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HYDROCARBON (OIL, GAS, AND COAL) PROSPECT FOR BURMA

by

Keith A. Yenne

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SUMMARY OF FINDINGS

1. Burma's estimated proved reserves on 1/1/82, according to the Oil and Gas Journal, are 28 million barrels of oil and 170 billion cubic feet of gas.

2. The potential for finding new deposits of oil or gas in the prospective petroleum areas of Burma is as follows:

   Chindwin basin - fair to good
   Central basin - excellent
   Irrawaddy basin - excellent
   Arakan coast and offshore area - good
   Gulf of Martaban - good

3. Petroleum exploration and development in Burma is hampered by the unfavorable weather of the monsoon season. Offshore, however, the environment is favorable for low cost production facilities.

4. Any oil or gas field discovered will probably be small. Giant fields (500 million barrels of oil or 3.5 trillion cubic feet of gas) are rare in Southeast Asia.

5. Burma's measured and indicated reserves of hard coal total 42 million long tons: measured and indicated reserves of brown coal total 266 million long tons.

6. Almost all the coal used in Burma is imported. known deposits being high-ash lignite to sub-bituminous in rank.

7. The potential for discovering new deposits of hard coal in Burma is poor: for brown coal the potential is fair.

INTRODUCTION

This report was prepared under RSSA no. INT-USGS 1-80 as a component of technical assistance to countries assisted by the Agency for International Development, U.S. Department of State, in the exploration and development of conventional energy resources.

In 1963 Burma's Revolutionary Council passed the Enterprise Nationalization Law eliminating private industry in Burma. Two years later petroleum exploration, development, and production activities were handed over to the state oil company, Myanma Oil Corporation (MOC). Myanma's record has been relatively good in the short time it has been in existence, considering that the company has had very little foreign assistance and funds have been short.

Transportation of petroleum, however, is another story and Burma's oil industry in recent years has been plagued with transportation and distribution problems. The cause of the problems can be attributed, in large part, to antiquated equipment, lack of funds to repair and replace equipment, and poor planning.

The Burmese government maintains the position that the government is self-sufficient in petroleum; local consumption being limited to the capacity of Burma's refineries. The country has two old refineries, one 20,000 barrel-per-day unit at Syriam, near Rangoon (fig. 1) and another 6,000 barrel-per-day unit at Chaulk oil field. In the past, crude oil production has about kept pace with the two refineries and frequent petroleum shortages have been due mainly to transportation problems. A new refinery, with a 25,000 barrel-per-day capacity, is being constructed at the Mann oil field. With this new refinery on stream, Burma's ability to supply its domestic needs will be determined largely by crude oil output from its own oil fields. At the present time, gas is produced for use only in industry and in gas turbine generating plants.

HISTORY OF PETROLEUM EXPLORATION AND PRODUCTION IN BURMA

Petroleum has been extracted from Yenangyaung oil field for centuries, perhaps as far back as the thirteenth century. By 1797 the petroleum industry

Figure 1. Index map of Burma.

was firmly established at Yenangyang with several hundred hand-dug wells yielding 200 to 400 barrels per day.

Tainsh (1950) reported that in 1949 wells were still being dug to depths of 400 feet or more. The digger wore a helmet similar to a diver's helmet with a supply of air pumped from the surface; light was supplied by reflection of sunlight in a mirror; the sides of the pit were timbered as digging proceeded.

A number of small oil fields have been discovered and exploited in Burma, but most of the oil produced over the years has come from five large fields: Chauk-Lanywa and Yenangyaung, officially listed as discovered in 1902; Myanaung, discovered in 1964; Prome, discovered in 1965; and Mann, discovered in 1970. Among the more prominent oil companies in the development of the Burmese oil industry were the Burmah Oil Company, the Indo-Burma Petroleum Company, the British Burmah Petroleum Company, and the Nath Singh Oil Company.

During World War II the Chauk-Lanywa and Yenangyang oil fields were severely damaged in an effort to prevent access to the oil by the Japanese. The major oil companies began the costly task of repairing the fields after the war, but unfortunately, widespread political unrest in the country interfered with the orderly rehabilitation of the oil industry.

The petroleum industry was nationalized in 1965 and put under the jurisdiction of the national oil company, Myanma Oil Corporation (MOC). Myanma's most important contribution to the economy of Burma was the discovery of the Mann oil field in 1970. Mann reached peak production in 1979 of over 23,000 barrels of oil per day, which was nearly three-quarters of Burma's total production. Mann's production rate is presently declining however, in spite of efforts to stimulate production.

Myanma Oil Corporation began drilling offshore in the Gulf of Martaban in 1972 and by the end of 1974 had drilled 12 wells, all abandoned as dry holes. No information was released on these wells, but it is believed that one, and perhaps two, wells encountered gas that would have been commercial had the wells been located onshore.

In 1974, Myanma took radical departure from its former policy by inviting foreign oil companies to bid on production-sharing service contracts for exploring offshore blocks. Thirteen blocks were awarded to four bidders: Esso (Exxon), Martaban-Cities Service (U.S. consortium), Arakan Oil (Japanese consortium), and Totale (European consortium). The four operators released their offshore holdings in 1977 after drilling a number of dry holes. Totale was reported to have discovered gas in potentially commercial quantities off the Arakan coast but the offshore location made exploitation impractical at that time. MOC again opened bidding on 24 offshore concessions in 1978. Because of the contract terms, oil companies showed little interest in the bidding and no concessions were awarded.

Petroleum exploration onshore has been more successful and Myanma has kept all exploration and development rights for itself. Production has increased 50 percent since 1976, largely due to increased output from the Mann oil field.

Exploratory drilling in 1981 resulted in what appeared to be major discoveries of three oil and gas fields. The Htantabin wildcat, located about 180 miles northwest of Rangoon, discovered light oil and gas in Miocene limestone reservoirs. Kyontani wildcat, located approximately 75 miles west-northwest of Rangoon, also found hydrocarbons in Miocene limestones. Both of the above discoveries are in the Irrawaddy basin. In the Central basin a discovery was made at Pagan-Tuyintaung, located about 15 miles northeast of the Chaulk field. The reservoirs in this field are sandstones (about 300 feet thick) of the Oligocene Shwezetaw Formation.

