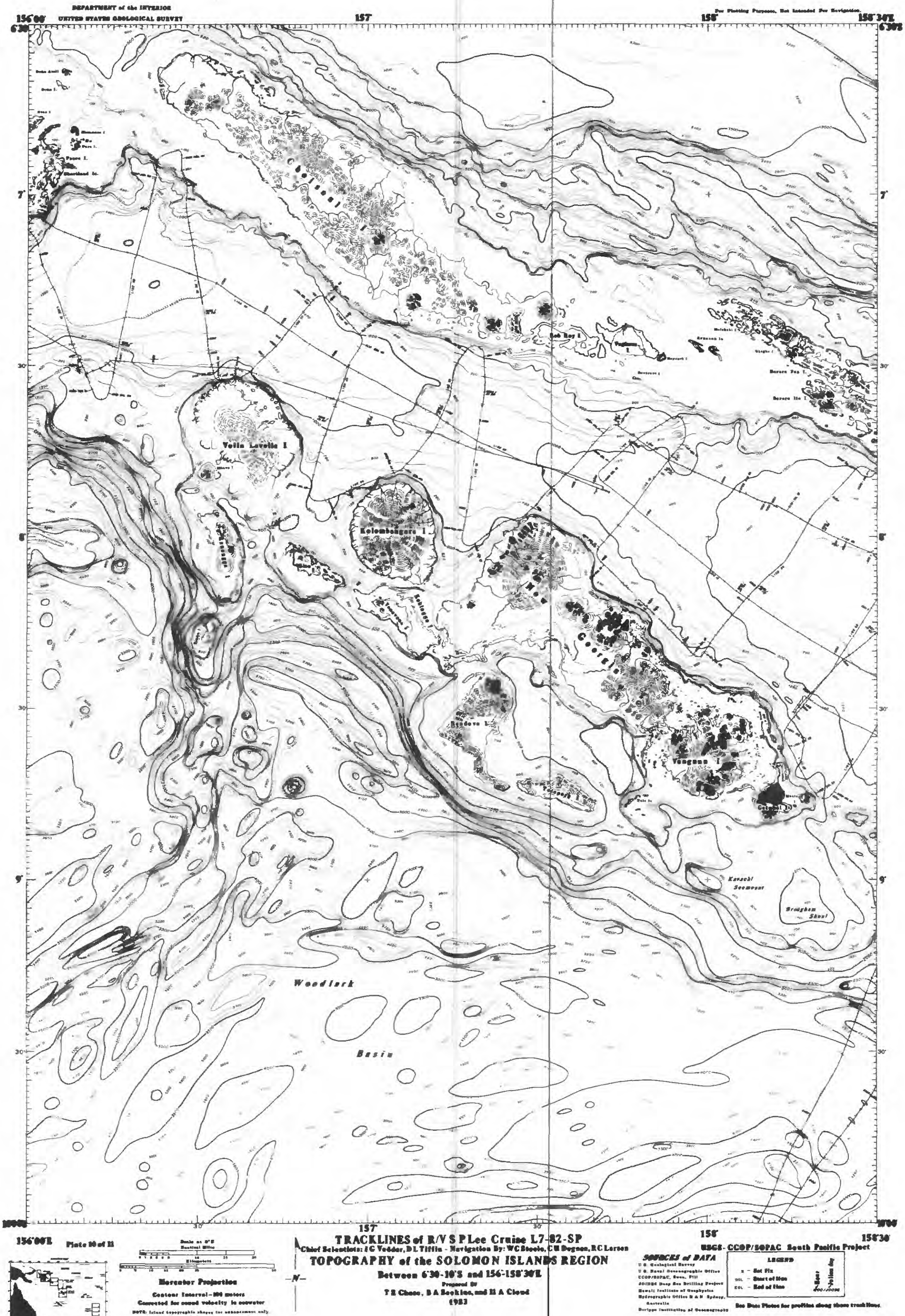


FIGURE 13.—Trackline map and bathymetry for Leg 3, Solomon Islands.

