

The Iron Ore Resources of Japan.

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The iron industry of Japan has recently made rather rapid progress owing to the development of the Imperial Steel Works. Inasmuch as the Iron Ore Survey was carried out in only a limited area in Hokkaidō, it has been impossible to reach any other conclusion respecting the supply of iron ore in Japan than that given in my former study.⁽¹⁾

Production.

Iron mines with smelters are three in number, the same as seven years ago; while those producing only ore have fluctuated in number according to the conditions of the mines and the market. It is a notable fact that during the last fifteen years, no mine has been able to establish new smelting works, probably owing to the difficulty of getting adequate fuel as well as to a lack of skilled labour, experience in steel work, lack of transportation facilities, etc. The Kamaishi mine, which is the largest, furnished eighty to ninety per cent of the total production of iron ore and iron (exclusive of the production of the Imperial Steel Works), the other two mines having yielded much less. Of iron sand, washing and smelting have been carried on in numerous places in Chūgoku, over ninety per cent of it having been smelted there.

Of iron ores and their derived products the production of the principal iron mines together with those of the Imperial Steel Works since 1908 has been as follows:

(1) K. Inoue: The Iron Ore Supply of Japan. The Iron Ore Resources of the World. 1910. p. 927-969.

Kamaishi

	1908	1909	1910	1911	1912	1913	1914
	tons	tons	tons	tons	tons	tons	tons
Ore.....	76,389	83,919	93,225	97,832	115,561	115,310	99,514
Pig.....	35,560	40,630	52,760	47,114	50,001	49,322	41,739
Steel	1,691	5,879	6,914	9,469	11,305	13,477	14,106

Sennin

	1908	1909	1910	1911	1912	1913	1914
	tons	tons	tons	tons	tons	tons	tons
Ore.....	9,728	6,519	4 149	4,491	5,240	3,869	6,130
Pig.....	2,933	3,203	2,170	1,706	2,273	2,194	2,657

Hitokabe

	1908	1909	1910	1911	1912	1913	1914
	tons	tons	tons	tons	tons	tons	tons
Ore.....	5,275	578	446	3,472	5,635	7,604	4,033
Pig.....	989	389	344	1,507	1,782	2,192	1,948

Imperial Steel Works

	1908	1909	1910	1911	1912	1913	1914
	tons	tons	tons	tons	tons	tons	tons
Pig	103,056	116,060	129,121	147,667	177,880	178,714	221,676
Steel.....	89,717	94,196	160,148	181,493	207,279	216,222	230,928
Ore	17,823	11,441	11,187	11,144	10,049	10,009	10,762

Chūgoku

	1908	1909	1910	1911	1912	1913	1914
	tons	tons	tons	tons	tons	tons	tons
Pig	3,270	3,117	2,679	3,043	2,513	3,054	2,884
Steel.....	1,033	455	931	899	1,252	816	1,468

The iron ore smelted by the Imperial Steel Works was all imported from Chōsen and China. The production of iron since 1874, the first year of recorded statistics in Japan was as follows (exclusive of the production of the Imperial Steel Works):

Iron			Iron		
Quantity	Value		Quantity	Value	
tons			tons	yen	
1874.....	4,867	—	1876.....	6,440	—
1875.....	3,433	—	1877.....	8,206	205,150

Iron		Iron	
Quantity	Value	Quantity	Value
tons	yen	tons	yen
1878.....10,154	253,850	1883.....14,816	338,819
1879.....11,484	287,100	1884.....11,846	271,342
1880.....13,619	330,475	1885..... 6,761	248,432
1881.....13,688	341,700	1886.....13,742	231,345
1882.....14,589	382,614	1887.....15,249	329,509

Pig		Steel	
Quantity	Value	Quantity	Value
tons	yen	tons	yen
1888.....14,456	253,475	3,714	178,165
1889.....14,597	247,469	6,539	280,250
1890.....18,571	330,253	3,811	163,846
1891.....15,805	254,104	2,665	108,147
1892.....17,283	304,367	2,382	113,165
1893.....16,074	310,986	1,565	78,239
1894.....18,127	506,196	1,284	62,295
1895.....24,663	808,234	1,102	61,968
1896.....26,122	865,982	1,218	67,782
1897.....26,877	937,821	1,080	67,502
1898.....22,481	763,815	1,100	64,233
1899.....20,752	740,325	2,285	176,322
1900.....13,427	725,240	2,383	230,046
1901.....26,793	960,046	5,520	249,181
1902.....29,401	934,429	2,689	240,042
1903.....30,623	1,004,077	3,146	261,464
1904.....35,394	1,213,114	2,702	200,318
1905.....46,585	2,126,971	6,561	512,146
1906.....43,759	2,076,045	6,480	519,077
1907.....45,275	2,114,998	6,603	519,732

Pig		Steel	
Quantity	Value	Quantity	Value
tons	yen	tons	yen
1908.....42,640	1,753,237	2,700	217,703
1909.....47,791	2,636,358	6,333	500,110
1910.....59,375	2,206,119	7,758	589,554
1911.....53,427	1,973,278	10,367	602,236
1912.....56,723	2,314,823	12,555	755,479
1913.....56,971	2,561,060	14,302	866,012
1914.....74,406	2,755,649	15,513	881,096

The production of iron by the Imperial Steel Works since the starting of its works has been as follows :

