

**Outline of Offshore Coal Fields in Japan (Part 1)\***

By

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**Introduction**

The coal field, where the coal bearing formation is covered by younger sediments and the outcrops of the formation are not visible on surface of the earth, is named as the concealed coal field.

The term "concealed coal field" is used frequently in Great Britain. Recently the concealed coal field is divided into two types in general consideration. One of them is offshore field and another is under-plain field. One of the problems on the concealed coal field is the existence and distribution of coal seams.

The solution of this problem calls for use of every kind of geological observation, geophysical prospecting and drilling method, and finally interpretation relating these methods to the coal bearing formation and to cover of overlying rocks are completed.

There are many offshore coal fields in the world as shown on figure 1. The offshore coal fields in the world are situated in restricted areas where are related to the geological features.

Especially in the island arc situated along the margin of Asian continent, offshore coal fields have an important value for fuel resources. The coal seams are explored in many areas of Japan, Taiwan and other places, and the exploration will be done also in other countries in future.

**Geographic and geologic distribution of coal fields in Japan**

The coal fields of Japan are scattered from Hokkaido, north to Kyushu, south and the geological age of coal fields ranges from Triassic of Mesozoic to Pliocene of Tertiary.

In the standpoint of nature of coal, anthracite, bituminous coal and lignite are produced and also regarding coking property, coking coal and non-coking coal are mined.

The standard classification of coal is decided by the Ministry of International Trade and Industry as shown in table 1. The basement factors of classification are the calorific value and fuel ratio.

The geological age of the main coal bearing formations in Japan are listed in table 2 and as shown in the table, the important coal fields belong to older Tertiary.

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The important coal fields economically are Ishikari, Kushiro, Jōban, Ube, Omine, Chikuho, Fukuoka, Miike, Sasebo, Sakito-Matsushima, Takashima and Amakusa. Almost important coal fields except Ishikari and Omine lie near sea-shore and then the coal bearing strata distribute in some offshore areas.

The Paleozoic strata in Japan are mainly composed of marine sediments and consequently the local terrestrial deposits found at some places include only thin coal seams.

On the Triassic of Mesozoic strata, some lacustrine deposits were formed between outer and inner tectonic zones of Southwest Japan.

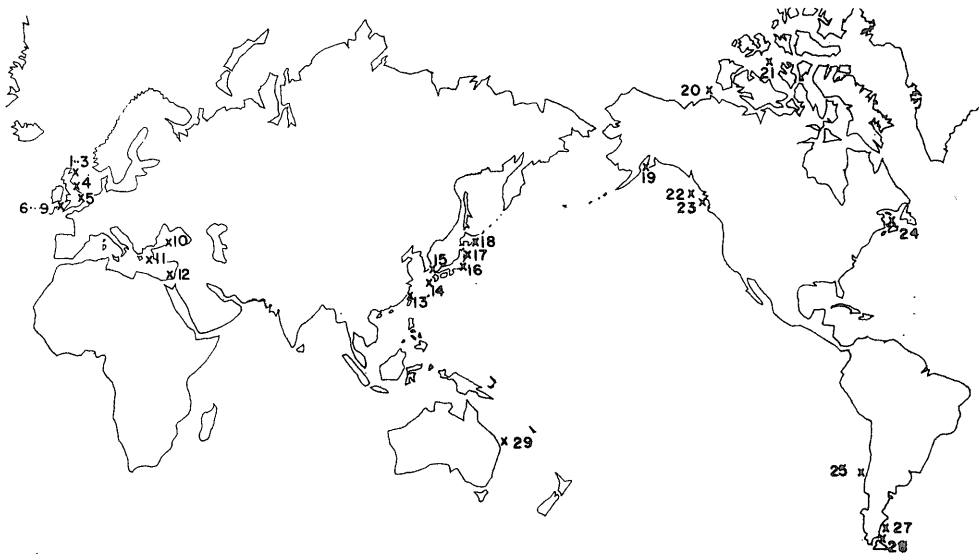


Fig. 1 Offshore coal fields in the world  
After Science & Technology Agency Resources Council 1966