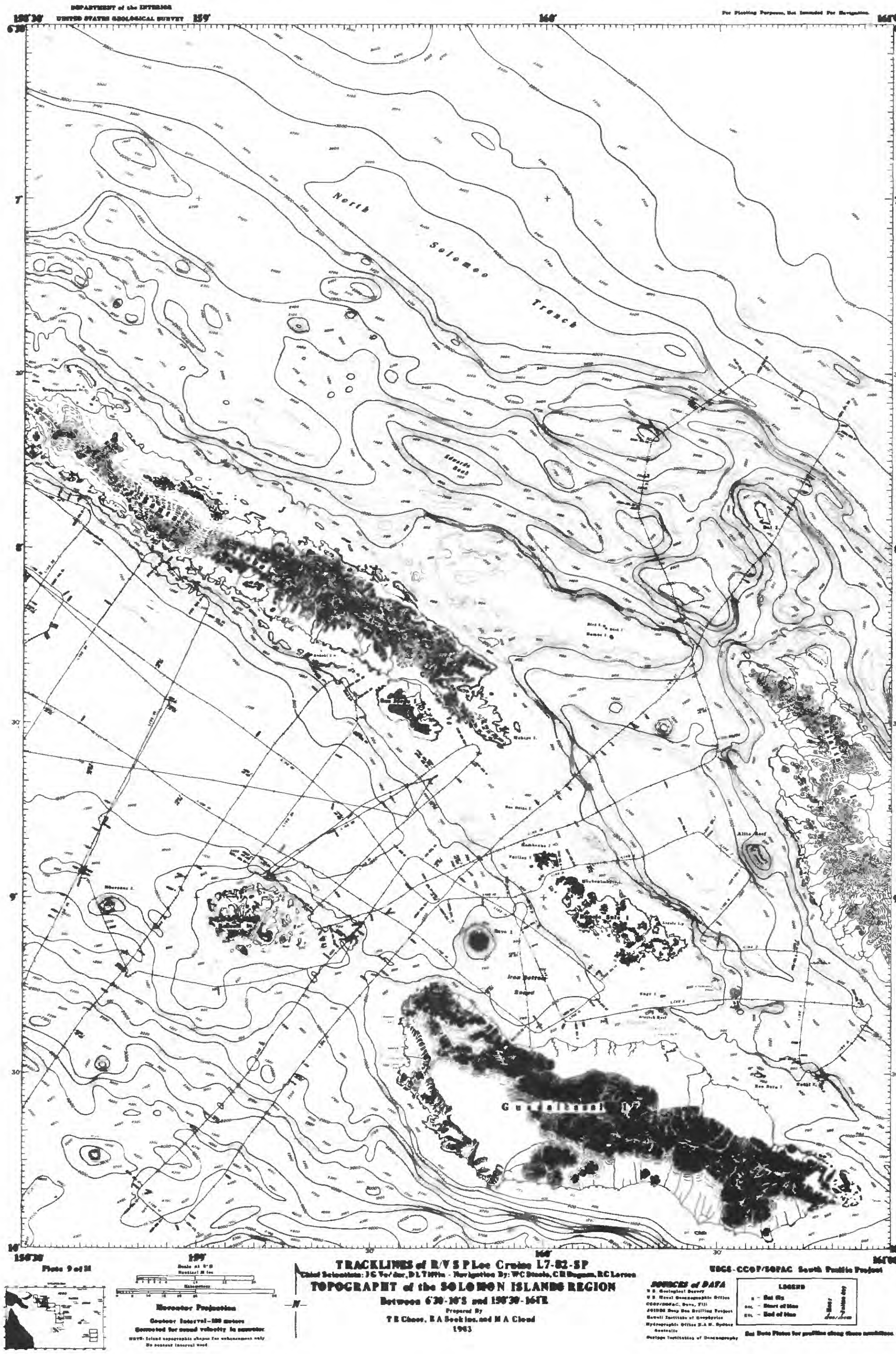


FIGURE 13.—Continued.

