

ling is being undertaken in the tertiary sediments of the Pohang area, on the east-west, to evaluate the potentialities for natural gas of which small quantities had been produced from a well from a depth of about 400 metres. Subsurface ecologic data obtained from this drilling programme would have a bearing also on the offshore potentialities of the adjoining area of shallow marine shelf.

Regional geology and offshore prospects for minerals in the Republic of Vietnam

Interest in the offshore prospects for minerals, including petroleum, in the Republic of Vietnam is rather new. Some attention has been given to the mineral content of beach sands, but very little has been done regarding oil and gas possibilities.

The parcels and sparsely islands are rich in phosphate deposits, but they are not truly offshore resources, as they are found on islands. There are no indications of possible phosphate deposits in the Gulf of Thailand. Gluconite has been found in small quantities in the sediments of the Gulf.

The possibility of marine placer deposits occurring in the east coast of Vietnam cannot be ruled out. From the distribution of terrestrial placers, central Vietnam (Da-Nang area) would be more favourable for tin and wolfram.

Showings of oil have been reported from many places on the Indo-China Peninsula, mainly in the Permian limestones of the "Indosimides" series, and in the "upper sand stone series" (Da Nang, Laos).

The picture of mineral and hydrocarbon potential in the offshore area of Vietnam, does not look very optimistic, the only area which seems to have rather good oil and/or gas prospects lies under fairly deep water, and the economic feasibility of development would be questionable with present marine techniques. These conclusions are based only on a

highly hypothetical interpretation of scattered work, so, they may well be false, but the recommendation for acting cautiously and progressively in the field of exploration will still hold true.

The potential Offshore Geothermal Areas of Indonesia

Offshore exploratory activities in Indonesia have so far resulted in two discoveries, one to the north of West Java in the Java Sea and to the north-east of North Sumatra in Malacca Straits, of these the former has proved to be commercial. The latter, however, has been not possible due to technical problems.

In the eastern part of Indonesia, oil has been produced in West Irian. Interest is now being displayed also in the offshore area to the west of the Barisan Mountains of Sumatra, which forms the foredeep of the Barisan Zone on the Indian ocean side, the backdeep being on the continental (eastern) side where the productive Sumatra basins are now situated. Sedimentary deposits with some indications of hydrocarbons have been reported on the island of Nias and on the west coast of Sumatra at Bengkulu.

The future outlook for oil and gas production in Indonesia will depend in part on successful discoveries of new oil in the offshore contract areas. By the end of 1972, the overall oil production in Indonesia may be expected to increase from its present level of 825,000 barrels per day to more than 1 million barrels per day, to which oil production from offshore areas is expected to make an important contribution.

Negotiations are now under way between the Ministry of Mines and Ocean Mining Inc. of U.S.A. to explore offshore areas west and south-west of Sumatra, south-west and south-east of Kalimantan and west and east of Southeastern Sulawesi for various minerals including gold, platinum, tin, zircon, diamond, and phosphosite. This offshore exploration will extend over ten separate areas, covering approximately

20,000 square miles. The exploration programme will involve extensive geophysical work, drilling and sampling. In the event that positive results are obtained from these exploration surveys, Ocean Mining Inc. will join an exclusive contractorship to mine the deposits.

In conclusion, it can be stated that with the recent opening of Indonesia's offshore areas for mineral, oil and gas exploration by private foreign companies it can be expected that in the near future a lot more will become known about Indonesia's offshore mineral potentialities. Knowledge and experience obtained during these large scale offshore exploration activities will undoubtedly be of great value to future exploration efforts in other offshore areas of the western part of the Pacific Region.

Detrital Heavy Mineral Deposits in East Asia

The exploration of offshore deposits of detrital heavy minerals in East Asia is still in its infancy. However, realising the growing awareness of the potential value of detrital heavy minerals in the ECAFE region, the CCOP at its Sixth Session endorsed the recommendation of its Technical Advisory Group to investigate the prospects for commercial accumulations of detrital heavy minerals in the near shore areas of the marine shelves of eastern Asia. As a preliminary step, the organisations concerned in the member countries prepared review of status of investigation and operations in this field in their respective countries. It was clear from these reviews that apart from the production of tin and associated minerals from near shore areas in Southern Asia, little had been done elsewhere in this field although extraction of detrital heavy minerals from beach sands had been undertaken on a small scale in some of the member countries for such minerals as monazite, ilmenite, xenotime and zircon. However, the recent survey, conducted with the assistance of experts provided by the Australian Government, has led to some encouraging assessment of the potential value of detri-

tal heavy minerals in this part of the world. A brief summary of the country-wise report is given below.

