Review and Evaluation

of

SOPAC Hydrocarbon Programme

1970 – 1992

by
Sione I. Tongilava
National Representative of Tonga to SOPAC

REVIEW AND EVALUATION OF SOPAC HYDROCARBON PROGRAMME 1970 - 1992

by

Sione L. Tongilava

National Representative of Tonga to SOPAC

TABLE OF CONTENTS

REVIEW AND EVALUATION OF SOPAC HYDROCARBON PROGRAMME 1970 - 1992

by

Sione L. Tongilava,

National Representative of Tonga to SOPAC

I) INTRODUCTION

The origin of SOPAC could be traced back to the following statement extracted from the preface of the first and second sessions of the then, CCOP/SOPAC in 1972 and 1973, I quote, "the need for assistance to the developing countries of the South Pacific in this field was first brought to the attention of ACAFE by the representative of Fiji at the Joint Eighth Session of the ACAFE working party of Senior Geologists of Mineral Resources Development in Dandung, Indonesia, on August, 1970, because of the interest aroused in the petroleum potentials of the self areas in the South Pacific after the discovery of seepages of crude oil in Tonga.

The attention being given to the possibilities of finding workable deposits of detrital heavy minerals in beaches and the nearshore areas of some of the countries, and investigation into the feasibility of mining manganese nodules from the ocean floor for the content of copper, nickel, cobalt, increased the need for a coordinated regional approach and guidance to the South Pacific countries which had, as yet, legal or no experience in this new activities."

The inaugural session of CCOP/SOPAC was held at Suva, Fiji on November, 1972 and its second session at Nukualofa, Tonga August/September, 1973. What the author of this paper would like to draw attention to is the origin of SOPAC was based on hydrocarbon and hydrocarbon has a global, regional and national coverage. The immediate impact of the interest aroused in the discovery of oil seepages in Tonga in 1968 was a great momentum and the interests of the scientific community as well as the oil industries were focussed in the South Pacific at the time.

The Governing Council should bear in mind that geology and geophysics do not recognise political as well as geographical boundaries. Hydrocarbon certainly attracted the interests of the world in the South Pacific and it is only wise to keep this momentum on a dynamic basis.

2) OBJECTIVES

The main objectives of the hydrocarbon programme of SOPAC are two folds as follows:

i) To promote the hydrocarbon potentials of the individual member countries of SOPAC to the oil industry and so attract investment by major oil companies.

ii) To coordinate, analyse, and evaluate all available seismic datas for the SOPAC region and to promote to oil companies the regional perspectives in a continuing programme.

The region's hydrocarbon potential itself is very dynamic. The SOPAC hydrocarbon programme aims to continue to build on the region's potential in the future by applying new state-of-the-art technology and geological concepts to seismic acquisition, processing and interpretation. The hydrocarbon programme also has a strong objective like a torch-bearer which over the years has certainly enhanced and has also attracted the interest and the focus of the world not only to the hydrocarbon programme but as well as to other programme elements of SOPAC.

3) WHAT IS HYDROCARBON AND SOURCE ROCK?

Hydrocarbons in particular, and as are known to producers, refiners, marketers, and consumers, are gas, liquid and solid compounds containing only two elements, carbon and hydrogen, often with a few impurities of nitrogen, sulphur, and oxygen. They can be classed by the complexity of the carbon bonding into four basic types, from the simplest the paraffins, such as methane, through the napthenes, and the aromatics, to the asphaltenes (Table I - Barclay).

Table 1

1 Refined Products (uses)	Natural Gas (fuel gas, carbon black)		LPG (fuel)	Gasoline (motor fuel)	Naphthas (solvents)	Kerosene (diesel fuel, heating)	Fuel Oil (furnace fuel, diesel)	Lubricating Oil (lubrication, solvent)	Wax (waterproofing, cand	Asphalt (roads, roofing)
2 Hydrocarbon Range	Natural Gas Dry / Wet			Liquid Crude					Solid	
Carbon Number	C_1	C_3	C_4	C_5		C_{11}	C_{13}	C_{18}	C_{36}	no C
				Increasing Paraffins						
				Increasing Aromatics and NSO						
3 Relative Density (API Range)	.800 - .835 (47° - 38°)			.840 - .876 (37° - 30°)			.900 - .970 (25° - 15°)			

Table 2

HYDROCARBON PROGRAMME

TASKS REQUESTED BY MEMBER COUNTRIES

	1972-74	1975-79	1980-84	1985-89	1990-92	TOTAL
FIJI	7	27	17	34	35	120
GUAM	-	-	2	2	-	4
FSM	-	-	-	-	1	1
PNG	-	3	10	14	9	36
SOLIS	3	11	17	27	22	80
TONGA	-	2	6	20	13	41
VAN	-	1	11	19	19	50
W SAM	-	1	5	3	-	9
AV TASKS/ YEAR	3	9	14	24	33	

Table 3

SOPAC CONTRIBUTION TO REPORTS

ON HYDROCARBON POTENTIAL

1975 - 1992

	1975-79	1980-84	1985-89	1990-92	TOTAL
FIJI	2	3	5	7	17
PNG	-	8	2	1	11
SOL. IS.	3	14	7	3	27
TONGA	3	6	10	3	22
VANUATU	-	10	3	3	16
W SAMOA	-	-	1	-	1
TRAINING	1	-	2	3	6
TOTAL	9	41	30	20	100

TABLE 4

HYDROCARBON PROGRAMME

MANPOWER REQUIRED TO CARRY OUT TASKS REQUESTED BY MEMBER COUNTRIES

	1972 -74			1975 -79			1980 -84			1985 -89			1990 -92			TO-TAL			MAN YRS
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
SM	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.04
TJI	-	6	1	-	22	10	2	13	4	11	14	-	17	15	-	30	70	15	32.9
LAM	-	-	-	-	-	-	2	-	-	3	-	-	-	-	-	5	-	-	0.2
NG	-	-	-	-	3	-	1	9	-	3	7	-	6	1	1	10	21	1	7.3
OL	-	2	2	-	8	6	4	9	4	15	15	1	13	9	-	32	43	13	23.6
G	-	-	-	-	-	2	2	1	3	10	8	-	11	2	-	23	11	5	9.5
AN	-	-	-	1	-	-	5	4	-	14	5	-	13	6	-	32	15	-	5.7
AM	-	-	-	-	1	-	3	4	-	-	3	-	-	-	-	3	8	-	2.5
EG*	-	-	-	-	-	-	7	6	-	11	11	-	9	6	-	27	23	-	7.3
OTL	-	8	3	1	34	18	26	46	11	67	63	1	70	39	1				
V # AN NTH YR	28			56			55			53			60						

k Categories: 1 = less than 1 man month
2 = 1 to 5.99 man months
3 = 6 to 12 man months

egional Projects requested to contribute to hydrocarbon assessment:
Project 3 - Melanesian borderland study
Project 25 - CCOP/SOPAC geophysical atlas of the southwest Pacific
Project 26 - Delineation of sediments in time and space
Project 33 - Hydrocarbon source, maturation and entrapment models in island arc settings and collision terranes
Project 38 - Island drilling in the southwest Pacific

Average man months per year calculated by multiplying task totals by the follow factors and then expressing as a yearly average:

0.5 months for category 1
3.5 months for category 2
9.0 months for category 3

New hydrocarbon reservoirs have become increasingly difficult to locate in recent years. In some areas virtually all seismically identifiable structural and stratigraphic prospects already have been tested. As a result, the petroleum industry has become more and more dependent upon new technologies to help locate hydrocarbons that traditional methods have overlooked.