Name	
1 Upper Forth	2 Lothian
3 Firth of Clyde	4 Northumberland
5 Durham	6 Cumberland
7 North Wales	8 South Wales
9 Kent	10 Mirton Sea
11 Zonguldak	12 Israel
13 Keelung	14 West Kyushu
15 Ube	16 Jōban
17 Kuji	18 Kushiro
19 Kenai Peninsula	20 Mackenzie
21 Parry Is.	22 Queen Charlotte
23 Nanaimo	24 Cape Breton
25 Conception	26 Naza
27 Santa Cruz	28 San Diego
29 Queensland	

The coal bearing formations in the Omine and Nariwa coal fields show mutually same depositional condition and the typical Triassic fossil flora, which is famous in Japan, are found in the roof of coal seams.

The anthracite from the Omine region is produced by violent folding and volcanic affairs after Triassic period.

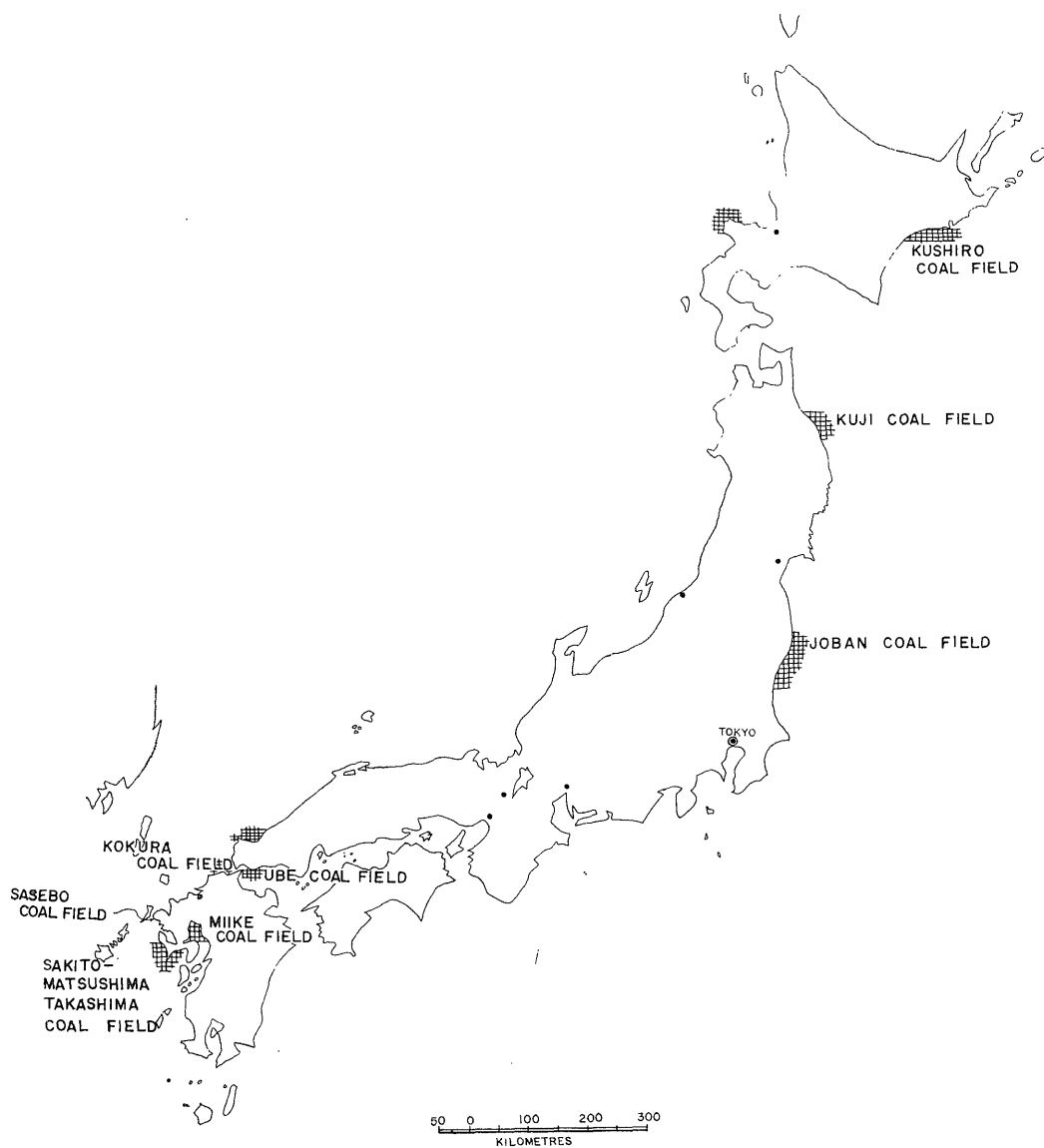


Fig. 2 Offshore coal fields in Japan

During Jurassic and Cretaceous marine sediments occupy the Japan islands, then coal basins are formed in very restricted area.

The project concerned with the boundary between Cretaceous and Tertiary is an important and interesting themes in Japan.

The Paleocene, earliest period of Tertiary, sediments are not yet found in Japan but the possibility of presence of Paleocene is considered by studies of fossil foraminifera and other fossils in the eastern part of the Kushiro coal field and of the "Akazaki formation" in coal fields of western Kyushu.

In general view, the coal fields of Paleogene are situated mainly in middle and eastern parts of Hokkaido, the Pacific coast of Main Island and in northwestern

Table 1 Classification of Japanese coal

Classification		Calorific value (moisture-and mineral matter-free) (K. cal/kg)	Fuel ratio	Coking property	Remarks
Class	Group				
Anthracite (A)	A <sub>1</sub>		>4.0	Non- Coking	Natural coke by volcanics