In recent years Burma has purchased new drilling equipment. This will allow MOC to explore deeper horizons and will quite likely further increase Burma's oil and gas reserves.

GENERAL GEOLOGY

From west to east, Burma can be divided into four physiographic zones (fig. 2):

1. Arakan Coast
2. Arakan Yoma - Chin Hills
3. Central Lowlands
4. Shan Hills

The Arakan Coast, fringing the Bay of Bengal, consists of Upper Cretaceous abyssal sediments, lower Tertiary flysch deposits, and upper Tertiary molasse deposits. The beds are thick and intensely folded and faulted.

East of the Arakan Coast is a mountain range known in the south as the Arakan Yoma and further north as the Chin Hills. The rocks making up the range are mainly dark Eocene shale and sandstone beds with interfolded thin Cretaceous limestones and shales. The latter shales are altered in part to slates and phyllites. On the east side of the range there is a more intensely metamorphosed group of quartzose schists and phyllites of unknown age. The opinion favored by most, however, is that the schists are dynamically metamorphosed Cretaceous and lower Eocene beds. Ophiolites are found at intervals along the entire length of the eastern margin of the range. Folding in the zone is moderate to strong.

The Central Lowlands include the drainage basins of the Chindwin River in the north and the Irrawaddy and Sittang Rivers in the south. The basins cover an area over 60,000 square miles located between the Arakan Yoma - Chin

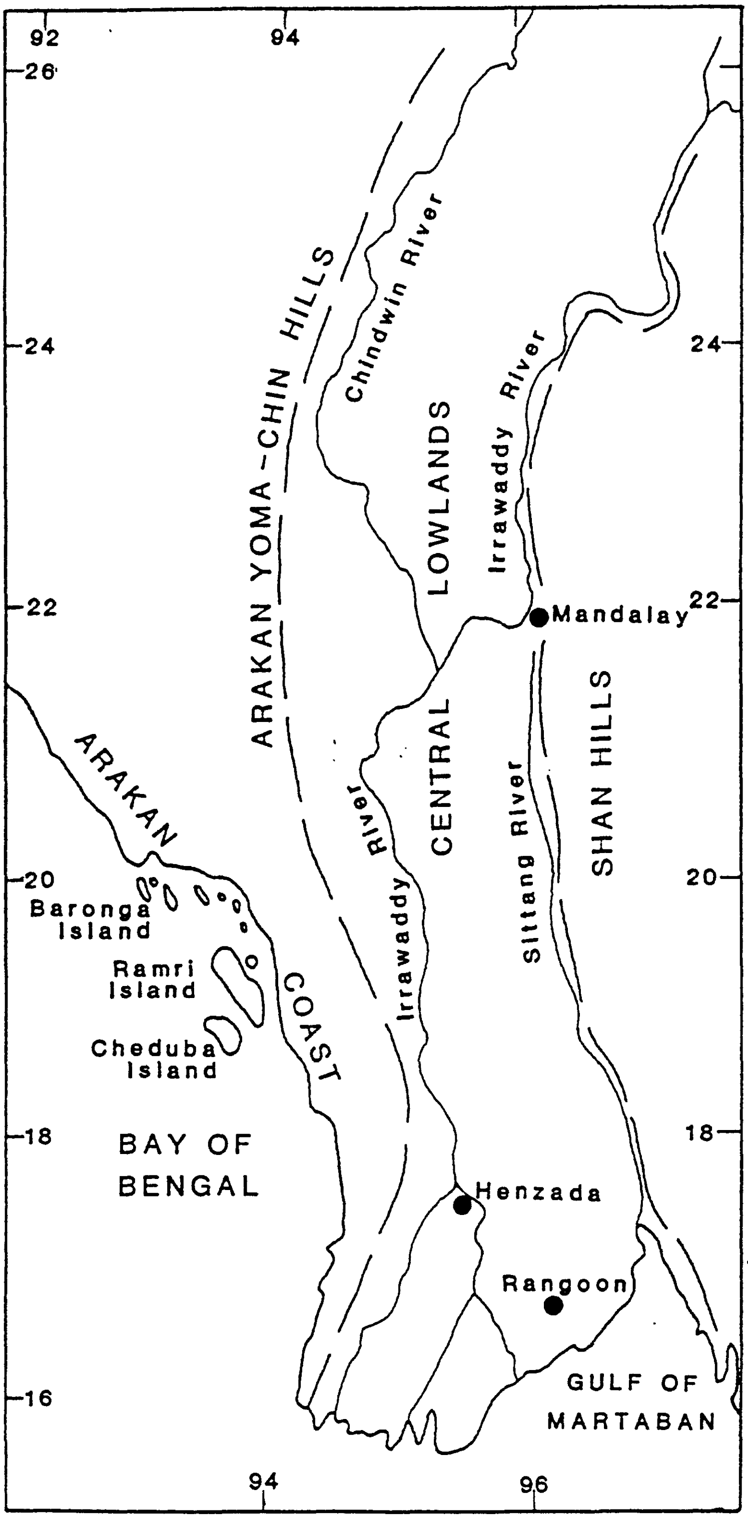

Figure 2. Physiographic zones of Burma. (from Lepper, 1933).

Hills on the west and the Shan Hills on the east. This area is frequently termed the Burma Tertiary basin. Sediments filling the Central Lowlands include sandstone, siltstone, shale, and claystone beds ranging in age from Late Cretaceous to Holocene. They are, for the most part, molasse facies. Minor lenticular limestones occur at a number of horizons. Tertiary intrusive and extrusive volcanic rocks crop out in the northern part of the lowlands and are present in the sub-surface in some areas to the south.

Folding is strong in the area bordering the Arakan Yoma - Chin Hills but diminishes toward the east.

All the major oil and gas fields of Burma are found in this physiographic zone and therefore the geology will be discussed in more detail under the heading, "Petroleum Geology".