Oil and some natural gas are produced by the breakdown of large, complex organic molecules (kerogen) in sedimentary rocks as a result of elevated sub-surface temperatures acting over extended periods of geologic time. Rocks within which oil or gas is generated

are called Source Rocks. The basic facts about hydrocarbon generation are well understood, although the details of the chemical reactions are not.

Duran and Paratte (1983) discussed the relationship between type III kerogen and coal, and the possible role of coal as a source rock for oil. Coal is now widely recognised as an important source for gas as exemplified by the numerous gas fields of north western Europe (North Sea, Netherlands, and West Germany).

4) WHY DO WE EXPLORE FOR HYDROCARBON?

Present world civilisation is very much based around the utilisation of energy, and most of that energy comes from fossil fuels. Fossil fuels are ancient organic material containing stored solar energy which can be used as sources of energy. The most important fossil fuels are coal, natural gas, and oil. Natural gas and oil were referred to as "petroleum" or "hydrocarbons".

Put bluntly: planet earth has only a limited supply of fossil fuels; we are using that supply at a frightening rate; we are not developing alternatives for the use of fossil fuels; and future supplies are getting harder and harder to find.

Energy will get more difficult to find, and more costly. Nations who have developed a "Western" style of life may find that life style impossible to support because of the cost of the energy it requires. Ships, planes, cars, electricity, modern buildings and "modern conveniences" may, in the future cost more to operate then they are worth.

Our search for the ever smaller remaining reserves of petroleum has forced us to explore in more difficult areas, and areas where success is less likely. The SOPAC areas is still regarded by the oil industry as the Frontier Area simply because it has not been more extensively explored in the past and hence the probability rate of discovery as of now is not considered as very high. However, interest is now being expressed in the South Pacific, and the nations in the SOPAC areas must be prepared to regulate and control the exploration that may result.

To be safe, smaller nations are left with two choices: allow large foreign governments to explore for petroleum; or allow large transnational cooperations in to do the task. But are these choices safe? Do they protect the best interest of the nation? Which choice is better? Most nations choose to allow transnational cooperations to explore within their lands and waters, but only under strict regulations which protect the interests of the nations and its citizens.

5) OIL EXPLORATION COMPANIES

Petroleum companies do not explore because of a humanitarian interest in a nation, or in the future of civilisation. They explore for profit: and future profit. In order to ensure that in several years they have a supply of petroleum to sell, for a profit, they are willing to spend part of their present profit on the risky business of exploration. If a nation is to regulate these companies then it must understand this profit motives. Understanding why a company may choose to spend its exploration budget in one place rather than another is also important, as well as how to attract exploration companies to your area (if that is what is decided as desirable).

Stability

Because they are exploring today, with today's profits, in order to secure tomorrow's profits, companies must be assured that they will be able to produce discovered petroleum under a set of regulations they can plan for. Having policies and regulations that are not likely to dramatically change is also very important.

6) OIL LEGISLATIONS

All countries who do have oil potentials for explorations have legislations and regulations, and all companies are accustomed to working under them. What is important is that legislations and regulations be clearly set down, be perceived as fair, ensure a long term profit for the company exploring, and are understood. Remember, regulations must protect and promote the nation, its citizens, its environment and their partners which are the oil companies.

I would like to cite here the experience which occurred in Tonga when the oil seepages were discovered in 1968. The impact of the discovery was immediate. The main concern of course was directed not only towards the possible existence of oil in Tonga but also throughout the South Pacific region where most of the SOPAC member countries are situated.

There was no need for publicity because the oil companies went to Tonga but there was an immediate need for new oil legislation and expert advice in the administration of all phases of petroleum exploration. The United Kingdom Ministry of Overseas Development was requested by Tonga to provide the services of its Head of the Economic Section, to handle all matters regarding application for prospecting licences in 1968, shortly after the discovery of the oil seepages in Tonga.

A Tongan high-level delegation went to London in January, 1969 and entered into discussions and negotiations with the UK government on the award of oil prospecting rights and appropriate legislation. It was necessary that any legislation ensured that Tonga's economic interest in oil exploration and possible future development would be appropriately safeguarded.

The legislation also had to be acceptable to oil companies with a view to serving the interests of both sides. The Malaysian Petroleum Legislation was considered to be the most relevant for Tonga's requirements in many respects and upon these principles drafting of the Tongan Oil Legislation was based. During the London talk, several applications from well known oil companies including Shell and the British Petroleum, had already been received.

To achieve equitable oil legislation copies of the Proposed Petroleum Mining Act and Model Petroleum Agreement had been distributed to the interested oil companies for comments and their reactions. Having reached agreement in principle with the interested oil companies it was thought the next appropriate step would be to produce a Petroleum Income Tax Bill under which the main bulk of the government's revenue from oil proceeds would be collected. Privy Council subsequently approved the following Petroleum Legislation:

(a) Petroleum Mining Bill

(b) Petroleum Income Tax Bill

(c) Model Petroleum Agreement

(d) Petroleum Licence

These Bills were eventually passed by the Parliament in September, 1969.

7) THE RISK FACTOR

Risk is the chance of not being successful in the search for producible petroleum. Risk is a complex function of the geology (the probability that petroleum has been created and trapped), geography (the difficulties caused by climate, water depth, distance to market, and so forth), economics (the discovery of petroleum does not mean that the deposit can be economically produced) and politics (the risk that changes in government or regulations may change the companies ability to explore or exploit discovered petroleum). Many risk factors are beyond the control of a nation. You cannot change your geology or geography. What can be done is to make as much information available, to ensure that interested companies are well informed on these risks. The one risk factor which many nations have some control over is the risk of political instability.

8) SECRECY AND CONFIDENTIALITY

Petroleum exploration is a very competitive business. In order to compete, many companies are very secretive about their areas of interests, geologic concepts, and technical plans. When dealing with companies you must be aware that they are concerned about secrecy and confidentiality and nations should respect these standards of oil companies. Often times a government has entered into a Petroleum Agreement with an oil company so that that oil company is being given certain rights within the Agreement to explore and if oil is discovered then there is a certain condition regarding royalties, and how many barrels of oil to be produced say daily or monthly for a certain period of time. Although the government will respect and honour this Agreement it will at the same time not really safeguard its own interest because, an oil-potential nation has to publicise openly in the market the conditions to be offered to an oil company.

9) ETHICS

Inspite of fierce competition, most companies are extremely ethical in law abiding. It is very important that they feel they are being treated honestly and fairly, and to a high standard of ethics. Oil companies have been around in the oil scene for a long time and they do have rigid ethical guidelines. Sometimes during civil strifes in some major oil producing countries oil companies are being given the respect to move around freely because they are not really concerned themselves with politics but with trying to earn revenues for themselves as well as for the nation itself.