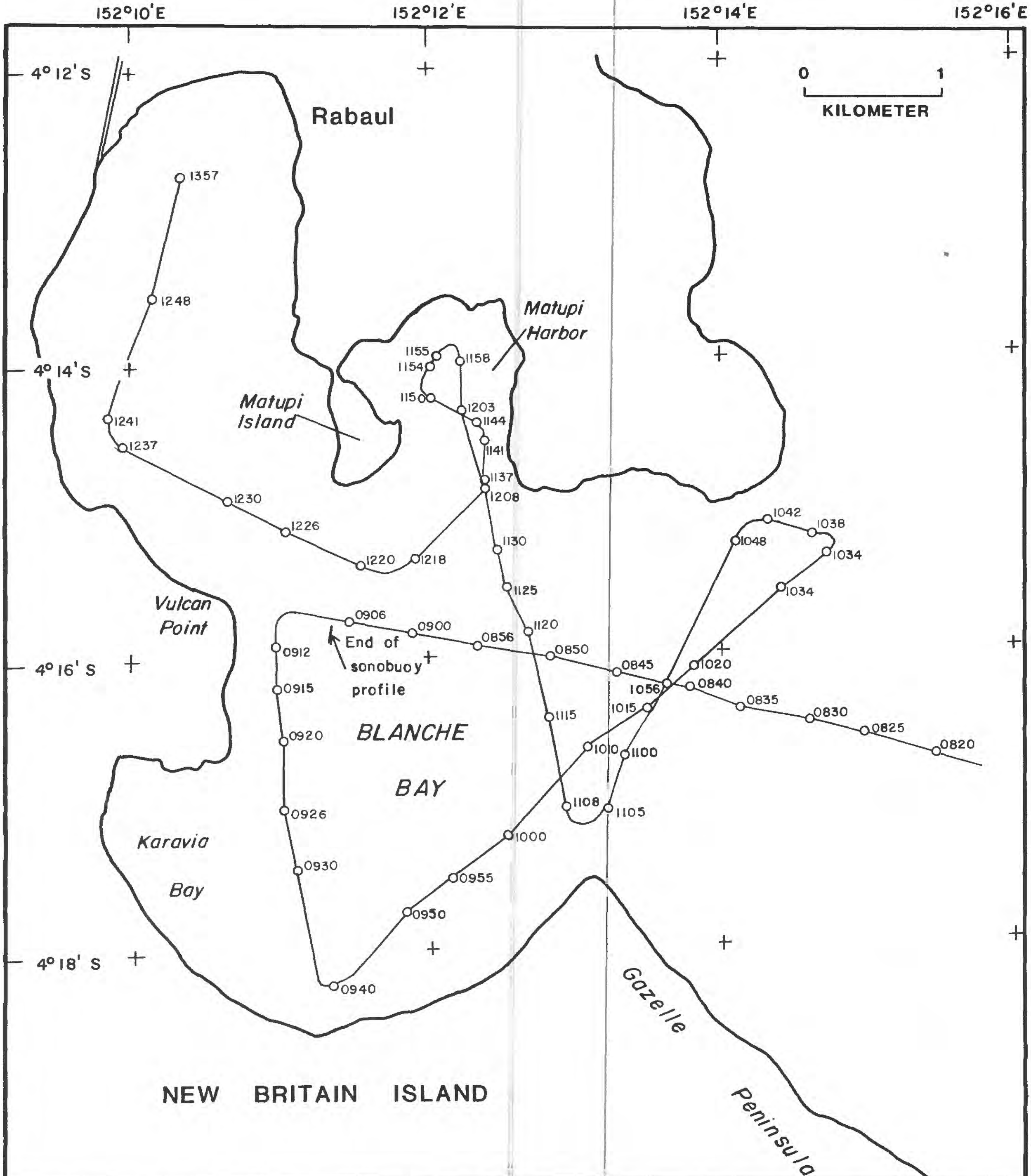


FIGURE 14.—Trackline map, Leg 3, Rabaul harbor area, New Britain, Papua New Guinea.