	A <sub>2</sub>				
Bituminous coal (B. C)	B <sub>1</sub>	>8,400	>1.5	Strong	
	B <sub>2</sub>		<1.5	Coking	
	C	8,100 — 8,400		Coking	
Sub- bituminous coal	D	7,800 — 8,100		Weak Coking	
	E	7,300 — 7,800		Non- Coking	
Lignite	F <sub>1</sub>	6,800 — 7,300		Non- Coking	
	F <sub>2</sub>	5,800 — 6,800			

(After M. I. T. I., 1954)

Table 2 Geologic age of Japanese coal fields

Geologic age	Name of coal field	Name of prefecture
Miocene	Gifu-Aichi (Lignite)	Gifu & Aichi pref., Honshu
	Sendai (Lignite)	Miyagi, Honshu
	Mogami	Yamagata, Honshu
	Tempoku	Hokkaido
	Sasebo	Nagasaki, Kyushu
Oligocene	<u>Kushiro</u>	Hokkaido
	<u>Jōban</u>	Fukushima, Honshu
	Fukuoka	Fukuoka, Kyushu
	Chikuho	Fukuoka, Kyushu
	<u>Kokura</u>	Fukuoka, Kyushu
	Karatsu	Saga, Kyushu
	<u>Sakito-Matsushima</u>	Nagasaki, Kyushu
Eocene	Ishikari	Hokkaido
	<u>Ube</u>	Yamaguchi, Honshu
	<u>Miike</u>	Kumamoto, Kyushu
	<u>Takashima</u>	Nagasaki, Kyushu
	<u>Amakusa</u>	Kumamoto, Kyushu
Triassic	Omine	Yamaguchi, Honshu

Each of under-lined coal fields shows the offshore field or that a part of the field distributes in offshore area.

Kyushu.

The exploitations in offshore areas of these coal fields are carried out from land area or island. In the Kushiro, Miike, Ube, Sasebo and Amakusa coal fields, the shaft or oblique shaft are settled on land and in the Sakito-Matsushima and Takashima coal fields, these are settled on island.

### Procedures of exploration in offshore coal fields in Japan

The first step of discovery of offshore coal field is a finding of outcrops of coal seams on the coast region. Another development of offshore coal field is owing to stretching the galleries from land area to sea-bottom.