10) PROFIT MARGIN

This is the bottom line, without this nothing else matters. A company must feel that, after the cost of exploration, the costs of production and transportation, taxes, and royalties, they can make a profit in line with profits to be made elsewhere in the world. A country who has given a Petroleum Agreement to an oil company should bear in mind that the oil company has invested millions of dollars in the project to be recouped later if oil is discovered. However, whether through the sale of petroleum to earn foreign dollars (if oil is discovered) or through the development of an internal energy source, one of the main goals of oil exploration is to improve the economic climate of that particular country but above all is to enhance the credibility and improve the lifestyle of its inhabitants.

In most cases in the developing countries who do have aspirations for oil exploration mentioned earlier in this paper the main thing where revenue is to be earned is through the Petroleum Income Tax Bill where certain conditions are written. There is also the question of royalty once oil is being discovered, a petroleum operations include a great deal of property value and cash flow both of which are obvious things to tax. A royalty, as a percentage of production also generate large sums of money for a government. These funds are then available to fund government, lower other taxes from citizens and in SOPAC member countries to fund economic development.

11) INTEREST AND CONCERNS OF SOPAC MEMBER COUNTRIES

This is a more difficult topic then the concerns of companies, because the concerns of nations vary so considerably. The aspirations of nations also vary. Some nations, such as New Zealand which is a member of SOPAC initiate exploration in an attempt to find fossil fuel to be used within the nation. This decreases a nation's dependence on foreign source of energy, and provides a fuel source for a developing economy. Other nations, such as in the Middle East, hope to export raw petroleum as a source of income to finance economic development. Regardless of aspirations, nations must clearly state their concerns, so that exploration companies can be aware and sensitive to them.

During the late 1970s, oil exploration was planned for the Gulf of Alaska region. This is a rugged, sparsely populated, and economically depressed region. In preparation for exploration the State of Alaska did a lot of soul searching and attempted to formulate their concerns for the regions. The result was a published book "Planning Offshore Oil Development - Gulf of Alaska - OCS Handbook". This book is a discussion of a wide range of concerns, including the petroleum potential development scenarios, employment of local residents, social impacts, environmental protection, government policy changes, and so forth.

Then there are the concerns about economic development, tax and royalty, employment, safety and environmental protection, cultural protection, neo-colonialism, promotion of future exploration, and the reliance on technical experts.

12) GEOPHYSICAL RELATIONSHIP BETWEEN THE REGIONAL AND NATIONAL HYDROCARBON PROGRAMME

I will briefly discuss this topic in order to strike the balance and identify the overlapping and the supplementary requirements between the regional as well as national hydrocarbon activities in the SOPAC region.

Regional Perspective

In the past, the regional work has contributed much to our basic understanding of the petroleum potential of the South Pacific. Between 1971-1973, regional exploration cruises were carried out by the oil industry such as, Gulf, Mobil, Shell and Western. Later, in 1982 and 1984 most of the existing regional seismic data was acquired by the Tripartite programme, jointly managed by CCOP/SOPAC. From the data collected during these cruises it has been possible to identify the major sedimentary basins favorable for petroleum prospects.

Regional work continues with Ocean Drilling Program in various scientific cruises collecting seismic data. It is important that the SOPAC Hydrocarbon Programme continues to contribute to the planning of this otherwise scientific cruises, so that they may include surveys of shallow water regions prospective for hydrocarbons.

Techsec contributes to regional development with promotional work at oil industry conferences. This includes giving talks on the hydrocarbon potential of the region and exhibiting the hydrocarbons display.

National Perspective

International oil companies explore for hydrocarbons on a country by country basis. Consequently, the emphasis of Hydrocarbons Programme is geared towards developing the hydrocarbon potential and promoting this to the industry for its member country.

In order to carry out an effective evaluation of a member country's hydrocarbon potential it is necessary to have a sufficient amount of seismic and geological data. The needs of each member country differ according to the amount of data available.

Fiji and Tonga

Both Fiji and Tonga already have masses of seismic and geological data. These data have formed the basis of thorough evaluations of hydrocarbon potential by Techsec. This must be promoted to the oil industry and the data made easily available to oil companies.

- Techsec should continue to produce glossy promotional brochures, write papers for publication in oil industry journals, and continue to give talks and present exhibits on the hydrocarbon potential at major oil industry conferences.

- There is a clear need to organise and participate in promotional tours to major oil companies in the USA, Europe and Australia. This is probably the most effective method of promotion. It is traditionally done by small independent oil companies which attempt to attract major oil companies as partners since they do not have sufficient financial resources themselves. However, being driven purely by commercial motives, these arrangements are often not in the best interests of the country. In its role as a development organisation, Techsec should take the place of the small independent oil companies and promote directly to the major oil companies.

Solomon Islands and Vanuatu

The Solomon Islands and Vanuatu lack sufficient seismic data in their most prospective, shallow water areas to make proper assessment of the hydrocarbon potential of these countries. Consequently, it is most important that more data is collected.

- The most important data required to evaluate hydrocarbon potential is multichannel seismic data. In order to further develop the hydrocarbon potential of these member countries, Techsec should acquire, process and interpret new seismic series using state-of-the-art technology.

- Techsec should continue to use state-of-the-art seismic processing techniques to enhance the hydrocarbon prospectivity of member countries with good seismic coverage. New seismic techniques combined with new geological concepts continue to reveal potential hydrocarbon traps that previously could not be detected.

- To date Techsec's seismic processing has been done by contractors, and requires large annual expenditure (e.g. FS150,000 estimated for 1992). A cost effective alternative to contractor reprocessing is to purchase similar state-of-the-art seismic processing in the modelling software, and the associated hardware (total cost of FS130,000) so that otherwise expensive processing can be done in-house on the existing SOPAC computer workstations by the Petroleum Geophysicist.

- Promotion to the oil industry should continue but at a low level until more seismic data is available.

Papua New Guinea

Papua new Guinea already has discoveries of commercial oil and gas fields and major international oil companies are continuing to explore in onshore and offshore areas. Consequently, Techsec's work gives priority to developing the support services (see General Support Services below).

General Support Services

- Techec should continue the retrieval, archiving and updating of data and the Petroleum Data Packages on behalf of the member countries and continue to advise member countries on data management and archiving.

- There are need to promote proposals for new petroleum legislations in Solomon Islands and Vanuatu and to revise existing legislation in Fiji. Techsec has made a major contribution in this field and should continue to assist in this way.

- Techsec should continue to provide training to member country nationals in the methods of hydrocarbon assessment and database management during short visits and through longer secondments to SOPAC Techsec.

- Should oil companies be awarded exploration rights in the member countries, Techsec should advise governments on monitoring exploration operations, their rights regarding data provisions, safety and environmental issues.