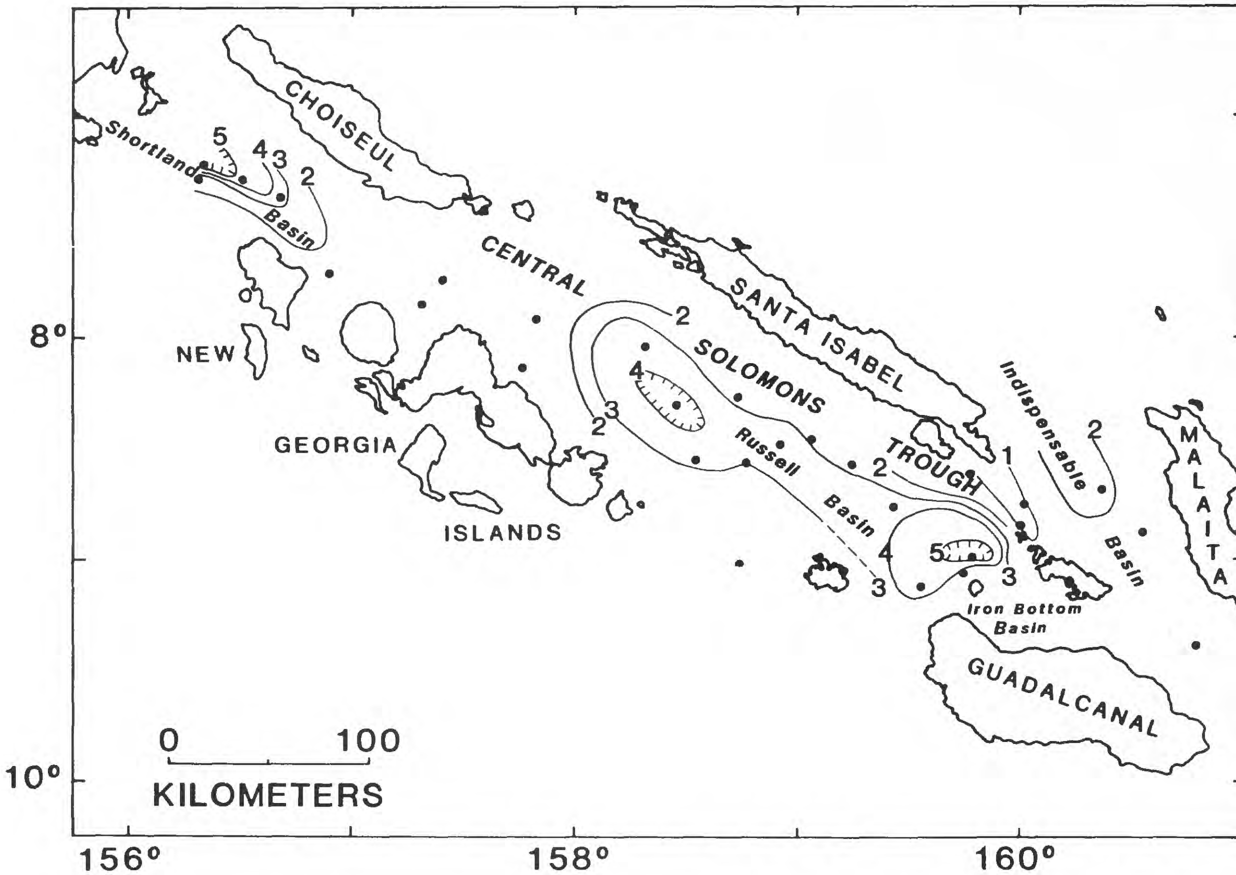


FIGURE 15.—Structural basins and preliminary isopach map of sediment overlying basement rock in the Solomon Islands. Dots are sonobuoy locations at which basement refractors were recorded. Contours are sediment thickness in kilometers.