The easternmost physiographic zone is the Shan Hills consisting of low moutains or plateaus. The Shan Hills are made up of Precambrian schists, Paleozoic limestones and dolomites, and Jurassic and Cretaceous red beds. Serpentines and marbles of unknown age are also present. These rocks are cut by Late Mesozoic-Tertiary granitic intrusions aligned in a north-south direction. The western boundary of this zone is marked by a major fault system.

The geologic history of Burma is vastly different than that of neighboring India. In Paleozoic time Burma was a part of the supercontinent Laurasia while India was a part of the supercontinent Gondwana. A comparison of Permian rocks in India and Burma illustrates their different origins. In India Permian rocks contain warm water faunas and extensive reef complexes.

In Early Cretaceous time, shortly after or during the epeirogenic uplift of the Shan Hills, compensatory subsidence began to affect large offshore areas of the Burma portion of the Laurasian shelf. During Late Cretaceous time the approaching Indian plate began to deform the subsiding area into a typical geosynclinorium that received terrigenous sedimentation of abyssal facies in the south and flysch facies in the north. At the beginning of the Tertiary an island arc was raised directly to the west of the present position of the Arakan Yoma - Chin Hills, and the flysch sedimentation of the northern areas began to expand southward.

As the result of the collision of the Indian and China plates in Oligocene time, the Arakan Yoma - Chin Hills were raised from this flysch trough and moved against and over the island arc, whereas on both flanks of the new range, molasse basins were formed. Continuing compressional phases, up to Quaternary time, narrowed the bordering basins.

Offshore from Burma in the Gulf of Martaban and further south in the Andaman sea, the major structural elements are parts of an island arc system (fig. 3). To some degree these elements can be traced ashore in Burma. Deep seated earthquake foci onshore attest that a subduction zone is present corresponding to the offshore trench. Volcanoes onshore are aligned with volcanic islands and seamounts offshore. Other elements of the island arc system are not so clear-cut onshore. It is probable that during the Neogene, a fault-fold pattern of wrench tectonics was established over the earlier island arc pattern. As a consequence, the Neogene basins of Burma have a character of their own that is unlike any neighboring basins.

PETROLEUM GEOLOGY

In this report, Burma has been divided into three areas with proven or potential hydrocarbon resources.

1. The Central Lowlands (proven)
2. Arakan coast and offshore area (potential)
3. Gulf of Martaban offshore area (potential)

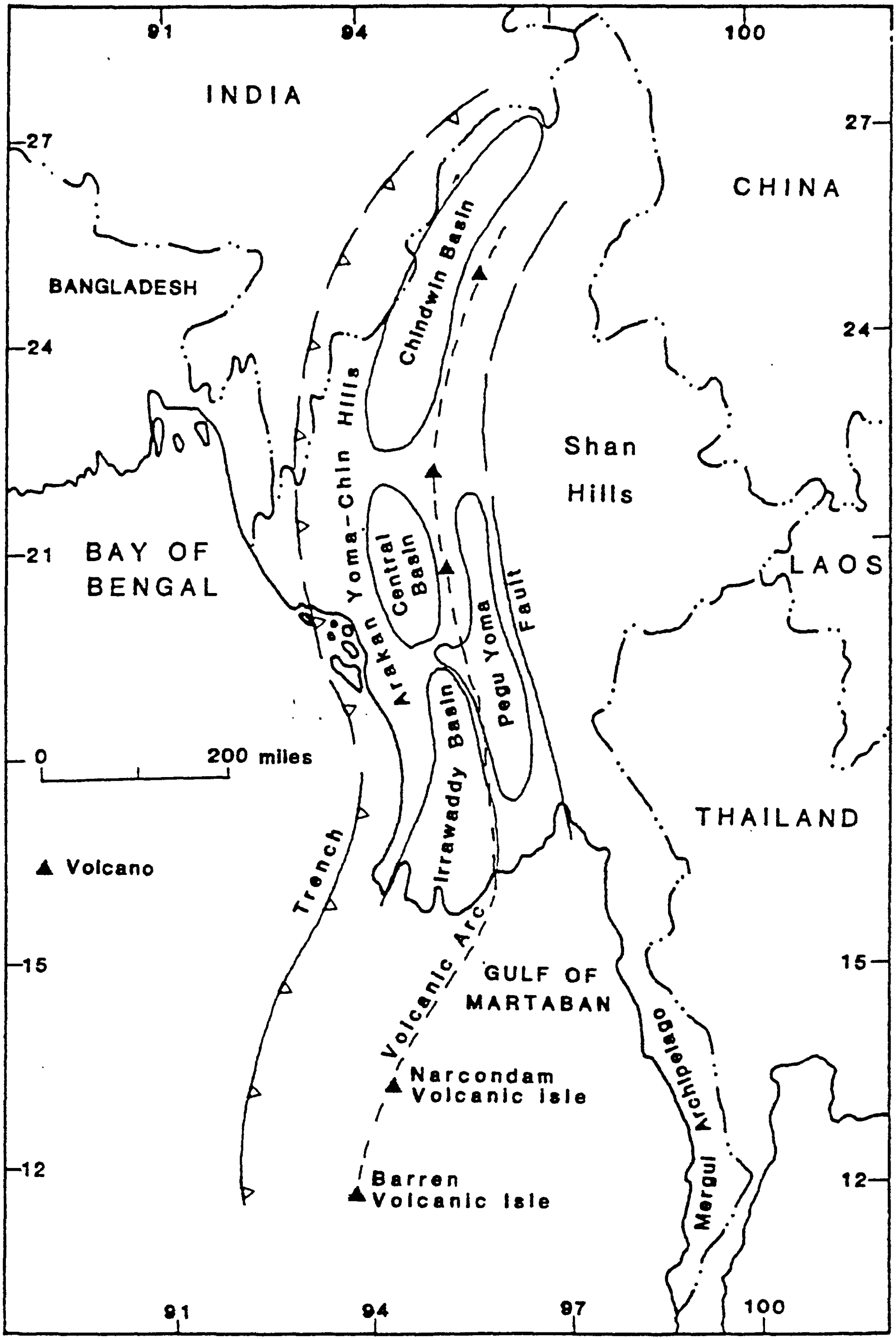

Figure 3. Principal structural features of Burma. (After Paul and Lian, 1975).