INDONESIA

Excluding cassiterite, the detrital heavy minerals found in the beach sands of Indonesia have previously been shown to be important only in Java, although more recently an extension of the deposits has been traced to Bali. Much of the Indonesian coastline still remains to be explored and there may be good reasons to search for titaniferous iron sand deposits along such places as the coastline of West Irian. This report also includes a brief discussion of the by product minerals produced with tin ore on the Islands of Banka, Belitung and Singkep.

The main difficulties connected with future exploration and evaluation stem from lack of experience and a limited budget. The current staff shortage could be readily overcome as many of the operations can be supervised by intelligent laymen, if properly trained. The technical personnel associated with this work appear to be well trained in basic principles and should respond quickly to training in modern exploration, mining and mineral processing techniques.

REPUBLIC OF KOREA

The placer deposits of southern Korea are of two general types, beach placers and fluvial placers. Valuable minerals in the beach placers are predominantly magnetite and ilmenite in the north, and monazite and zircon on the central western coast. The wide-spread fluvial placers may contain significant quantities of gold and monazite and recoverable concentrations of other minerals such as fergusonite and cinnabar may also be present.

Although conditions are generally favourable for the establishment of a small beach mining industry, the existing data are insufficient for a final evaluation. Investigations should be aimed at establishing projects with sufficient proved reserves for a minimum operating period of ten years at the

scale of mining selected. The economic study should include the cost of hauling concentrates from the various deposits to a central separation plant. This may prove to be a critical factor in the evaluation.

The development of placer mining in Korea will require larger resources of personnel, equipment and funds than are available locally and some early aid may be needed; an immediate requirement is adequate supplies of bromoform or tetrabromoethane for testing the heavy mineral contents of samples; the latter is cheaper than bromoform and is equally effective. Consideration might also be given to inviting foreign mining companies to co-operate in joint ventures with Government agencies and private Korean companies.

WEST MALAYSIA

Detrital heavy minerals are distributed widely in West Malaysia and concentrations may be found wherever drainage patterns have developed in and adjacent to the granite and contact metamorphic areas. The minerals of greatest economic interest are cassiterite, gold, wolfram, ilmenite, rutile, zircon, monazite, xenotime and columbite.

Cassiterite has been mined for more than a century and has played a major part in the economic development of the country. However, the residues from tin dressing operations, known locally as "amang", have been largely neglected until recent years when expanding markets for zircon, titanium and the rare earth elements have drawn attention to their potential value as by-product minerals. A number of small operations now produce a total of about 120,000 tons of ilmenite annually and lesser quantities of the other minerals.

PHILIPPINES

Detrital magnetite from beach sands in Luzon is finding a profitable market in Japan because of its relatively favourable titanium content (up to 7 per cent); current exports to

Japan are at the rate of about 600,000 tons annually. The concentrates from Luzon are blended with magnetite extracted from beach sands in Japan which has an average of about 53 to 59 per cent of Fe and 8 to 12 per cent of TiO₂; pig iron for production of high quality steel is produced from the mixed ores by electric arc smelting. The operating companies, which now have assured markets for their output, should consider revising their operational methods and modernizing their plants; provided that sound basic principles are applied, both output and profits could be substantially increased. Many other similar deposits are present in the Philippines but few have yet been thoroughly investigated; some of these could have prospects for producing heavy minerals other than magnetite, as in the case of beach sands in northwestern Palawan Island which contains substantial percentages of ilmenite.

