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Preliminary Report on Iron Deposits in Sebuku Island, Kalimantan, Indonesia

by

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Introduction

It has been well known that there are good iron deposits in the south-eastern part of Kalimantan, that is, the Indonesian territory of Borneo. The main localities are Mt. Tanalang, Mt. Kukusan, Pelaihari and Sebuku. (see Fig. 1) Mt. Tanalang is characterized by hematite deposits, Mt. Kukusan is well known as iron beds, and a lot of magnetite boulders was found at the Pelaihari area. Iron ore in Sebuku island has been said to be "laterite" which generally means some iron-rich parts derived from ultra-basic rocks, e. g. serpentine or peridotite, by the strong equatorial weathering.

Not only the Dutch government but also the Japanese military have ever developed them. After World War II, several prospecting parties from foreign nations came into these areas to support the new Indonesian government. Among them, West Germany and U. S. S. R. are notable. It seems that U. S. S. R. has already promised to exploit the area of Mt. Tanalang keeping her eyes on the good hematite ores, but nothing by West Germany.

Japan, paying attention to the "laterite", has studied about the Sebuku's iron deposit keeping negotiations with the Indonesian government. Mr. Naoto Ichimada (The former Japanese Minister of Finance, Member of the Japan National Diet), Mr. Kenzo Saito (Member of the Japan National

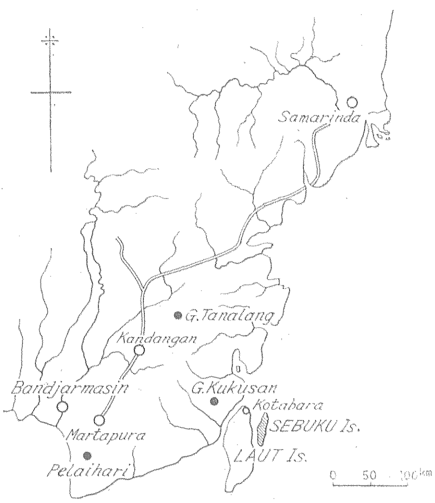

Fig. 1 Southeastern part of Kalimantan

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Diet), Dr. Daisuke Kamishima (Iron metallurgical engineer) and others visited to Indonesia under the name of "Ichimada Mission" for a week from September 2, 1961 in order to negotiate closely with the Indonesian government. According to the joint statement of Indonesian and Japanese governments at that time, the following surveying party was sent to the Sebuku Island.

Members of the party were Ir. Soerodjo Ramoekoesoemo (Mining engineer, Chief of Mining Bureau of Indonesia), Ir. Ridwan Mahmud (Mining engineer, Member of Mining Bureau of Indonesia), Mr. Naoji Koike (Mining engineer, Colombo Plan Expert from Japan), Dr. Kazuhiko Asai (Mining and consulting engineer, Colombo Plan Expert from Japan), and the writer of this paper (Mining geologist, Colombo Plan Expert from Japan). They left Djakarta on September 8, 1961 and spent a week for the reconnaissance. Transportation, however, was so inconvenient that they barely could work at Sebuku for two days (Sept. 11 and 12) only.

Geology and Iron Deposits

Very few report concerning the geology and the iron deposits of the area besides one written by F. Lehmann and F. Baum[1] are available, although the iron deposit has been pretty well known. According to R. W. Bemmelen[2] and others, the geology of the island is composed of Tertiary pyroclastic sediments and ultra-basic rocks. The pyroclastic sediments occur in the western and southern parts of the island, and the strike and dip are generally N 20° E and 20° ES. The ultra-basic rocks occur at the hill range of the east side of the island, and a fault is inferred along the boundary between the western and the eastern halves.

Outcrops of iron ore have been found only in the western Tertiary volcanic sediments area, and the main ore body seems to extend conformably with the sediments for about 18 km from Cape Batu, the northern point of the island, to Sarakaman, the middle western part of the island. Close observations are made at Sungaibali and Sarakaman. (see Fig. 2)

The iron ores are divided into two kinds; (1) bedded iron ore and (2) boulder- and soil-ore.

(1) The bedded iron ore which constitutes the main body of the deposit is found along the hill-ridge of the area. The strike and dip are N 20° E and 20° ES. The average thickness is 4 m. Banded structure is often seen by the unaided eye. Boundary between the ore body and the country rocks is hardly observed, because of thick overburdens which often contain boulder- and soil-ore. However, basic tuff and tuff-breccia form the footwall of the ore body as seen at the water-fall near Sarakaman, suggesting that the ore bed is sandwiched in the tuffaceous layers.