Central Lowlands

The major oil fields of Burma are found in the Central Lowlands in the broad median valleys of the Chindwin and Irrawaddy Rivers (fig. 4). Although the eastern boundary of the Central Lowlands is formed by the pre-Tertiary massif of the Shan Hills, the eastern portion of the lowlands south of Mandalay is separated from the Irrawaddy valley by a long belt of hills known as the Pegu Yoma (fig. 3). The high ground of the Pegu Yoma marks an uplift of intensely deformed Tertiary rocks with some basaltic intrusions.

North of Mandalay the area of the divide between the Chindwin and Irrawaddy Rivers is superficial Tertiary and Quaternary sedimentation on an uplifted basement surface.

Within the Central Lowland there are three sedimentary basins separated by arches (fig. 3). These basins, from north to south, are the Chindwin, Central, and Irrawaddy. The basins are elongated in a general north-south direction along the western side of the Central Lowlands.

A prominent feature of the lowlands is a number of extinct volcanoes that are aligned approximately north-south along the eastern borders of the sedimentary basins. These volcanoes are part of the volcanic arc that is represented by volcanic islands and seamounts offshore (fig. 3).

The Tertiary stratigraphy of the Central Lowlands is summarized in figure 5. Brunnschweiler (1974) has catagorized the Upper Cretaceous through Eocene rocks as flysch, and post-Eocene rocks as molasse. The Pegu Group, which contains the hydrocarbon reservoirs, is predominantly marine with deltaic and fluvial intervals. In the Central and Irrawaddy basins, Pegu and Eocene rocks consist of alternating successions of sandstones and shales or claystones, with lesser amounts of grits, conglomerates, and limestones. Locally there are deltaic and fluviatile sandstones and shales with lignites, coal beds, and fossil wood. The Pegu Group generally becomes more sandy and less marine northward.

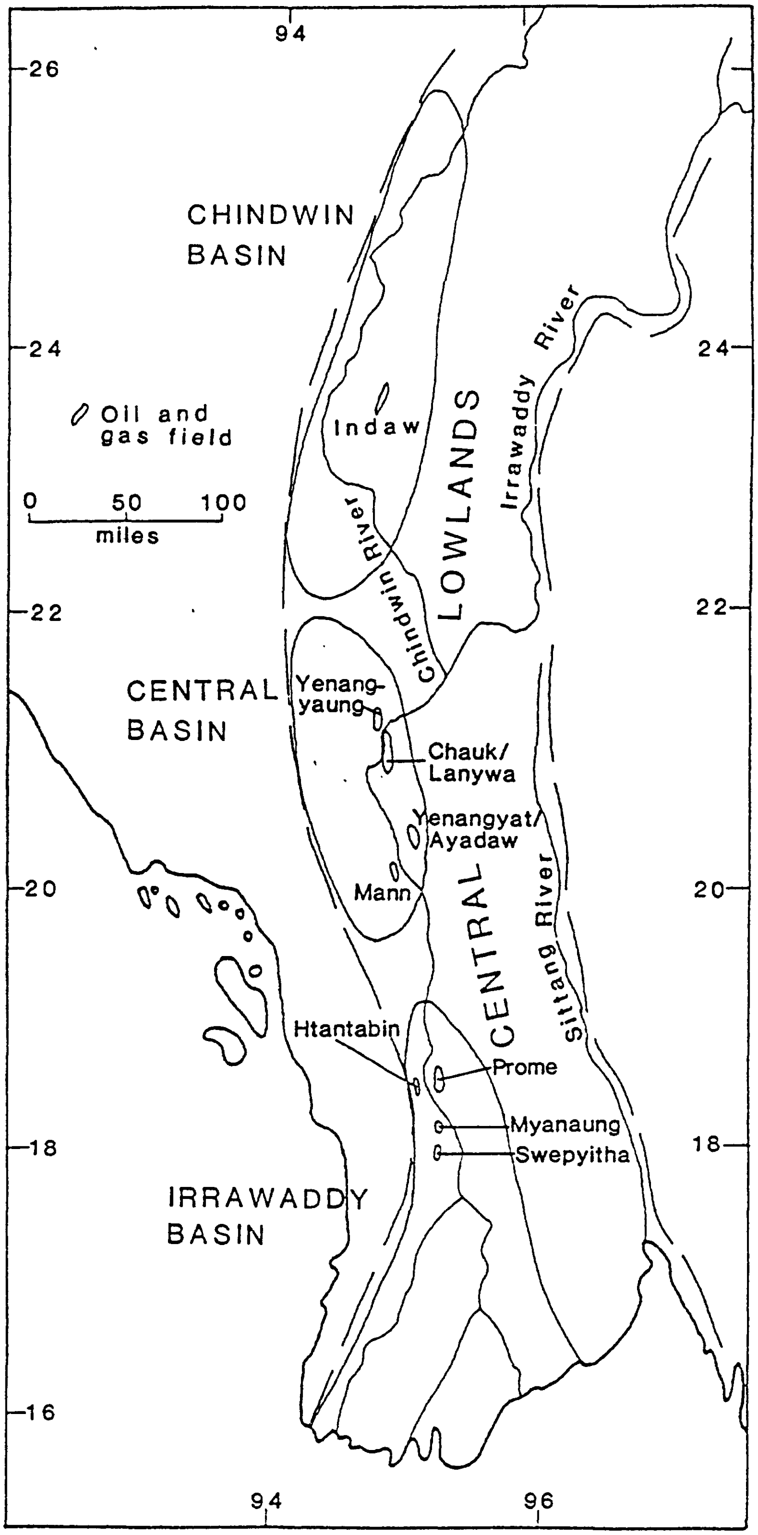

Figure 4. Principal oil and gas fields of Burma. (after Lepper, 1933).