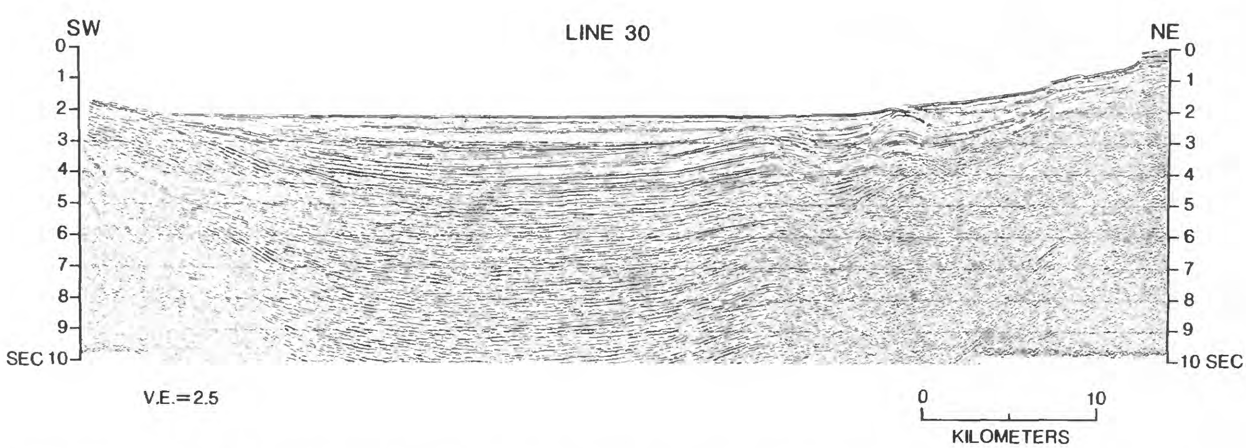


FIGURE 16.—Uninterpreted multichannel profile, Leg 3, line 30 between Russell Islands and the southeast end of Santa Isabel. See figure 13 for location.

were developed at a postcruise meeting held in Honolulu, Hawaii, August 19-20, 1982, in conjunction with the Third Circum-Pacific Energy and Mineral Resources Conference. At this meeting, many of the cruise participants as well as other interested scientists discussed the initial scientific results, the status of data processing and distribution, the scientific commitments and coordination, and future work and concluded that future investigations would be required to more fully assess the resource potential of the 1982 study area and adjacent areas. Their conclusions, which were fundamentally logical extensions of the 1982 work, formed the basis for the following recommendations, presented first at the Eleventh CCOP/SOPAC Session held at Wellington, New Zealand, in November 1982.

I. Tonga Platform-Lau Ridge (continuation of Leg 1)

Multichannel seismic-reflection work to supplement that of Leg 1 is recommended in the southern Tonga platform area and over the adjacent Lau Ridge, which is underlain by a coeval if not syngenetic section (figs. 2, 17). Reflection seismology is especially needed over the far southern region of the Tonga platform (south of 23.5 S. to about 27 S.), which still is nearly unstudied, and the closely adjacent Lau Ridge. The closeness of the ridges separated by Lau Basin in this area indicates the rifting event that split them may have been less severe (rapid) and possibly occurred later than the event that rifted the southern Tonga platform area to the north. These circumstances may enhance the hydrocarbon potential of the ridge's far southern platform section. Valuable resource information can also be extracted by extending the collection of geophysical data farther northward along the Lau Ridge. Further investigation in the Tonga-Lau region would in general be aimed at clarifying the early and mid-Tertiary history of this area, which would significantly advance the evaluation of its overall resource potential.

Additional sampling is also needed in the southern Tonga platform area, as well as along the adjacent Lau Ridge. The sampling program carried out during the present investigation was assembled from shipboard analysis of seismic-reflection records. By studying these records in greater detail, sites for another dredging program can be selected to sample more comprehensively the platform's exposed sedimentary sequence; without this program, questions regarding the ridge's geologic history and resource potential cannot be resolved. The sampling program should include the flanks, which may comprise outcrops revealing substantial middle and late Cenozoic subsidence, and crestal areas of both Tonga and Lau Ridges. Resolution of the history of vertical tectonism of these two geanticlinal ridges is particularly significant in assessing their hydrocarbon potential, which, if present at all, is likely contained in porous reefal masses of early and middle Tertiary age.