13) HYDROCARBON POTENTIAL OF SOPAC MEMBER COUNTRIES

Petroleum Prospects of Fiji

Most petroleum exploration in Fiji has been directed towards the shallow water sedimentary basins around and extending onto Viti Levu, Bligh Water, and Bau Waters Basin. A large amount of commercial multichannel seismic-reflection data has been acquired across these basins since 1971. Commercial and non-commercial reconnaissance geophysical surveys have also been conducted across other sedimentary basins in Fiji, including the deep-water Suva and Baravi Basins and Basins around Vanua Levu and on the Lau Ridge. Five deep wells were drilled offshore and on Viti Levu from 1980-1982. All the wells were dry, although some had minor shows of gas and oil fluorescence. The Lower to Middle Miocene shallow water limestones, which were the primary targets were not encounted.

Up to about 4km and 2km of Late Miocene and younger strata are present in the Bligh Water and Bau Water Basins, respectively. The sedimentary sequences off Viti Levu are cut by large folds, and the pre-Pliocene rocks are affected by folding weeds is locally quite intense.

Source rocks have been identified in the deep wells and in tests of outcrop in the stratigraphic bore hole material from Viti Levu and Vanua Levu. Anomalous amounts of pentane in seabed sediments off Northern Viti Levu suggest that some thermogenic hydrocarbons have been generated. Information on subsurface reservoirs is sparse, but limestones are generally considered to have better reservoir potential then coarse volcaniclastic and are the more desirable targets.

Late Miocene and younger sequences contain numerous structurally form potential traps, and several Pliocene reef-like seismic mounts also occur in the Western Bligh Basin and form potential traps.

Petroleum Prospects of Papua New Guinea

Papua New Guinea is a Western Pacific nation with a large combined population of 3,200,000. Total land area is 462,240 sq km of which the main land forms over an estimated 80%. The waters covering the EEZ comprise 3,120,000 sq km.

PNG can be conveniently described as forming to tectonic units. The South West mainland which is the leading edge of Indo-Australian plate, this being sutured to a complex combined mobile belt and several island arcs which are still tectonically active.

There are six large sedimentary basins. Intensive exploration and production development continues in the continental mainland Papuan Basin where oil seeps were discovered in 1911. The first oil production commences in 1992 with export of up to 125,000 barrels per day from the Kutubu Field. Proven reserves are estimated to be 200 billion barrels.

There are five sedimentary basins: off North Guinea, Manus, New Ireland, Bougainville and Cape Vogel are relatively unexplored with thick sedimentary sequences, much of which is in deep water. However, the shallow water margins of these Basins could contain substantial reserves. Petroleum exploration and productivity in PNG is covered by comprehensive legislation being with all currently unlicenced areas being open for

application. Extensive reports including seismic survey data are available for inspection or purchase whether from the government or its agent, the SOPAC Petroleum Data Bank in Canberra, Australia.

Petroleum Prospects of Tonga

The Kingdom of Tonga is a small Pacific nation comprising 171 islands of which about 37 are inhabited. The total land area is about 700 sq km, but the territorial waters cover about 700,000 sq km. Although much of this area is part of the Pacific Ocean the main islands are the surface expression of a large NNE-Trending Ridge immediately to the west of the Tonga Trench, that marks the boundary between the Pacific and the Australia-India Plates.

The Tonga Ridge is a large (60,000 sq km) sedimentary basin with significant potential for hydrocarbon discoveries. Seismic data indicate a thick sedimentary sequence with potential for mature source. Oil seeps on Tongatapu and the seismic flat-spots are direct indications of hydrocarbon within the Basin. Several reef structures are recognised which form untested "plays".

In the Tongatapu 'Eua area there is a close grid of currently reprocessed seismic data, within an untested eocene reef "plays" located in the 'Eua Channel between the two islands. Drilling targets can be located without the need for additional seismic data.

Elsewhere in the Basin, a regional grid of seismic lines indicates potential for similar reef structures and many fault blocks. Several large structures and many fault blocks. Several large prospects are recognised, which require more detailed seismic coverage.

All reports and data, including a complete set of seismic datas, are available at the Ministry of Lands, Survey and Natural Resources for inspection of copying.

Petroleum exploration in Tonga is covered by comprehensive legislation with recent revised and reviewed amendments in 1985. There are two licence holders at present, one for a US oil company and the other for a Japanese oil company. All other areas are open for licence; the Government of Tonga is keen to see a further phase of exploration which is top priority of Tonga's SOPAC Hydrocarbon Programme.

Petroleum Prospects of the Solomon Islands

The total land area is about 24,000 sq km: New Georgia Sound the great internal waterway, occupies about 39,000 sq km. Because of the country's dispersed nature, the adjacent sea areas covered by the Exclusive Economic Zone run to 1,290,000 sq km, the trough is divisible into three major Basins - Shortland, Russell and Iron Bottom. There are three other peripheral Basins - Indispensable, Mbokokimbo/Nudha and Mborokua Basins. The maximum sediment thickness is over five kilometers thick, and ranges in probable age from Late Oligocene through Holocene.

The dorminant sedimentary rocks are volcaniclastic. But carbonates are also present, especially algal reefal carbonates. These bulk large in the stratigraphic column at times of relative tectonic calm - latest Oligocene/earliest Miocene, late Early Miocene, Late Miocene, Late Pliocene/Holocene. Along with antiforms, reef structures around the edges of the central basins, in water depths to 250 m, offer the best chances of petroleum discovery. This area of promise is more than 20,000 sq km. As well, large areas of deeper water, to 800 m, contain anticlinal structures, and very likely, more buried reefs.

About 25,000 km of marine survey have been traversed in Solomon territory, of which half if fair to excellent quality. The Tripartite multichannel surveys of 1982 and 1984 are especially good. Their results have been analysed and published and the survey tapes are available for further study and reprocessing.

The most prospective shallow water areas are:

1. Mbokokimbo Basin and marine extensions, eastern Guadalcanal;
2. flanks of Iron Bottom Basin, north of Honiara and between Guadalcanal and Florida;
3. southwestern flank of the high between Florida and San Jorge Island (Santa Isobel) and, possibly, the northeastern flank also;
4. Manning Strait area between Santa Isabel and Choiseul; and
5. parts of the shelf and upper slope area, Choiseul to Shortland Islands.

All these areas require additional seismic reflection surveying, before a full evaluation of their petroleum potential can be made. For some areas the work required is minimal.

Petroleum Prospects of Vanuatu

The Republic of Vanuatu in the Southwest Pacific includes most of the New Hebrides Archipelago, but not the northernmost islands (the Santa Cruz Group) which are politically part of Solomon Islands. The archipelago is the physical expression of the Cainozoic New Hebrides islands arc. The arc massif includes several large, axial intra-arc basins with large volumes of sediment - Vanikolo, North Aoba and South Aoba basins. The margins of the intra-arc basins, in particular the adjacent flanking sub-basins, Malakula, East Santo, and Big Bay have real prospects for petroleum. The geological and tectonic history of the arc suggests that these smaller basins are at least as old as the Neogene; they contain several thousands of metres of sediment including reefal limestones. The persistent presence of such limestones in the sequences of the Western Belt gives rise to an attractive marginal reef limestone play. This play is associated with the margins of the basins where reef build-ups accumulated on horst blocks that were part of an actively-faulted basement. Times of maximum reef growth were Late Oligocene, Early and mid-Miocene and Pliocene.