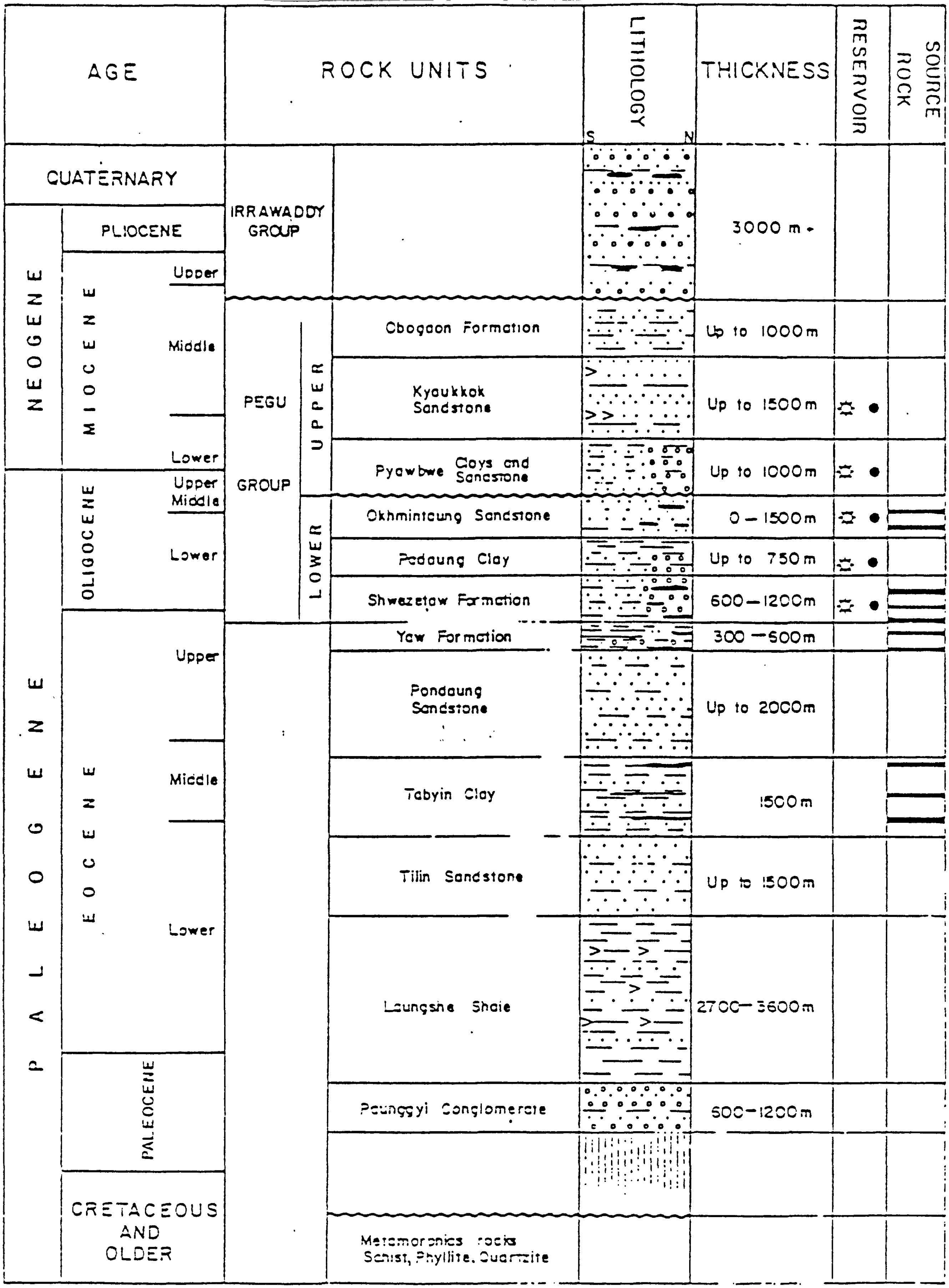

Figure 5. Stratigraphic sequence of the Tertiary Burma basin.

North of Latitude 22 degrees North, in the Chindwin basin, the Pegu and Eocene rocks are, for the most part, fresh water massive sandstones, grits, conglomerates, and mottled claystones.

The upper Miocene-Pliocene Irrawaddy Group consists of a thick succession of fluviatile conglomerates, grits, and ferruginous sandstones with subordinate claystones. Concretions are common in this part of the section.

Over a wide area in central and southern Burma the contact between the Irrawaddy and Pegu Groups is unconformable and commonly is marked by a prominent red bed consisting of white quartz and other pebbles in a ferruginous, lateritic matrix.

The general trend of folds, as would be expected in the basins of the Central Lowlands, is approximately north-south, parallel to the trend of the Arakan Yoma - Chin Hills. Many of the folds are tight, asymmetrical, faulted, and overthrust toward the east. The intervening synclines, however, are broad, commonly flat bottomed, and unfaulted.

Evidences of hydrocarbons have been found in most all the Tertiary formations of the Central and Chindwin basins. Commercial production to date has come, for the most part, from the Central basin. Indaw, an oil field of large area but limited productivity, was discovered a number of years ago in the Chindwin basin, and recently a gas discovery was reported near the town of Chindwin.

Four oil and gas fields are producing in the northern part of the Irrawaddy basin, and recently in this area, oil and gas were found for the first time in Miocene limestone reservoirs. New discoveries also have been made in the central and southern parts of the basin. These new discoveries are being evaluated and have not yet been put on production.

The eight major producing oil and gas fields of Burma are given in table 1. Production rates have been declining at Chauk, Yenangyaung, Prome and Myanaung oil fields in spite of MOC's efforts to maintain a steady level of production. However, the decline in production in the Yenangyaung oil field was arrested by the introduction of gas lift and water injection systems. MOC's development of the Mann oil field, which went on full production in 1979, has been the principle reason for Burma's more or less steady oil production rate. The Mann oil field produced 75 percent of the oil in Burma in 1981.

The major oil fields are located on a north-south trend near the Irrawaddy River in the Central basin of Burma. The best known of these is the Yenangyaung oil field located on a dome 25 miles long and 6 miles wide. The field is only slightly asymmetrical with dips up to 40 degrees on the east flank and 50 degrees on the west flank. On this structure 4,000 plus wells have been completed, producing from more than 50 sandstone reservoirs that range in thickness from 10 to 150 feet. The reservoirs are found from the surface to depths of 5,500 feet.