The important coal fields of Japan mainly lie near the coast as previous mentioned, therefore the geological survey and geophysical survey both are effective for the exploration of offshore area.

The procedures of exploration somewhat differ because of geological features in the explored area.

1st step; Geologic survey in coast area

Geologic and topographic survey in sea-bottom by diver

Dredging in offshore area

2nd step; Geophysical survey   Magnetic method

Gravity method

Seismic method (reflection, refraction)

Sonic method (Sparker, Rass)

3rd step; Drilling-Well logging   Floating baldge

Drilling from vessel

Electrical logging

Well shooting

Radioactive logging

Thermal measurements

The seismic survey is carried out where the strata are gently incline or simple structure is supposed, and sonic survey is very effective where the basement rocks under sea-bottom are composed of granite or hard Paleozoic rocks. The floating baldge is used frequently in shallow-water area, while drilling from vessel is carried out in deep sea area.

The first drilling from vessel was carried out in the area off the Kushiro city, Hokkaido and the drilling reached to 860m under sea-bottom. In the Kushiro coal field geologic survey on sea-bottom by diver worn aqualung was effective to finding of fault and sand dykes. In the Ube coal field, the seismic velocity of each formation was obtained by physical prospecting, and then crash-zone or faults in offshore area were clarified by seismic method.

During 50 years, 200 drillings were carried out on the north side of the zone, 35 in the zone and 30 on the south side of the zone.

The radioactivity well logging carried out in the field is one of the new

Table 3 Procedures of exploration in offshore coal fields  
After Science & Technology Agency Resources Council, 1966

Coal mine	1 9 5 9	1 9 6 0	1 9 6 1	1 9 6 2	1 9 6 3
Taiheiyo(Kushiro)	SD SS		SS	D	D
Ube(Ube)	SA DF	SA DF	RL GC DF	SA DF RL GC	SS RL DF
Ariake(Miike)	DF	SA DF	SA DF	DF	DF
Miike(Miike)	DF	SR	DF SE SA SS	DF	DF
Tobishima(Sasebo)	SS		D	D	D
Takeshita(Sasebo)					
Fukushima(Sasebo)		DV			
Sakito (Sakito- Matsushima)	SE SF SD	SS			
Oshima (Sakito- Matsushima)	WS MS	SE SS SR			
Ikeshima (Sakito- Matsushima)	MS SD	SS SR			
Iojima(Takashima)		SS GS MS		DF	
Futago Hashima (Takashima)	SD	SD SA SE SS	SD		
Shiki(Amakusa)		SS			DF SS
Horinosako (Amakusa)			SS		
Takenosako (Amakusa)			SS SR		SS SR

SD : Survey by Diver

D ; Dredging

SS : Sonic survey by Sparker

SR : Sonic survey by Rass

GC : Geochemical survey

RL : Radioactive Well Logging

MS : Magnetic survey

GS : Gravity survey

SE ; Seismic reflection survey

SA : Seismic refraction survey

DF : Drilling by Floating Balge

DV : Drilling vessel

WS : Well shooting

Compiled by Coal Section, Geol. Surv. Japan.

techniques in coal exploration and good result on correlation of strata was obtained.

In the Ariake district of the Miike coal field, more ten seismic surveys and about 100 drillings were done over the field, and in the main part of the field the Paleogene coal bearing formation is recognized by drillings from floating baldge and also seismic velocity of each formation were clarified by reflection and refraction method.

For surveying on the distribution of volcanic rocks cropped out on the surface of sea-bottom, magnetic method is most effective as shown in the Sakito Matsushima coal field.

Some examples of procedures in offshore areas are shown in table 3.