Investigation of the possibility that polymetal sulfides may be forming above the magma chambers (?) identified in Lau Basin immediately west of the Tonga platform is also needed. This reconnaissance exploration will involve the collection of close-line bathymetric data, bottom photographs, water samples for helium-isotope anomalies, and samples of young lava.

II. Vanuatu and Eastern Solomon Islands Basins (continuation of Leg 2)

Data collected during Leg 2 (fig. 17) delineated three sedimentary basins on the western margin of the Central Basin of Vanuatu that may have hydrocarbon and mineral potential. Before their potential can be defined and assessment of the area's geological hazards made, additional studies are needed. These include rock-sampling and heatflow measurements to determine source-rock potential, past sedimentary depositional environments, and hydrocarbon maturation history.

Previously gathered seismic-reflection data north of the Banks Islands indicate the presence there of other sedimentary basins (Katz, 1980). These basins probably are Miocene to Pleistocene in age and therefore possibly have resource potential. It would be particularly useful to extend the 1982 multichannel seismic-reflection grid to the relatively shallow shelf region that lies between the Torres Islands and the Santa Cruz Island group to determine the presence of sedimentary basins (fig. 17).

A 20-day survey is recommended: 10 days of seafloor sampling and heatflow measurements within the 1982 survey area and 10 days of multichannel seismic-reflection surveying in the northern Torres-Santa Cruz region. In addition, detailed seismic-reflection surveying is needed along the western Central Basin to further define potential struc-