The most prospective areas are along the western margins of the Malakula, East Santo, and Big Bay basins. The southeastern flank of the Torres High is also prospective. A moderate high resolution seismic programme in shallow water areas could show the presence of economically viable exploration targets, especially reefs.

Vanuatu is a young, developing country. The government is concerned with exploiting and managing Vanuatu's natural resources for the benefit of its people. Vanuatu has a liberal tax system and can offer many inducements to a company with serious exploration intentions.

Future Structure of the Hydrocarbon Programme

1. The Hydrocarbon Programme should continue to be a key programme element in the organisation of SOPAC Techsec.

2. Maximum effort should be made to ensure strong, longterm financial and in-kind support from donors.

3. Staffing should continue at the present level of one Petroleum Coordinator and one Petroleum Geophysicist at Techsec, and one SOPAC Data Manager at the SOPAC Data Bank in Canberra.

4. The basic staff should be increased by additional temporary consultants in short periods from time to time when required in order to follow closely with the advancement of the petroleum state-of-the-art technology.

(4) BENEFITS OF MEMBER COUNTRIES FROM THE SOPAC HYDROCARBON PROGRAMME

Fiji

A total of 1,692 km of seismic data has been acquired, together with gravity and magnetics data during CCOP/SOPAC cruises in 1976 and 1977 in offshore Fiji, the Koro Sea and the Bligh Water. These seismic data contribute significantly for the evaluations of Fiji's hydrocarbon potential.

SOPAC has made four major evaluations of hydrocarbon potential (not including the evaluation currently underway). These have integrated all the existing data in six offshore basins around Viti Levu and on the Lau Ridge. These evaluations provide the government with a thorough assessment of the Fiji's offshore hydrocarbon potential and form the basis for the promotion to the oil industry.

The hydrocarbon potential of Fiji has been promoted by SOPAC at three international oil industry conferences between 1988 and 1991 and a paper has been published in an oil industry journal. Work by SOPAC contributed significantly to the signing of four exploration licences with oil companies between 1977 and 1978.

A total of seventeen reports have been written by SOPAC detailing the hydrocarbon potential of Fiji.

SOPAC has established a central data base archive for efficient dissemination of data to the government and to potential oil industry investors. Concerted efforts have been made for further data retrieval, particularly for oil company surveys which will add significantly to ongoing evaluations.

Tonga

A total of 8,125 km of seismic data, together with gravity and magnetics data have been acquired during CCOP/SOPAC cruises in Tonga between 1979 and 1984. A further magnetometer survey was made in 1989. These data provide the basis for all subsequently technical evaluations of hydrocarbon potential in Tonga.

SOPAC has completed five studies which give a comprehensive account of the hydrocarbon potential of the Tonga Ridge and the Lau Ridge in the Tongan EEZ. These involved major reprocessing of seismic data and integrated all the available seismic, magnetic and geological data. The studies provide the government with a detailed knowledge of the hydrocarbon potential of Tonga and form the basis of promotion to the oil industry.

SOPAC has promoted the hydrocarbon potential of Tonga at three international industry conferences between 1989 and 1992, and has contributed to a promotional brochure. Work by SOPAC ultimately contributed to the signing of two exploration licences with oil companies in 1990 and 1991.

In all, twenty-two reports have been written by SOPAC on the hydrocarbon potential of Tonga.

SOPAC has established a central data base archive for efficient dissemination of data to the government and to potential oil industry investors. Concerted efforts have been made for further data retrieval, particularly for oil company surveys which will add significantly to ongoing evaluations.

Papua New Guinea

A total of 18,031 km of seismic data, together with gravity and magnetics data have been acquired by CCOP/SOPAC in 1981 and 1984. These data form the basis of hydrocarbon evaluations in five previously unexplored basins in Papua New Guinea.

SOPAC has contributed to two major evaluations which integrate all available seismic, magnetic and geological data. These evaluations provide the government with a thorough knowledge of the hydrocarbon potential of their previously unexplored basins.

SOPAC has promoted the hydrocarbon potential of Papua New Guinea at three international oil industry conferences between 1989 and 1992. A total of 11 reports have been written by SOPAC on the hydrocarbon potential of Papua New Guinea.

SOPAC has established a central data base archive for efficient dissemination of data to the government and to potential oil industry investors. Concerted efforts have been made for further data retrieval, particularly for oil company surveys which will add significantly to ongoing evaluations.

Solomon Islands

A total of 11,564 km of seismic data, together with gravity, and magnetic data has been acquired during CCOP/SOPAC cruises in 1979, 1982 and 1984 in the offshore Solomon Islands. These seismic data have made and will continue to make significant contributions to the government's understanding of the regional hydrocarbon potential of the Solomon Islands.

SOPAC has made two major evaluations of hydrocarbon potential (not including an evaluation currently underway). These have integrated much of the existing data in the seven major offshore basins and provide the government with thorough assessments of the Solomon Islands' hydrocarbon potential. These evaluations form the basis for promotion to the oil industry.

SOPAC has advised the government on completing their hydrocarbon legislation by producing draft Petroleum Regulations, a model Petroleum Agreement (to accompany their Petroleum Act), and identifying areas suitable for licensing for petroleum exploration. Advice has also been given on the employment of consultants with expertise in this specialised area.

A brochure on the Solomon Island's hydrocarbon potential was published in 1989 and has been beneficial to the government in promotions by SOPAC at three international oil industry conferences between 1991 and 1992. SOPAC has also published a paper in an oil industry journal.

A total of twenty-seven reports have been written by SOPAC detailing the hydrocarbon potential of the Solomon Islands.

Data is itself a key resource to the government. SOPAC has established a central database archive for efficient dissemination of these data to the Solomon Islands government and potential oil industry investors. Since then, concerted efforts have been made for further data retrieval, particularly for oil company surveys which will add significantly to ongoing evaluations.

Vanuatu

A total of 11,700 km of seismic data, together with gravity, and magnetic data has been acquired during CCOP/SOPAC cruises in 1980, 1992, and 1984 in offshore Vanuatu. These seismic data have made and will continue to make significant contributions to the government's understanding of the regional hydrocarbon potential of Vanuatu.

SOPAC has co-ordinated with the Ocean Drilling Program the sampling and analysis of rock cores and petrophysical data in the vicinity of basins with petroleum potential. Results of these greatly enhance the government's assessments and improve their ability to attract oil investment.

SOPAC has made two evaluations of hydrocarbon potential. A current evaluation includes recently upgraded processing of 600 km of seismic data and a funding proposal for further work of this type has been submitted to donors for funding. These evaluations integrate much of the existing data in the seven principal basins and provide the government with thorough assessments of Vanuatu's hydrocarbon potential. These evaluations form the basis for promotion to the oil industry.

SOPAC has advised the government on completing their hydrocarbon legislation by producing a draft Petroleum Act, Petroleum Regulations, a model Petroleum Agreement and identifying areas suitable for licensing for petroleum exploration. Advice has also been given on the employment of consultants with expertise in this specialised area.