(2) The boulder- and soil-ore are widely distributed and often have

Table 1 Chemical Analytic Data of Ore from Sebuku Island

No.	1	2	3	4	5	5′	7	8	9	11	12	14	15	16	17	18
SiO_2	5.43	13.01	3.79	2.94	2.78		9.79	8.00	9.17	1.54	2.55	2.02	1.93	2.12	0.68	8.48
Ⓙ SiO_2						1.04				1.12					1.04	
Fe	42.80	36.70	38.10	52.10	52.32		41.79	45.85	42.49	55.37	49.71	55.70	51.66	52.76	57.02	46.43
Ⓙ Fe	47.81	36.97	37.75	52.50	63.00	67.75	40.32	46.91	40.66	54.62	50.15	57.64	50.60	54.73	60.65	42.67
Al_2O_3	14.32	15.96	11.83	8.34	10.24		13.85	12.23	12.18	8.00	9.96	8.66	9.51	6.95	7.68	10.04
Ⓙ Al_2O_3						0.30				4.66					4.00	
Cr_2O_3	2.18	1.66	1.16	0.52	0.29		0.44	2.94	2.27	2.50	4.39	3.00	2.65	3.40	2.94	1.83
Ⓙ Cr_2O_3	2.56	3.36	2.40	3.64	3.68	0.00	2.40	3.36	3.76	3.84	5.08	2.68	2.48	3.28	2.36	4.72
TiO_2	0.32	0.67	0.38	0.16	0.15		0.15	0.15	0.15	0.26	0.19	0.37	0.30	0.19	0.37	0.47
Ⓙ TiO_2						0.01				0.60					0.60	
MgO	0.32	0.13	0.10	0.13	0.28		1.08	0.50	0.65	0.23	0.20	0.10	0.05	0.03	0.08	none
Ⓙ MgO						0.20				0.46					0.24	
Ⓙ CaO						0.22				0.30					0.22	
Mn	0.06	0.03	0.02	1.84	0.32		2.41	0.37	1.84	0.21	0.48	0.74	0.59	0.24	0.06	0.03
Ⓙ Mn						0.05				0.16					0.12	
P	none	0.11	0.25	none	0.24		none	0.15	none	none	none	none	none	none	0.10	none
Ⓙ P						0.01				0.07					0.09	
Ni	0.25	0.27	0.28	1.13	0.45		0.84	0.46	0.99	0.43	0.50	0.94	0.68	0.50	0.24	0.14
Ⓙ Ni	0.30	0.16	0.19	0.65	0.32	0.006	0.79	0.33	0.90	0.30	0.40	0.67	0.41	0.41	0.35	0.17
Ⓙ Co						0.005			0.19	0.03		0.04			0.02	
Cu	0.04	0.08	0.00	0.02	0.01		0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ⓙ Cu						0.01				0.00					0.00	
As	none	none	none	none	none		none	none	none	none	none	none	none	none	none	none
Ⓙ As						0.00				0.005					0.005	
S	0.31	0.10	0.29	0.26	0.23		0.07	0.19	0.15	0.16	0.16	0.17	0.40	0.16	0.08	0.13
Ⓙ S						0.03				0.13					0.08	
H_2O+	14.54	11.82	16.16	8.98	9.69		10.61	8.98	11.41	7.10	10.21	3.97	9.75	10.81	6.04	12.86
Ⓙ H_2O+						1.00				8.79					2.32	
H_2O-	2.10	2.80	2.80	0.70	1.20		2.17	1.45	1.00	0.48	1.44	0.50	1.77	0.67	1.31	1.19
Ⓙ H_2O-						0.24				1.56					1.93	
	Gripbed sample, boulder-ore at northeast foot of Mt. Batubrani, Sarakaman.	Channel sample, test-pit (30cm deep) at northeast foot of Mt. Batubrani, Sarakaman. soil-ore.	Same as No. 4	Gripbed sample, boulder-ore at northeast foot of Mt. Batubrani, Sarakaman.	Channel sample, outcrop of iron ore bed (4m thickness), top of Mt. Batubrani, Sarakaman.	Best magnetite rich ore only from No. 5	Same as No. 9 Lower-part.	Same as No. 9 Middle-part.	Channel sample, Upper-part of iron-bed (4m thickness) out-crop at the waterfall, near Sarakaman.	Same as No. 12	Same as No. 14	Gripbed sample of the boulder-ore, Mt. Tabuan, Sungaibali.	Channel sample of the pit (mentioned above), 2m from surface to the bottom.	Channel sample of pebble-rich layer (30cm thickness) in the bottom (2m deep) of test-pit at west foot of Mt. Tabuan, Sungaibali.	Outcrop of iron bed at Mt. Tabuan, Sungaibali. Free sampling.	Pebbles only from surface soil-ore, near Sungaibali village.