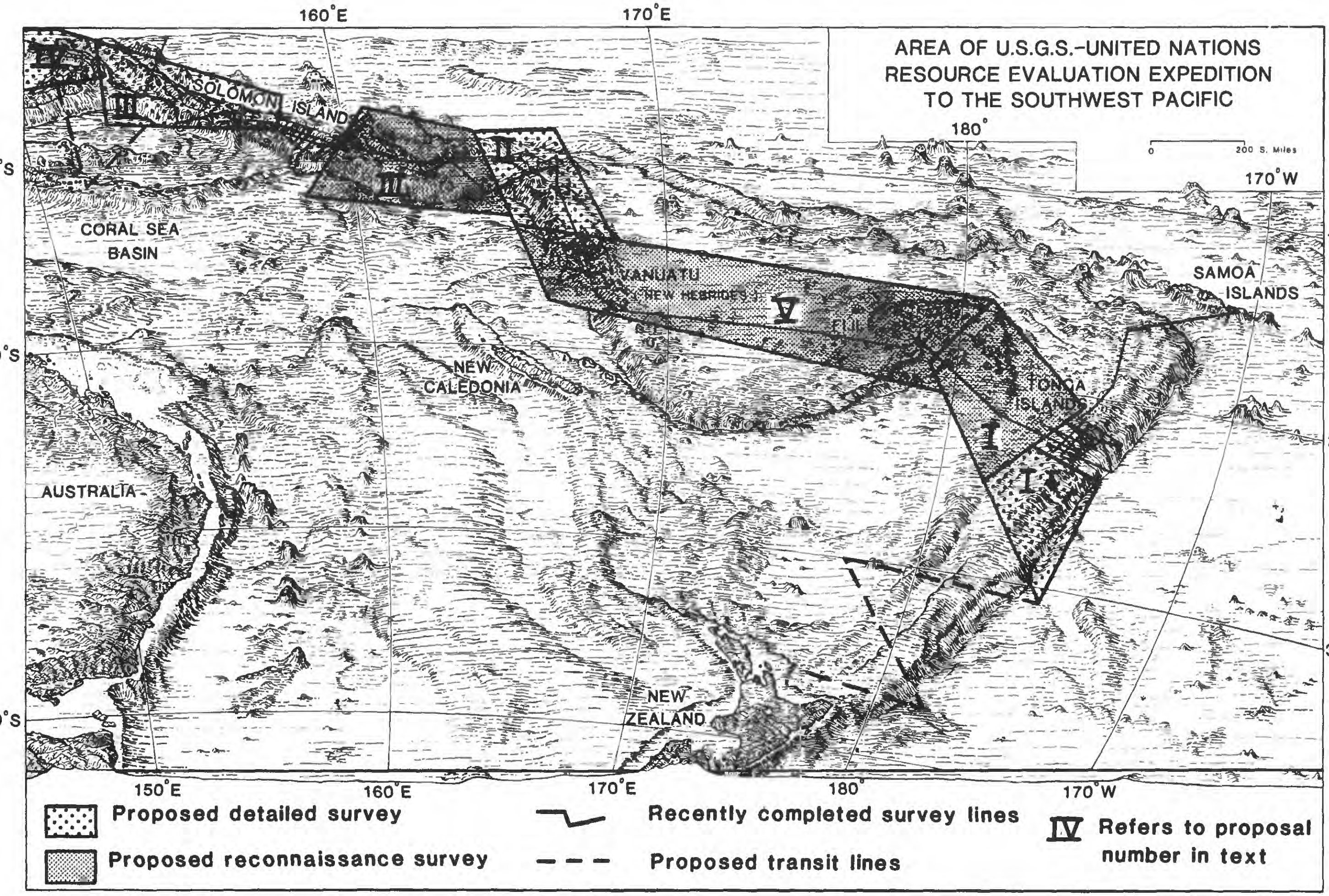


FIGURE 17.—Recommended survey areas of the USGS in the South Pacific.

tural and stratigraphic traps and to assess possible geologic hazards.

Preliminary interpretation of the 1982 *Lee* data have shown two other areas in Vanuatu that should be studied in more detail, preferably with seismic-reflection and rock-sampling techniques: (1) the relatively shallow shelf area south of Malekula and Efate Islands, where sedimentary basins have been identified, and (2) along the flanks of Maewo and Pentecost Islands, where structures indicating hydrocarbon traps may exist.

Studies of the deep structure in the Vanuatu and eastern Solomon island arc province may be possible using a two-ship operation. Should it be possible to coordinate two ships in the region, it is recommended that an arc transect involving expanding seismic spreads parallel to the arc plus constant offset spreads across the arc be undertaken. It would also be desirable to collect wide-beam sidescan sonar survey data in the Vanuatu region to better define the bedrock sea-floor exposures.

III. Solomon Islands and Bougainville, Papua New Guinea, Basins (continuation of Leg 3)

Additional geophysical work, in particular multichannel seismic-reflection surveying, and sea-floor sampling are needed to adequately evaluate the resource potential in the West Melanesian arc. Although more information to determine the nature of the tectonic framework would also be desirable, the recommendations here are confined to those relating directly to resource potential.

A multichannel seismic survey of the southeastern part of Indispensable Strait and the basin areas north and east of San Cristobal Island are required to complete the present work. This work should have first priority and should be extended eastward to correlate with the present investigation in Vanuatu and the New Hebrides arc (fig. 17). Several tracklines toward Santa Cruz Islands from the vicinity of San Cristobal would be sufficient to accomplish a reconnaissance survey.

Bottom sampling is necessary to determine the age, nature, and stratigraphic relation of rocks beneath the arc, particularly in the central Solomons Trough, but also in other areas of the arc including Indispensable Strait and the region east of Bougainville and north of Choiseul. Inasmuch as the offshore basins in this region represent much greater areas than the islands, and may reflect much different histories, sampling should be useful in revealing resource potential as well as the evolution of the arc.

Before the hydrocarbon potential of the sea-floor areas of the Solomon Islands can be fully evaluated, additional multichannel tracklines are required, particularly in the Indispensable Strait-San Cristobal area and in the western part of the Shortland Basin. Sea-floor sampling needs to be done, based on the recently collected geophysical data, to correlate acoustic stratigraphy with rock types that make up the thick sedimentary bodies.