Porosities and permeabilities of the reservoirs vary, but maximum porosities of 25 percent and maximum permeabilities of 200 millidarcies have been measured. Reservoir pressures to a depth of 5,000 feet are equal to hydrostatic pressure. In the central part of the field, however, at depths below 5,000 feet the reservoirs are over-pressured and the pressure gradient is equal to one pound per square inch per foot of depth below the surface. The high pressure reservoirs are water bearing only.

Initial production per well has ranged from 0.5 to 1,000 barrels of oil per day and some wells have produced for more than 50 years. The crude oil has a paraffin base and a high-wax content. There are no gas caps on the shallow

Table 1.

BURMA

CRUDE OIL AND NATURAL GAS PRODUCTION 1975-1981

	CRUDE OIL (million bbls.)	NATURAL GAS (MMCF)
1975	6.48	7,300
1976	8.18	8,900
1977	8.99	8,910
1978	10.03	9,890
1979	10.82	12,030
1980	9.32	20,016
1981	8.26	20,372

1981 PRODUCTION BY FIELDS

	BBLS. OF OIL	MILLION CUBIC FEET OF GAS
Mann/Htankshabin	6,387,865	4,380
Yenangyaung	730,000	365
Chauk/Lanywa	273,750	4,380
Yenangyat/Ayadaw	91,250	4,380
Prome	334,705	1,825
Myanaung	243,455	365
Shwepyitha	121,545	4,380
Htantabin	584	297
Others	60,225	---

From: Petroconsultants

and intermediate depth reservoirs. Flowing wells get their energy from a dissolved gas drive or from gravitational flow.

Because of the large number of individual, lenticular, sandstone reservoirs, it has been difficult to apply secondary recovery methods to the field. Gas injection has been tried over the years but the results have been questionable.

Inasmuch as petroleum is known to be present and there are many untested structures in the basin, the potential for discovering new deposits of oil or gas in the Central basin is excellent.

Potential petroleum-bearing structures in the Irrawaddy basin south of Henzada are concealed beneath the surficial deposits of the Irrawaddy delta. Locating favorable drill sties, therefore, depends upon costly and time consuming geophysical surveys, which explains why the surface structures of the Central basin have been exploited for a number of years whereas the Irrawaddy basin is just beginning to be developed. Two gas discoveries have been made near Rangoon and several oil and gas discoveries have been made in the northern part of the basin. Additional drilling is being done to evaluate these potential oil and gas fields.

The potential for discovering new deposits of oil or gas in the Irrawaddy basin is excellent.

Except for the Indaw oil field and a potential gas well recently discovered, petroleum exploration in the Chindwin basin has been unsuccessful. One possible explanation is that the Tertiary sediments in the basin are mostly non-marine and source beds of petroleum in the Central basin may be entirely marine. Whatever the reason, the potential for finding new deposits of oil or gas is only fair in the northern half of the Chindwin basin and fair to good in the southern half.

There is very little published information regarding the structural geology of the Pegu Yoma. Tainsh (1953) states that the Pegu Yoma is, for the most part an anticlinorium of tightly packed folds of small amplitude, intersected by cross faults, and exposing no great thickness of Miocene rocks. Some of the folds of the Pegu Yoma have been tested by shallow wells. All tests were abandoned as dry holes, though a few oil and gas "shows" were encountered during the drilling. Because the rocks have been intensely deformed and the Tertiary section is believed to be thin, the potential for finding new deposits of petroleum in the Pegu Yoma is poor.

Arakan coast and offshore area

Interest in the petroleum potential of the Arakan coastal area has existed for many years because of the well known oil and gas seeps on several of the islands along the Arakan coast. On Cheduba Island (fig. 2) the oil occurs in very compressed folds and is associated with mud volcanoes, some of which are subject to sudden eruptions of gas and mud. On Ramri and Baronga Islands (fig. 2) oil occurs in narrow faulted folds. Shallow wells, hand dug on these islands, have produced minuscule amounts of oil over the years. The oil seeps are believed to be in rocks of Eocene age.

During 1979 and 1980 five tests were drilled on Ramri Island on the so-called Yenandaung structure. These wells tested 5 to 30 barrels of oil per day from Miocene clastic rocks at depths of 4,600 to 5,250 feet. Two other structures on the island, Kyaukpyu and Ledaung, are being explored at the present time.

North of the islands along the Arakan coast, oil and gas seeps are less numerous but nevertheless present. At the Bangladesh border several anticlinal trends are present which continue into Bangladesh. Some of these trends have proven productive of gas in Bangladesh, but none of the trends have been tested on the Burmese side of the border.

The stratigraphic section of the Arakan coastal area ranges from abyssal Upper Cretaceous sediments plus ophiolites and tuffs at the base, through Paleogene flysch and molasse, to Neogene molasse at the top (Brunnschweiler, 1974). Estimated thicknesses of these rocks are: Cretaceous 3,000 feet, Paleogene 33,000 feet, Neogene 13,000 feet.

Offshore along the southern half of the Arakan coast, the shelf with water depths less than 200 meters is quite narrow, but the northern half of the shelf is wider and the area accessible for petroleum exploration is more extensive.

One wildcat has been drilled off the southern tip of the Arakan coast and six have been drilled off the northern Arakan coast in the vicinity of Cheduba, Ramri, and Baronga Islands (fig. 6). One of the six tests, drilled by a consortium operated by Cie. Francaise des Petroles, struck gas in potentially commercial quantities but the location made exploitation impractical at that time.

The potential for discovering new deposits of oil or gas in the Arakan coast or offshore area is good.

Gulf of Martaban offshore area

This area includes the waters of the Gulf of Martaban and waters to the south in the Andaman Sea bordering the Mergui Archipelago.

A number of wells have been drilled in the Gulf of Martaban (fig. 6) but very little has been published concerning the geology of the area. Wells drilled in the eastern part of the Gulf of Martaban reached total depths between 13,000 and 14,000 feet. Inasmuch as the principle oil and gas reservoirs of Burma are the Pegu Group of Oligocene and Miocene age, it is assumed that in most wildcats the entire Pegu Group was penetrated before drilling was abandoned.