A brochure on the hydrocarbon potential of Vanuatu is currently being printed and will be beneficial to the Government in promotions by SOPAC. Other promotion has taken place at three international oil industry conferences between 1991 and 1992.

A total of sixteen reports have been written by SOPAC detailing the hydrocarbon potential of the Vanuatu.

Data is itself a valuable resource for the government. SOPAC has established a central database archive for efficient dissemination of these data to the Vanuatu government and potential oil industry investors. Concerted efforts have been made for further data retrieval, particularly for oil company surveys which will add significantly to ongoing evaluations. (See map denotes potential area for four member countries).

Western Samoa

SOPAC has made an evaluation of Western Samoa integrating all available seismic and geological data. This provides the government with an assessment of the hydrocarbon potential.

15) REGIONAL BENEFITS FROM WORK BY THE HYDROCARBON PROGRAMME

The five member countries with significant petroleum potential, Fiji, Papua New Guinea, Solomon Islands, Tonga and Vanuatu which cover an extensive area of 7,130,000 sq km which is also 40% of the total SOPAC region of developing island countries, and have a population of 4,436,000 which is 90% of the total. Representing such a large proportion of the region, the development of the hydrocarbon potentials in these countries signify a major benefit to the region as a whole.

A total of 51,998 km of seismic data have been acquired, together with gravity and magnetic data during eighteen regional CCOP/SOPAC cruises between 1976 and 1987. SOPAC has improved this data by processing in three countries and can apply the experience gained to other countries. These seismic data have made and will continue to make significant contributions to the member countries knowledge of the regional hydrocarbon potential.

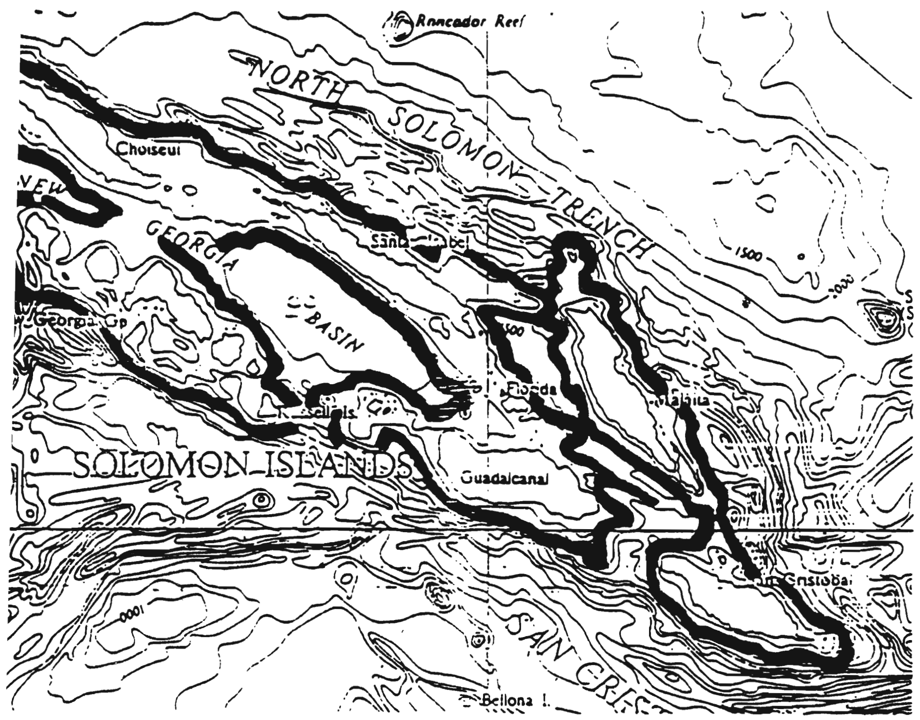
In making evaluations of the hydrocarbon potential on a national basis, SOPAC draws on experience gained throughout the region. These evaluations integrate much of the existing data in the many offshore basins and provide the governments with a thorough assessment of the region's hydrocarbon potential. These evaluations form the basis for promotion to the oil industry.

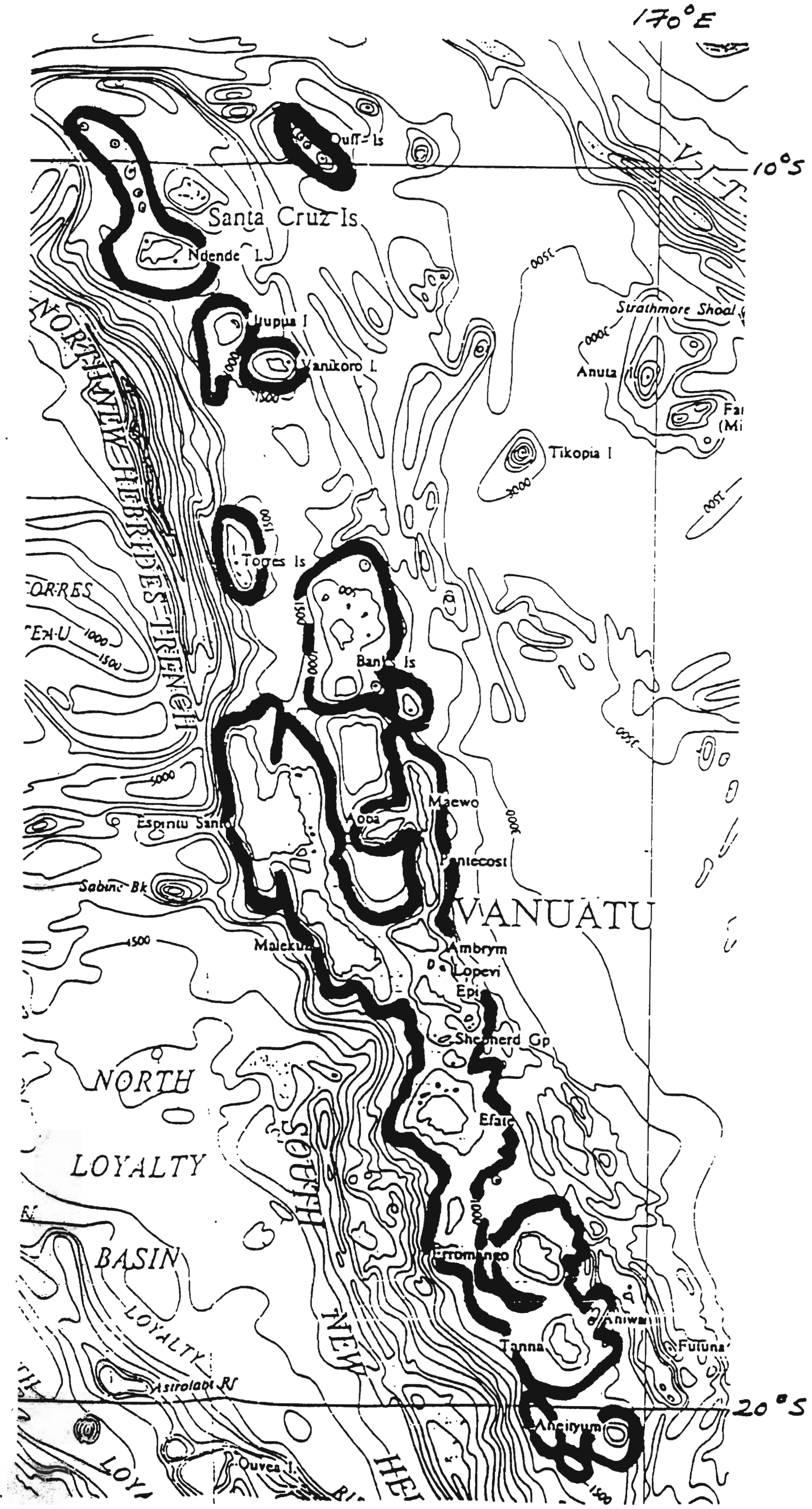
SOPAC has assessed the comparative terms of Petroleum Legislation of the region and is organising a regional workshop in this field. This same expertise has been drawn on when advising individual member countries either on drafting new, or on revising existing hydrocarbon legislations.