It is estimated that approximately 30 days of ship time are needed to accomplish the work recommended for the Solomons area. This time could be divided into three 10-day phases, with the time devoted to geophysical work and sea-floor sampling being divided equally.

Recommendations IV and V represent adjoining areas where regional geological and geophysical study can significantly increase resource assessment data; scientists attending the *Lee* post-survey meeting in Honolulu in August 1982 recommended this work be initiated under the same Tripartite Agreement and scientific guidelines as for the present study.

IV. New Ireland Basin, Papua New Guinea

The New Ireland Basin is a continuation of the Vanuatu, Solomon Islands, and Bougainville Basins associated with the Melanesian arc. It extends for about 900 km from eastern New Ireland to western Manus Island and lies mostly offshore, south of the islands. It averages 160 km in width and has a sedimentary section that is locally thicker than 5 km. Water depths range from 0 to 3,000 m. The basin is truncated on the southwest by a system of transform faults, and much of the sedimentary and carbonate sequence pinches out against the Northeast Ridge, which was the outer arc of the West Melanesian Trough during Oligocene time.

Neville Exon of the Australian Bureau of Mineral Resources and Donald Tiffin of CCOP/SOPAC made considerable progress in assessing the hydrocarbon potential of the New Ireland Basin from seismic-reflection surveys carried out by CCOP/SOPAC, Gulf Oil, ORSTROM, (Office de la Recherche Scientifique et Technique Outre-Mer) and the Australian Bureau of Mineral Resources.

Land geology and interpretation of present offshore seismic-reflection data (Exon and Tiffin, 1983) indicate that the basin comprises a thick Oligocene volcaniclastic sequence overlain by as much as 2 km of Miocene platform and reefal carbonate beds, and a similar thickness of younger volcaniclastics and biogenic sediment. Should the offshore Miocene sequence prove to consist largely of carbonates, the New Ireland Basin would be considered to have good hydrocarbon potential.

To further evaluate the basin, which has not been drilled and from which few bottom samples have been recovered, it is suggested that a three-week research program be carried out, consisting of approximately 40 percent multichannel seismic-reflection surveying and 60 percent sampling. The seismic surveying should concentrate on the eastern and western areas where no multichannel data exist (fig. 17). The sampling should consist largely of dredging and, if possible, heatflow work to assess the present day thermal gradient in the basin. The dredging would be designed to sample the older sequences identified seismically, and especially the carbonate sequence. Dredging should also be carried out, if possible, on steep slopes along the faulted southwest margin of the basin, around the uplifted Tabar-Feni Islands in the northeast, and possibly in the West Melanesian Trench.

The proposed New Ireland Basin study would not only greatly increase knowledge of the geology, geophysics, and resource potential of the basin, but also would aid in the understanding of the tectonic framework in this highly complex region, which involves at least four crustal plates.

V. North Fiji Basin

A reconnaissance geophysical survey and sampling program within the North Fiji Basin (fig. 17), especially in its southernmost area that geologically connects Fiji with Vanuatu, is highly desirable. It has been shown (Falvey, 1978) that the Fiji Islands and the New Hebrides arc regions were once adjoining structures and that they were separated beginning in late Oligocene to early Miocene time to form the North Fiji Basin. This hypothesis suggests that the sedimentary basins located in Bligh Waters of Fiji, which have been explored for oil and gas, may have evolved adjacent to and contemporaneously with the Central Basin of Vanuatu. To confirm or discount this hypothesis and thereby more completely assess the resource potential of both regions, it is proposed that multichannel seismic reflection profiles and other geophysical data be collected along the north and western margins of Fiji and that several long multichannel lines be taken across the central and southern part of the North Fiji Basin (fig. 17). In addition, sea-floor sampling should be done along the north and west margins of Fiji and on selected sites along the tying traverses. Approximately, 20-30 days of ship time would be required for this investigation.

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