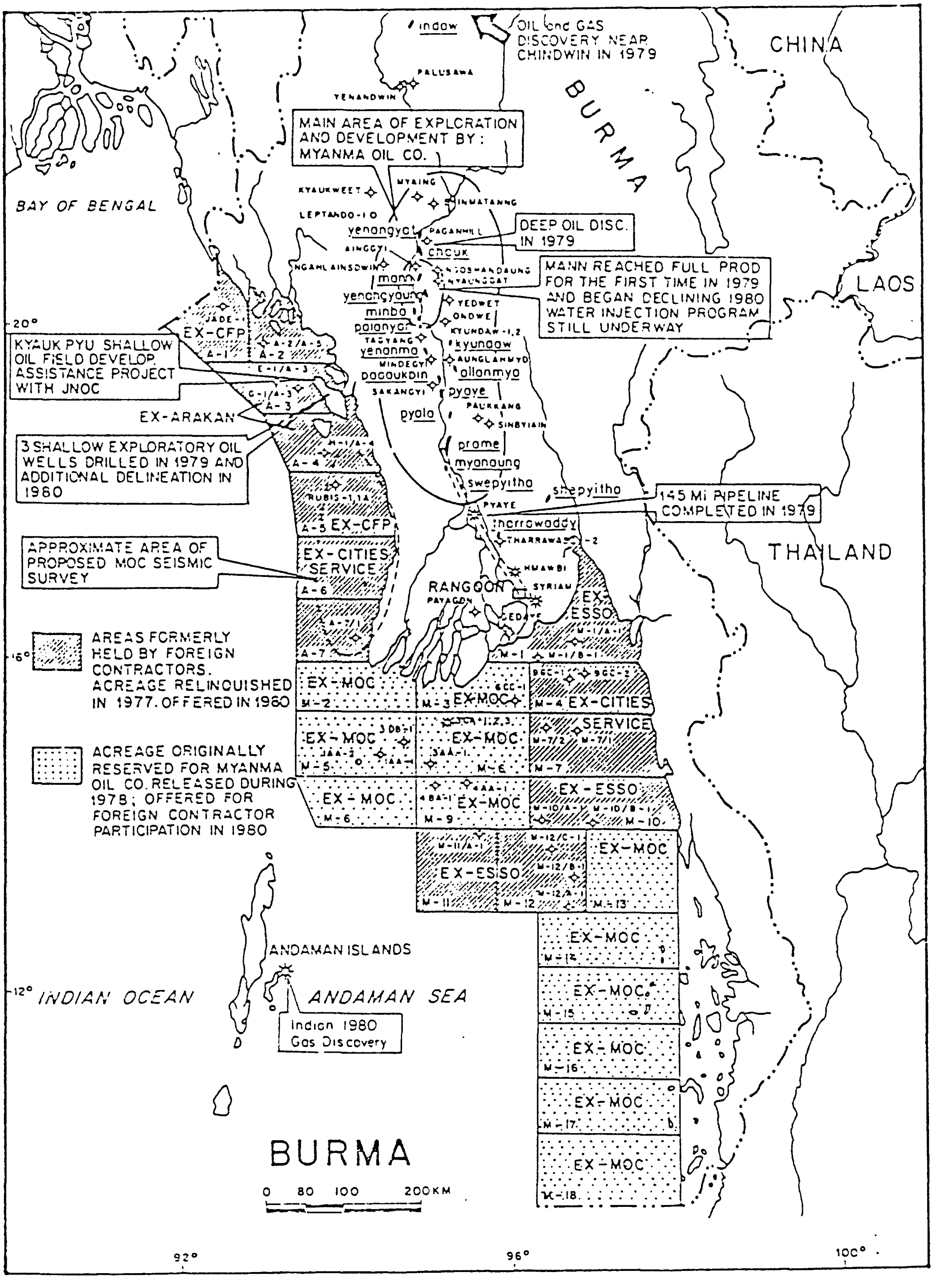

Figure 6. Offshore blocks and wildcat wells. (from American Association of Petroleum Geologists, October 1981).

The combined thickness of the Pegu Group and the overlying Irrawaddy Group, therefore, is probably in the range of 13,000 to 14,000 feet. The beds are believed to be somewhat thinner to the west. The Paleogene sediments below the Pegu Group probably are more than 15,000 feet thick.

A wildcat well drilled southwest of Rangoon in the Irrawaddy delta found middle (?) Miocene strata directly overlying a thick series of volcanic agglomerates. A positive Bouguer gravity anomaly suggests that volcanics may be present at shallow depths over a fairly large area both onshore and offshore in the northwest corner of the Gulf of Martaban. Paleogene rocks probably are present in considerable thickness beneath the volcanics.

Twenty two wildcats have been drilled in the Gulf of Martaban - 12 by the Myanma Oil Corporation (MOC), 8 by Esso (Exxon), and 2 by a consortium operated by the Cities Service Company. One well drilled by MOC in block M-6 about 30 miles south of the Irrawaddy delta encountered gas but apparently not in sufficient amounts to be commercial. Gas shows also were found in some of the other wildcats drilled by Myanma.

Offshore areas along the Mergui Archipelago appear to be unattractive for petroleum exploration because of the presence of Paleozoic and crystalline rocks. No offshore wells have been drilled in the area but seismic surveys are being conducted at the present time.

In the Gulf of Martaban the potential for finding new deposits of oil or gas is good.

COAL IN BURMA

Burma's coal imports are currently costing about $10 million per annum. Production of coal in Burma more than doubled in the fiscal year 1980/81. The amount produced, 32,000 long tons, was minor, however, compared to the needs of the country. It is not known what type of coal was produced or from what area it was mined.

Coal Worldwide-Petroconsultants (1975) reports Burma's coal reserves in long tons to be a follows:

	HARD COAL	BROWN COAL	TOTAL
Measured	26,000,000	-----	26,000,000
Indicated	16,000,000	266,000,000	282,000,000
Total	42,000,000	266,000,000	308,000,000

The figures above indicate that Burma ranks 54th among the coal producing countries of the world. Indicated reserves of brown coal are much larger than indicated reserves of hard coal.