THAILAND

Reconnaissance sampling has revealed the presence of a number of large low grade tin placers along the beaches of southwestern Thailand and along the coast of Phuket Island. The most important deposits are located on the beaches of Mai Khao, Thai Muang, Takua Pa (Phang Nga) and Ko Kho Khao. Some small placers on other beaches may eventually prove to be suitable for mobile plant operation. Cassiterite is the principal mineral of value and, although small amounts of zircon, rutile, ilmenite and Nb-Ta minerals are present, only the tin and Nb-Ta minerals would significantly affect the valuation of the deposits in these areas.

(vi) NOTE ON MINERAL POTENTIALS
(Prepared by A.A.L.C.C. Secretariat)

A. Possible Impact of Sea-Bed Mineral Production in the area beyond National Jurisdiction on world markets, with special reference to the problems of Developing Countries : A Preliminary Assessment.¹

Interest in the offshore prospects for the minerals from the sea-bed is rather new. However, from the available geological evidence it is safe to speculate that eventually deep sea exploitation of minerals would not only be possible, but also commercially feasible. Some of the important minerals that might be exploited from the sea-bed are petroleum, manganese, copper, nickel and cobalt. Among them, the exploration of petroleum has achieved a great success in many parts of the world.

Since the last decade consumption of petroleum has been rising at an overall rate of approximately 8 per cent per annum. Today petroleum is the largest single item in the world trade both in terms of value and volume of trade.

According to an estimation prepared by the *Institute Francais du petrole* petroleum resources of the world are abundant and quite sufficient to meet the demand upto the year 2000. The estimation of proved, probable and possible reserves in the major region is presented in the following two tables :

1. This summary has been prepared from the Report of the Secretary-General submitted to the Committee on the Peaceful uses of the Sea-Bed and the Ocean Floor beyond the Limits of National Jurisdiction, Document A/AC. 138/36 of 28 May, 1971.

TABLE—1
Petroleum demand forecast 1970-2000*

Year	Consumption in millions of barrel per day	Average annual growth rate	Share of petroleum in total consumption of energy
1970	46		47
1980	90	7	57
1990	154	5.5	65
2000	208	3	59

TABLE—2
Petroleum reserves as at 1 January 1969*

Region	Proved Reserves	Probable Reserves	Possible Reserves
North America (including Alaska and Arctic)	56,000	45,000	200,000
Central America, the Caribbean and Mexico	6,300	7,200	35,000
South America	23,000	17,500	80,000
<i>Total American Continent</i>	85,300	69,700	315,000
North Africa	40,700	16,700	37,000
Rest of Africa	6,000	24,200	95,000
<i>Total African Continent</i>	46,700	48,900	132,000
Middle East	300,000	246,000	305,000
Asia & Oceania	14,200	18,300	120,000
Western Europe	1,800	900	35,000
USSR and rest of Socialist block	42,000	41,300	155,000
TOTAL :	490,000	425,100	1,062,000

Source : *Institut Francais du petrole*.

* On shore reserves and off-shore reserves. Under less than 200 metres of water.

In this connection it has been pointed out that offshore petroleum production is increasing at a much faster rate than on-shore. For instance, the off-shore production in 1970 accounted for 18.5 per cent of the total world production and it is expected that by 1980 this contribution will rise upto 32.5 per cent.

Importance of Petroleum production for Developing Countries.

Petroleum plays an important role in the economy of many developing countries. The major developing countries exporting petroleum are : the countries bordering the Persian Gulf, Libya, Algeria, Nigeria, Venezuela, Indonesia and Gabon. In eight of these countries : Libya, Kuwait, Iran, Iraq, Algeria, Saudi Arabia, Venezuela and Gabon, the value of petroleum exports accounted for more than 50 per cent of their total export earnings and contributed as much as 20 per cent of their gross domestic products. The following table indicates this more clearly :

Crude petroleum¹ exports of selected developing countries as a percentage of total exports and gross domestic product, 1968

Country	Exports in 1968 (Millions \$US)	Value of petroleum as a percentage of	
		Total exports	Gross domestic product
<i>A. Petroleum as major foreign exchange earner (above 10 per cent of total exports)</i>			
Libya ²	1,860.0	99.6	58.4
Kuwait ³	1,590.0	96.8	59.7
Iraq ²	996.0	95.5	35.9
Iran ²	1,686.6	89.7	19.5

1. Crude petroleum (SITC 331)

Data is obtained from IMF-IFS individual countries.