Notes : Data analyzed by Geological Survey of Japan are marked with Ⓙ, the other without Ⓙ are from Geological Survey of Indonesia.

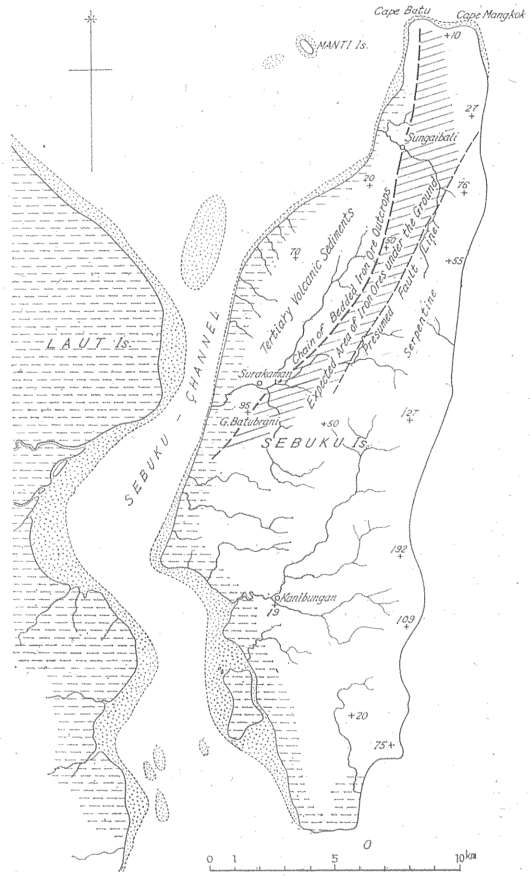

Fig. 2 Sketch map of iron deposit, Sebuku island

considerably high contents of iron. There is a lot of large boulder-ores near the outcrops of the bedded iron ore body. They suffer the so-called lateritization under the strong equatorial weathering and often change to soil-ores.

In the vicinity of the village of Sungaibali, there is a lot of iron ore, especially being rich at the southern hill named Gunung Tabuan. Boulder- and soil-ore are abundant in the vicinity of the bedded iron ore body which crops out at its west slope. Another representative locality is the vicinity of Sarakaman. There are also very much boulder- and soil-ore. Outcrops of the bedded iron ore body are known at two place, (a) a waterfall at upstream of the Sarakaman river and (b) Gunung Batu-Brani about 1 km south of the village. (a) On the valley bottom, there is a lot of large boulder-ore and a bedded iron ore body crops out which overlies the tuff bed. (see Photo. 1) Thickness of the ore body is about 4 m. Strike and dip are N 20°E and 20°ES. (b) Gunung Batu-Brani which means "magnetic stone mountain" shows comparatively strong magnetism. It is rather steep and has an altitude of 75 m above sea level, and all sides of slopes are covered with a large amount of boulder- and soil-ore. Outcrops of the bedded iron ore body are seen at the top of the hill. Their strike, dip and thickness are N 20° E, 20° ES and 4 m respectively. A recent outcrop of the bedded iron ore and a lot of new boulders are distinctly visible at the northwestern edge of the top-plateau. (see Photo. 2) Very clear banded structure running parallel to the dip and strike of the ore bed is seen by the naked eye.

Ore and Its Reserves

Chemical compositions of ores are given in Table-1. Constituent minerals of ore have been studied by means of microscope, X-ray diffraction, chemical test and others. In general, ore is composed of goethite, hematite, magnetite, gibbsite (?), chromite, spinel, siderite (?), chamosite (?) and others in rough order of frequency.