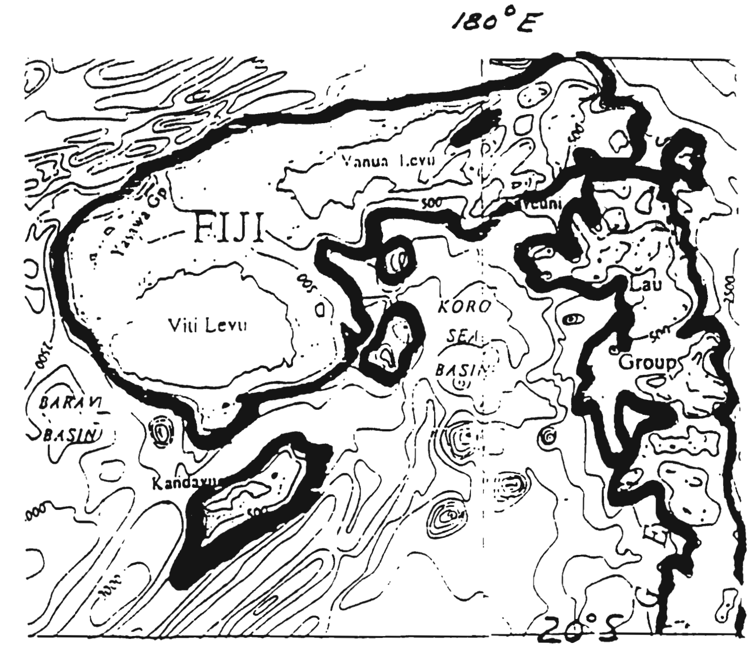
SOPAC has produced displays of the regions's hydrocarbon potential which are exhibited at international oil industry conferences. The display is beneficial to both the region and the individual member countries as it shows the latter their regional geological contacts relevant to countries with producing oil and gas fields.

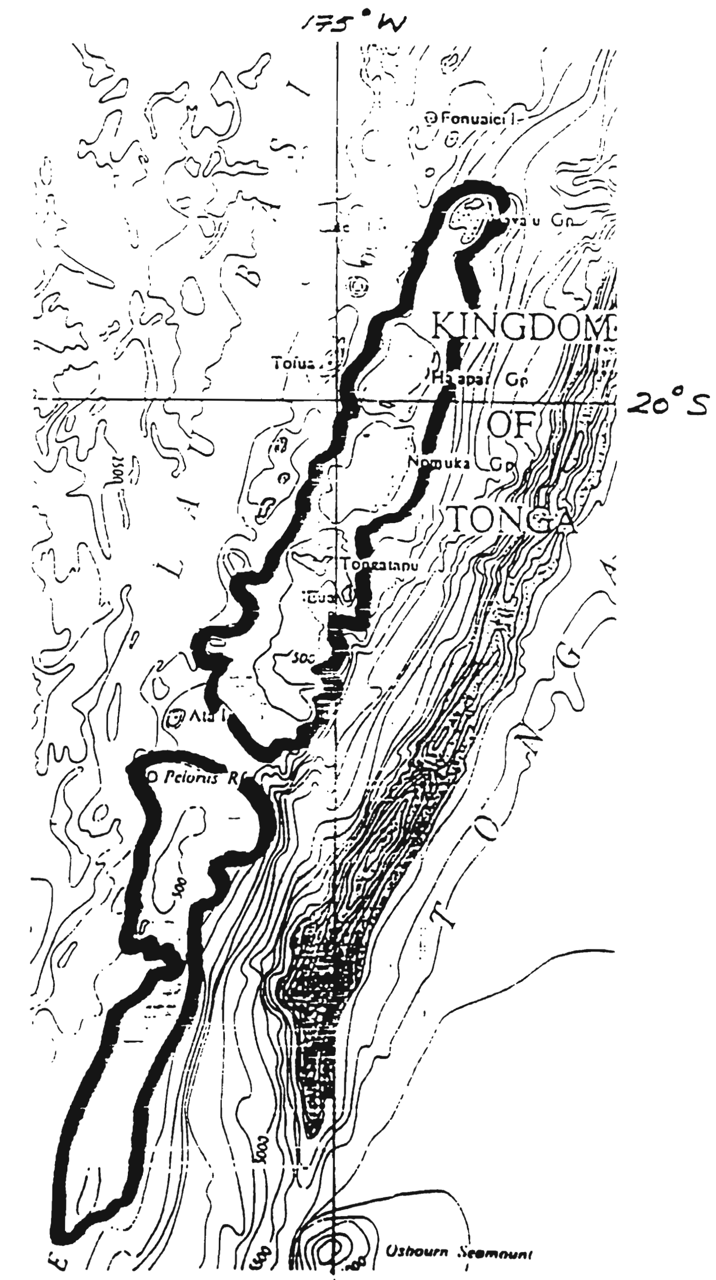
A total of 100 reports have been written by SOPAC detailing the hydrocarbon potential of the region and advising member countries on the related issues.

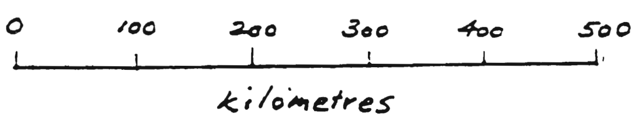
SOPAC has established a central database archive containing all relevant data for the region. This centralised system means that data can be efficiently disseminated to the member country governments and potential oil industry investors. Concerted efforts have been made for further data retrieval. It is often more efficient to retrieve data from oil











OPAC HYDROCARBON PROGRAMME

denotes potential area for four member countries

Areas requiring acquisition of additional regional geological and geophysical data for evaluation of hydrocarbon potential.

companies on a regional basis, since most of the oil companies have acquired the data in several countries. This data add significantly to ongoing evaluation. (See map denotes regional setting of hydrocarbon projects)

16) CONCLUSIONS

1. The Hydrocarbon Programme of SOPAC has promoted and it will continue to promote the hydrocarbon potential of the region to the oil industry with the aim of attracting investment from major oil companies. It is a dynamic, scientific evolution using the latest state-of-the-art technology.