Localities of coal deposits in Burma are shown on figure 7. Jurassic hard coal occurs on the edge of the Shan plateau where it is scattered in pockets, streaks, and lenses. Exploration in the area has been unsuccessful because coal beds are exceedingly irregular, crushed, and broken, and reserves appear to be very small. Estimated measured reserves are only 40,000 long tons.

Hard coal of Jurassic or Cretaceous age is known also in the Henzada area. Near Kywezin there is an 8-foot bed, perhaps the best of all the occurrences, but the local rocks are tightly folded and the coal has been crushed. Attempts at mining here have not been successful and large scale tests of the coal have been disappointing.

The most extensive coal fields of Burma lie in the Upper Chindwin valley. They are brown coals of Eocene age. Coal beds less than 2-feet thick are the general rule, but thicknesses up to 12 feet are reported.

The brown coals of late Tertiary age in Burma differ from the Eocene coals described in the preceeding paragraph by reason of their freshwater, lacustrine and fluvio-lacustrine origin. They are found in the extreme south in the Mergui district and in the Shan States.

In the Mergui district, the Theindaw-Kawmapyin field, which has been known for over a century, contains several beds of brown coal that range from 4 to

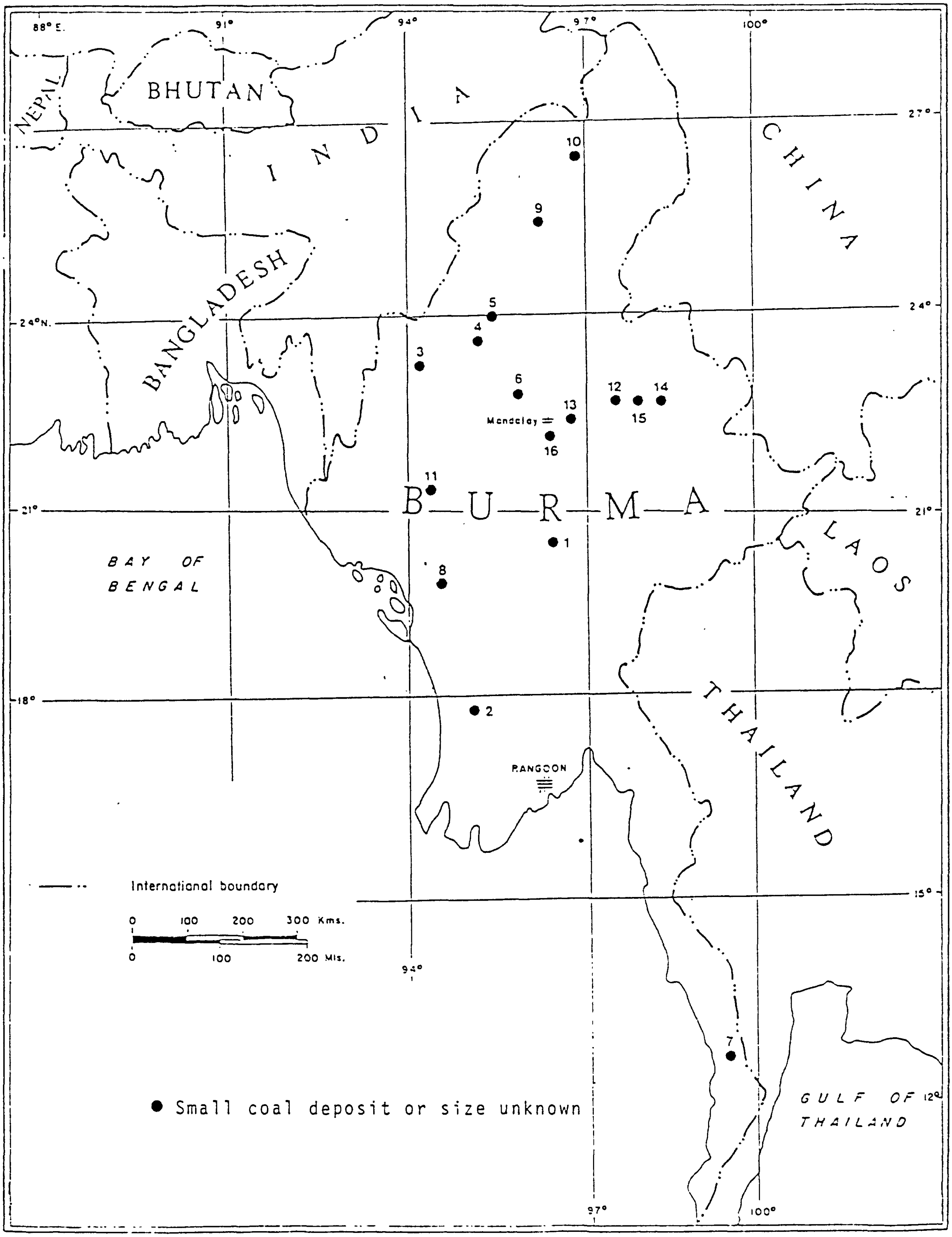

Figure 7. Coal deposits of Burma. (from Petroconsultants).

15 feet in thickness. The coal beds are believed to cover an area of about 30 square miles but at present the reserves are unknown. Average samples have been assayed as follows: moisture 13.87 percent, volatile matter 35.74 percent, fixed carbon 43.75 percent, and ash 6.64 percent.

In the Shan States, a number of intermontane basins are filled with Plio-Pleistocene strata containing brown coal. Perhaps the best known is the Namma coal field, situated about 11 miles south of Lashio, with a area of approximately 50 square miles. Two beds of brown coal, one 12-feet thick and the other 21-feet thick, contain an estimated 30 million tons and 50 million tons respectively. The mean of five assays showed moisture 16.58 percent, volatile matter 36.90 percent, fixed carbon 38.81 percent and ash 7.71 percent. Namma is the only Shan field that has been extensively explored: the Burma Corporation Ltd. did most of the exploration in 1918 - 19.

Almost all the coal used in Burma is imported: known indigenous deposits are high-ash lignite to sub-bituminous in rank.

The potential for discovering new deposits of hard coal in Burma is poor: for brown coal the potential is fair.

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