### Present status of coal mining industry and coal reserves in offshore areas

The coal exploitation in offshore area began in 1860 in the Takashima coal field and now twenty-two mines are working; one in Kushiro, two in Ube, one

Table 4 Coal reserves and output in offshore coal fields

Name of coal field	Coal reserves in off-shore coal fields (1000 t)	Output from off-shore coal fields (1000t/year)	Remarks
Kushiro	308,197	1,498	Bituminous coal
Ube	409,333	934	Bituminous coal
Ariake	406,806	0	
Miike	946,176	3,425	Bituminous & coking coal
Sasebo	130,740	716	Bituminous & coking coal
Sakito-Matsushima	643,561	1,575	Bituminous & coking coal
Takashima	330,325	1,615	Bituminous & coking coal
Amakusa	57,662	228	Anthracite coal
	(in 1967)	(in 1963)	
Total	3,232,800	9,991	
Total in all Coal fields of Japan	20,245,786 (in 1955)	51,098 (in 1963)	

After Science & Technology Agency Resources Council, 1966  
Compiled, Coal Section, Geological Survey of Japan

Table 5 Workable coal seams in offshore coal fields

Name of coal field	Name of coal mine	Coal bearing formation	Coal seam	Thickness of coal seam (m)	Thickness of coal seam including partings (m)
Kushiro	Taiheiyo	Harutori	Main seam	2.70	2.76
Ube	Ube	Okinoyama	Itsudan	1.30	1.50
Miike	Miike	Inari	Main seam	3.03	3.37
Sakito-Matsushima	Sakito Oshima	Sakito	15 Shaku	3.10	3.76
		Sakito	Main seam	2.75	4.71
Takashima	Iojima	Hashima	10 Shaku	3.60	3.60
	Futago	Hashima	18 Shaku	4.00	4.20
	Hashima	Hashima	1 Jyo	2.70	2.70
Amakusa	Shiki	Toishi	4 Shaku	1.07	1.20
	Uonuki	Toishi	5 Shaku	1.50	1.50

in Miike, five in Sasebo, three in Sakito-Matsushima, three in Takashima and seven in Amakusa, and exploration is progressing in the northern part of the Miike coal field.

The first affairs of coal exploitation in Japan were very small on scale but gradually it increases and develops, and the coal output from offshore area is estimated at about ten million tons as shown in table 4. The coal output from

Table 6 Depth and distance of working area

Names of coal mine & coal pit	Depth of working area below sea level (m)	Depth of water at working area (m)	Distance from shore at working area (m)	Distance from shore at deepest working face (m)
Taiheiyo(Kushiro C.F.)	-200~ -493	30	1,200~3,300	4,200
Ube (Ube C. F.)	-95~ -360	15	750~7,000	7,000
Ariake (Miike C. F.)	—	10	—	—
Miike (Miike C. F.)	-100~ -700	0~10	2,800~5,600	5,600
Sakito (Sakito-Matsushima C. F.)	-124~ -130	33	100~ 900	1,600
Oshima (Sakito-Matsushima C. F.)	-584~ -590	10~15	100~ 250	900
Ikeshima (Sakito-Matsushima C. F.)	-290~ -390	30~65	250~1,300	1,500
Futagoshima (Takashima C. F.)	-290~ -900	30~80	2,500~3,500	4,200
Hashima (Takashima C. F.)	-880~ -940	45~55	650~ 700	2,130
Shiki (Amakusa C. F.)	-180~ -250	0~41	0~ 100	200

After Science & Technology Agency Resources Council, 1966  
Compiled. Coal Section, Geol. Surv. Japan

offshore area occupies 20.6 percents of total in 1963.

About the depth of working area, the deepest working area lies at 700 m under sea-level, and in other coal mines, the gallery where diggings are progressing lies from 200 m to 500 m in depth.

The distance between working area and shore-line became longer and longer as progress of working and the level gallery in Ube which is the longest in offshore area, shows seven thousands meters long. While the water-depth at the working area is related with the topographic features of sea-bottom. The deepest water-depth known in the Takashima coal field is over fifty meters at the working area, whereas in the Ube coal field the water-depth shows only fifteen meters at the working area in spite of far away from shore-line and in the Miike coal field, at the time of lower water tide, water ebb away.

The water-depth and distance from the shore-line are shown in table 6. The coal reserves in offshore areas are estimated about three thousand million tons and they occupy 21.3 percents in total coal reserves in Japan. (Continued)