Goethite is the main constituent mineral of the ore. Two colours, red and brown, of it are usually observed in thin sections. Sometimes it shows the microscopical banded and granular texture. (see Photo. 3)

Hematite and magnetite often come together but hematite is more abundant than magnetite. Some hematite are clearly martite which are formed by the oxidation of magnetite.

Gibbsite (?) was described by Y. SHIMAZAKI[3)] as one of the forming minerals of the iron ore from the island. It is rich in both weathered- and fresh-ore.

Table 2 Reserves of Iron Ore in Sebuku Island

	Visible-ore			Provable- and Possible-ore			Total
	Strike length	Dip-side extension	Amount	Strike length	Dip-side extension	Amount	
Sungaibali Bedded-ore	2 km	0.5 km	12million tons	5 km	3 km	180million tons	192million tons
Sungaibali Boulder- and Soil-ore	1	0.5	6	5	2	120	126
Sarakaman Batubrani Bedded-ore	1	0.5	6	3	2	72	78
Sarakaman Waterfall Bedded-ore	1	0.5	6	1	1	12	18
Sarakaman Boulder- and Soil-ore	1.5	0.5	9	2	1	24	33
Others						100	100
Total			39			508	547

Notes: 4 m in average thickness and 3 in average S.G. were used.

Chromite and spinel are about 0.1～0.2 mm in diameter. Sometimes they form the granular aggregate. Microscopic observation and X-ray diffraction study suggest that the chromite is somewhat magnesian picrochromite.

Siderite (?) is seen under the microscope in the aggregate of goethite.

Chamosite (?) was reported by LEHMANN and BAUM[1], and they ascribed its formation to the sedimentary process because this mineral is usually found in sediments. The present writer has not yet definitely identified this mineral.

Outcrop ore of the main bedded iron ore body seems to have little variation in grade. No. 5' in Table-1 is an example of the best ore. Average iron content of ores is nearly 50%. H_2O (+) is not small in amount, but it decreases in hematite-magnetite rich ore. About 0.5% Ni and 2～3% Cr_2O_3 are to be noted. Grades of boulder- and soil-ore vary in a wide range, but over 35% Fe is common and 50～55% Fe are not rare.

Data are not yet sufficient to calculate the ore reserves. The writer, however, tried to estimate them on a basis of the available field data. (see Table. 2) As a result, total reserves amount to nearly several hundred million tons with the average grade of about 50% Fe, about 10% Al_2O_3, about 2.5% Cr_2O_3 and about 0.5% Ni.

Based on the field occurrence and some data of mineralogical investigation, the writer now considers a possibility of syngenetic sedimental deposition in the Tertiary pyroclastic sediments as a genesis of the main bedded iron ore body. Iron elements may have been supplied by the pre-Tertiary laterite derived from serpentine. Boulder- and soil-ore seem to have been formed by the lateritization of the bedded iron ore.

References

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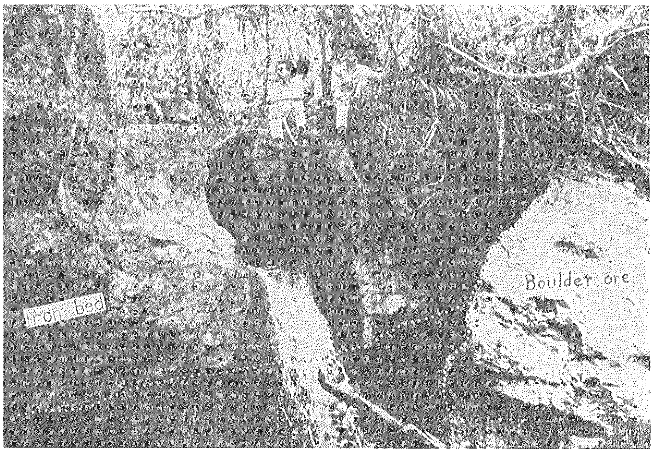

Photo.1 The outcrop of the iron bed (N 20°E in strike, 20°ES in dip, 4 m in thickness) at the waterfall near Sarakaman, Sebuku island. There is a fine tuff layer just under the iron bed at the dark place in the picture. (photo by N. Koike)

Photo.2 The outcrop of the iron bed (N 20°E in strike, 20°ES in dip, 4 m in thick ness) at the northwest edge of the top plateau of Gunung Batu Brani, 1km south of Sarakaman. Sebuku. (photo by N. Koike)