Source : United Nations Statistical Papers, *World Energy Supplies* 1965-68 ; Organisation for Economic Cooperation and Development, Series C, 1968 (January-December), *Commodity by Trade* ; International Monetary Fund, *International Financial Statistics*, April 1971 ; *Monthly Bulletin of Statistics*, March, 1971 ; gross domestic product print-outs in national currency ; Agency for International Development, *Data Year Books*.

Country	Exports in 1968 (Millions \$US)	Value of petroleum as a percentage of	
		Total exports	Gross domestic product
A. <i>Petroleum as major foreign exchange earner</i> (above 10 per cent of total exports)			
Algeria	699.8	84.3	20.8 ³
Saudi Arabia	1,487.3	78.4	43.6
Venezuela	1,973.9	69.1	19.9
Gabon	63.9	51.5	26.8 ⁴
Lebanon ⁵	50.8	34.8	16.9
Indonesia	276.2	33.7	3.8
Tunisia	35.5	22.5	3.3
Nigeria	118.0	20.0	2.9 ⁴
Bolivia	21.1	13.8	2.5
B. <i>Petroleum as important foreign exchange earner</i> (between 3 per cent—10 per cent of total exports)			
Syria	14.1	8.2	1.2
United Arab Republic	51.3	8.2	0.8
Colombia	40.3	7.2	4.4

3. As percentage of gross national product or total exports from AID Yearbook.

4. Using 1967 gross domestic product.

5. Value of petroleum exports as reported by OECD importing countries.

Trinidad and Tobago	29.0	6.2	3.6
Mexico ⁵	40.8	3.2	0.2

C. *Petroleum as minor foreign exchange earner*
(Less than 3 per cent of total exports)

Congo (Brazzaville)	1.0	2.0	...
Peru	12.5	1.4	0.3
Liberia ⁵	2.18	1.3 ³	0.9 ³
Malaysia	8.1	0.6	0.25 ⁶
Uruguay ⁵	0.54	0.3	0.03
Southern Yemen ⁵	0.27	0.2	...
Burma ⁵	1.52	0.13	0.08 ⁴

Solid Minerals

The development in exploitation of off-shore minerals, other than petroleum, has not been so rapid. However, the occurrence of marine nodules and their exploitation in not too distant future is beyond doubt. These marine nodules contain four major metals—manganese, copper, nickel and cobalt. A breakdown of volume and export earnings from these metals in the developing countries is presented in the following four tables :

3. As percentage of gross national product or total exports from AID Yearbook.
4. Using 1967 gross domestic product.
5. Value of petroleum exports as reported by OECD importing countries.
6. Using 1966 gross domestic product.

Manganese exports¹ of developing countries as a percentage of total exports and gross domestic product in developing countries 1969

Country	Export in 1969		Value of manganese exports	
	Thousand metric tons	US dollars (.000)	As a % of total exports	As a % of gross domestic product
A. Manganese as major foreign exchange earner (above 10 per cent of total exports)				
Gabon	1,584	30,095	21.2	12.7 ²
B. Manganese as important foreign exchange earner (between 3 per cent—10 per cent of total exports)				
Ghana	305	9,149	33.04	0.43 ³
C. Manganese as major foreign exchange earner (less than 3 per cent of total exports)				
Democratic Republic of the Congo	272	9,134	1.6	0.63 ³
Brazil	808	25,408	1.10	0.09 ³
India	897	17,619	0.96	0.04 ²
Morocco	73	4,407	0.91	0.14
Guyana	29	501	0.4	0.2 ³
Ivory Coast	82	1,573	0.35	0.12
Trinidad and Tobago	13	487	0.1	0.05 ³
Philippines	31	815	0.08	0.01

Source : Agency for International Development, *Economic Data Book* ; *Bulletin annuel de la statistique de la Rep. Gabon* 1964 and 1970 ; *Monthly Bulletin of Statistics*, March 1971 ; International Monetary Fund, *International Financial Statistics*, April 1971.

1. Manganese ore concentrate (SITC 283.7)
2. 1967 data.
3. 1968 data.