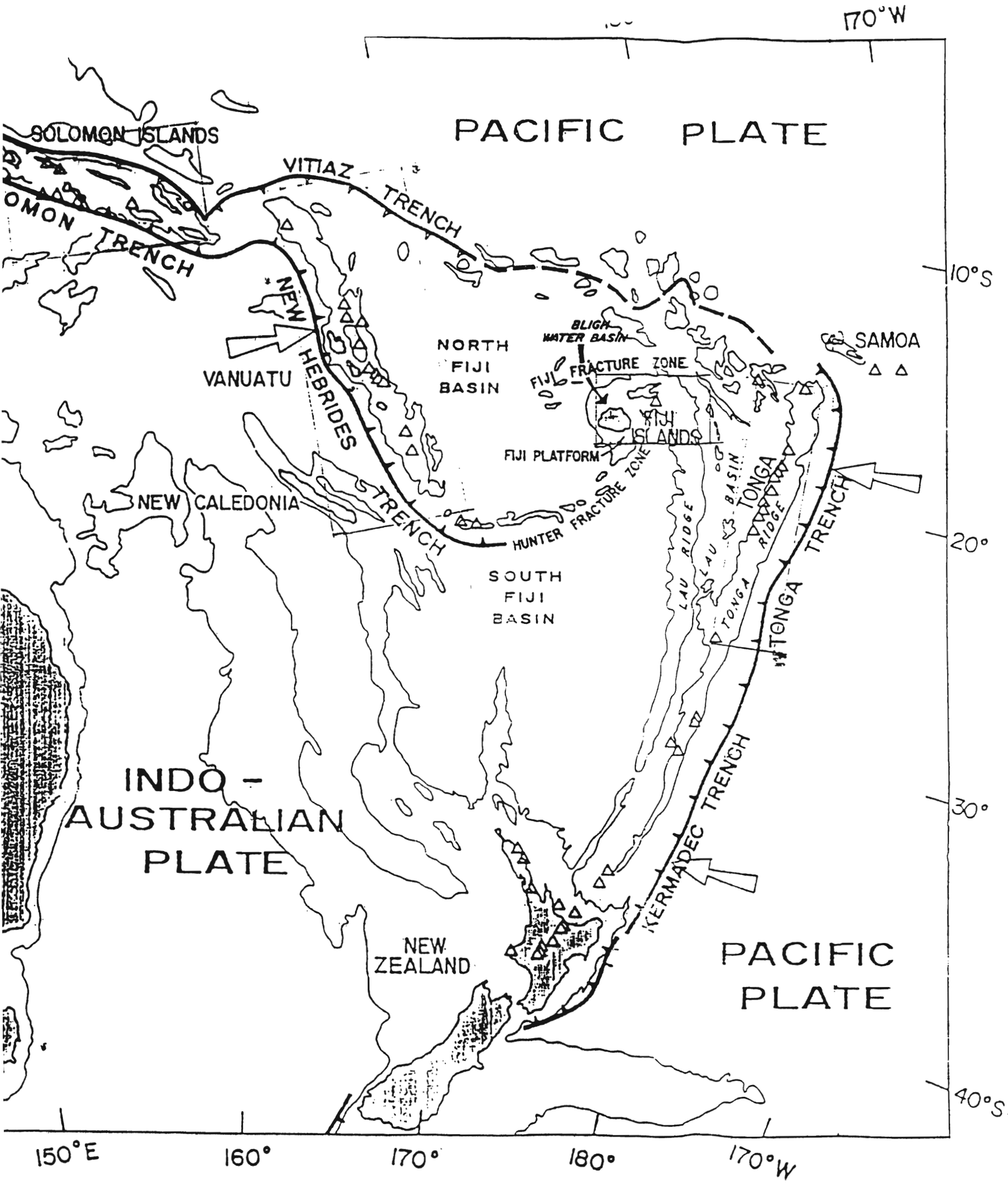
2. Since SOPAC work on hydrocarbon commenced in 1974, a total of 7 exploration licences have been signed with oil companies in member countries.

3. The Hydrocarbon Programme continually builds on the region's hydrocarbon potential by applying new state-of-the-art technology and geological concepts to seismic acquisition, processing and evaluations.

4. The Hydrocarbon Programme draws on experience gained in the region to assist individual member countries. This is a major benefit in key areas such as developing the hydrocarbon potential, assisting in the drafting of new petroleum legislation and establishing a central database archive.

5. Future work required by the member countries is determined by their hydrocarbon potential, which in turn is largely dependent on the amount of the seismic data available:

   - Fiji and Tonga have sufficient seismic data and good hydrocarbon prospects have been established. Future work should therefore concentrate on promoting these to the oil industry.



SOPAC HYDROCARBON PROGRAMME

Regional setting of hydrocarbon projects

- Solomon Islands and Vanuatu lack sufficient seismic data to properly assess their hydrocarbon potential. Future work should therefore concentrate on acquiring, processing and interpreting more seismic data.

- Papua New Guinea already has commercial oil and gas discoveries and so requires work in the support areas: training national staff and developing data management facilities. The hydrocarbon potential of offshore basins should be promoted to the oil industry.

17) RECOMMENDATIONS

1) It is strongly recommended that SOPAC Hydrocarbon Programme should continue on for the future as one of The Top Priorities of SOPAC's work programme.

2) Staffing of the Hydrocarbon Programme should be maintained at the present level of two or increased (note that an estimated 60 man months of work has been requested by member countries for 1992):

   - Two permanent professional staff at SOPAC Techsec with extensive experience in exploration with oil companies.

   - One SOPAC Data Manager at the SOPAC Petroleum Data Bank at Canberra.

   - Additional consultants should be employed when necessary in short periods from time to time.

3) There should be a strong management commitment to a high profile for the Hydrocarbon Programme in the organisation of SOPAC Tehcsec.

4) A high level financial and in-kind support from donors must be earmarked and required with an estimated budget of FS8,000,000 over the next five years.

5) The Key Hydrocarbon Work Programme over the next five years is :

- Fiji and Tonga: Promotion targeting major oil companies. Promotional tours to American, European and Australian oil companies and their financing banks, to present the hydrocarbon potential and legal/fiscal framework for investment to senior management. Continue presenting talks at international oil industry conferences and publications in oil industry journals.

- Solomon Islands and Vanuatu: Acquire more seismic data to develop the hydrocarbon potential. Seismic acquisition surveys should be carried out in the most prospective shallow water areas and the data interpreted.

- Papua New Guinea: Developing the support areas. Continue to provide training for nationals and improve the data management facilities. Promote the hydrocarbon potential of offshore basins.

Crude Footnote Analogy by the Author

The author would like to bring to the attention of the members of the Governing Council the following, "There is a bottle of milk at your doorstep in early morning and the owner of the milk bottle would like to know which cow] 9Xthilk in the bottle was milked from. Upon investigation the dairy farmer identified the cow and the grass paddock where the cow grazed. Similarly, oil seepages (milk) have been discovered in Tonga as well as source rocks (grazing grass- hydrocarbon) have also been discovered in Fiji and Vanuatu. If the milk is there where is the oil?"