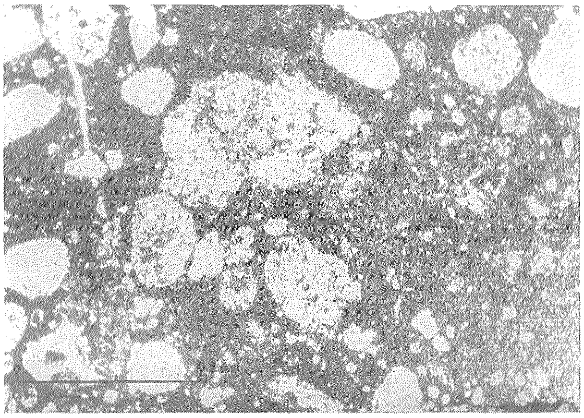

Photo. 3 Granular texture in goethite rich ore (No. 11). Thin section. Open nicol. Pure white ; holes. white with black spots ; grains of brownish goethite. Dark ; mixture of reddish goethite and hematite. Diameter of grains ; about 0.05~0.2 mm.

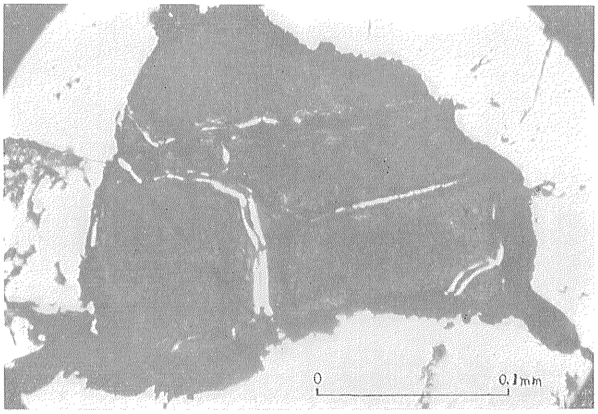

Photo. 4 Chromite grain in serpentine (white) erratic boulder being surrounded by magnetite (?) (black). In thin section. Open nicol.

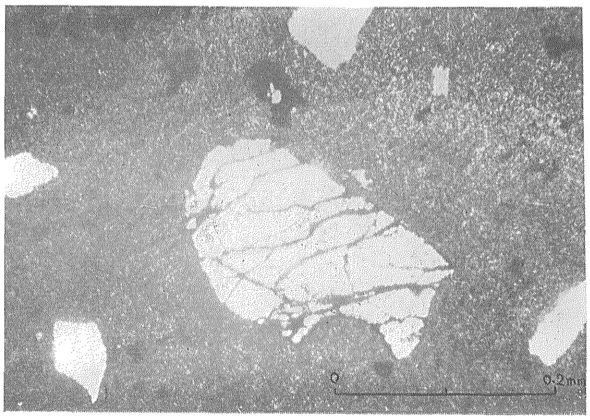

Photo. 5 Spinel grain in reddish goethite with spots of hematite (black). Open nicol. Thin section of No. 5.

インドネシア，カリマンタン，スブク島鉄鉱床概査報告

菊　池　　徹

要　旨

(1) 本報告は，コロンボ計画によりインドネシア出張中，現地2日間（1961年9月11～12日）の概査で得られた，わずかのフイールド・データと，帰国後に行なつたいくらかの室内研究に基づいてまとめた予報である。

(2) 当地の鉄鉱床は，徒来いわゆるラテライトとしてよく知られていたが，今回の調査によれば，その主体鉱床は，第三紀火山性堆積層中の鉄鉱層として，再考察した方がよいと考えられた。

(3) その鉄鉱層は，走向 N 20° E，傾斜 20° ES，厚さ4mで，第三紀凝灰岩層に挟まれている。露頭の延長は 18 km に及ぶ。

(4) そのほかに，この鉄鉱層からくずれて生じたと考えられる，転石鉱・粉鉱が各所に見られ，その量もかなり大きい。

(5) 試料の化学分析値を第1表にかかげる。これらの鉱石は，針鉄鉱・赤鉄鉱・磁鉄鉱・ギブサイト（Gibsite）（?）・クロム鉄鉱・尖晶石・菱鉄鉱（?）・シヤモサイト（Chamosite）（?）などからなつている。

(6) 鉱量は数億トンに達し（第2表），その品位は平均して Fe 50 %，Al_2O_3 10 %，Ni 0.5%，Cr_2O_3 2.5%，$H_2O(+)$ 1～10 % とみられる。