Pig		Steel	
Quantity	Value	Quantity	Value
tons	yen	tons	yen
1900..... 876	13,143	—	—
1901..... 30,041	1,191,398	4,957	600,314
1902..... 10,218	456,090	29,732	3,424,436
1903..... —	—	38,506	3,267,944
1904..... 32,503	1,538,777	58,396	5,064,176
1905..... 32,441	2,818,614	65,874	7,654,363
1906.....100,570	3,134,280	64,276	6,661,909
1907..... 96,758	2,908,992	85,060	8,982,912
1908.....163,050	3,030,847	89,717	9,399,818
1909.....116,060	3,419,263	94,196	8,636,323
1910.....129,121	3,563,749	160,148	14,394,328
1911.....147,667	4,130,921	181,493	12,540,223
1912.....177,880	4,310,902	207,279	14,609,565
1913.....178,714	3,588,010	216,222	13,685,040
1914.....221,676	4,522,188	230,928	13,383,611

The production of iron smelted from iron sand tends to decrease,

in contrast to the increase of iron smelted from iron ore, the production (exclusive of the production of the Imperial Steel Works) and ratios of each having been as follows:

Iron Ore		Ratio	Iron Sand		Ratio
	tons	%		tons	%
1908.....	116,709	81.2	26,986		18.8
1910.....	105,038	82.9	21,655		17.1
1912.....	140,449	89.1	17,182		10.9
1914.....	121,491	88.9	15,159		11.1

Pig Ratio Steel		Ratio	Pig Ratio Steel		Ratio
Smelted from iron sand			Smelted from iron ore		
	tons	%		tons	%
1908.....	3,288	7.7	1,032	38.2	
1910.....	2,744	4.6	930	12.0	
1912.....	2,529	4.5	1,251	9.9	
1914.....	2,937	3.9	1,469	9.5	

Import.

Iron ores are imported from Chōsen and China, the quantity during the last seven years having been as follows:

Chōsen		China	
	tons		tons
1908.....	56,896	133,427	
1909.....	98,520	89,016	
1910.....	78,687	107,844	
1911.....	107,474	123,001	
1912.....	123,534	195,869	
1913.....	142,570	278,230	
1914.....	162,214	297,183	

This imported ore was mostly smelted in the Imperial Steel Works.

The import of iron shows a rapid yearly increase, the quantity since 1908 having been:

	tons		tons		tons
1908.....	389,512	1909.....	334,303	1910.....	401,576

	tons		tons
1911.....	536,487	1913.....	708,739
1912.....	736,336	1914.....	533,636

Distribution and Amount of Iron Ores.⁽²⁾

Of late surveying for domestic iron ores has been rather neglected, and no discoveries have been reported. In 1911 Mr. J. Ōhigata, then the geologist of the Survey, conducted the geological survey of the provinces of Oshima and Iburi, the iron deposits there having been investigated at that time⁽³⁾. The said deposits consist of bog iron ores and iron sands. These bog iron ores are believed to have been deposited by ferruginous springs, and form beds in Diluvium, sometimes lying directly on it or on liparite. Iron sand is found mixed with sea-sand along the shore of Volcano Bay and the southern coast of the province of Oshima. The amount of some of these deposits had been estimated by Mr. Yonekura⁽⁴⁾, but Mr. Ōhigata investigating them more closely has given the following results:

Mr. Ōhigata's calculation (Actual)

	tons	
Wakkatasappu.....	6,980,000	Former calculation (Probable)
Akagawa	147,000	
Abuta	395,600	tons
		200,000
Oshima & Iburi.....	728,001	225,798

Iron ores and iron sand mined since 1908 have been:

	tons		tons		tons
Kamaishi...	681,750	Sennin...	40,126	Hitokabe...	27,043
Chūgoku ...	82,415	Abuta ...	35,468		

(2) The Iron Ore Supply of Japan. The Iron Ore Resources of the World. 1910.

(3) Report of the Mineral Survey. (Japanese). No. 8. Imp. Geolog. Survey Japan. 1910.

(4) Report of the Mineral Survey of Hokkaidō. 1880. Government of Hokkaidō. The Iron Ore Supply of Japan. 1910.

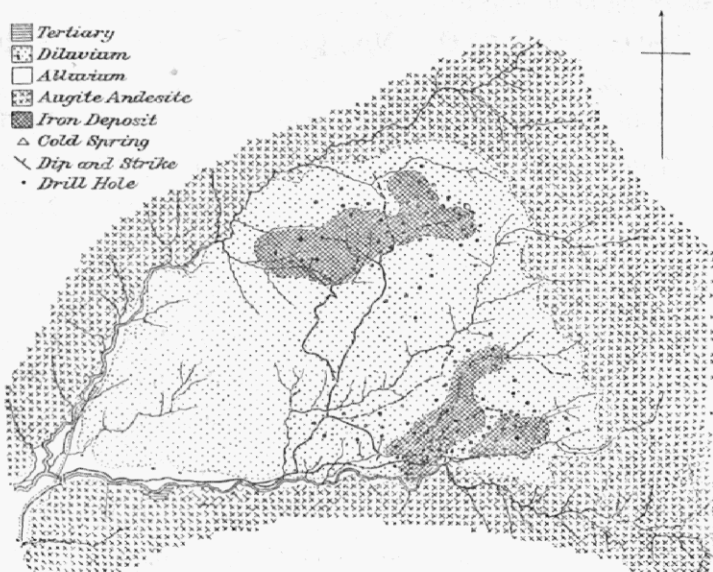
Description of Iron Ore Deposits.

WAKKATASAPPU IRON MINE, PROVINCE OF IBURI.

This mine is situated about 8 km. west of Higashi-Kutchan, a small town 16 km. west of Kutchan Station on the Kanson Railway connecting Hakodate and Otaru. The district forms an undulatory plateau, and is surrounded by low mountains consisting of augite-andesite. The plateau consists of clay in the lower, of sand and pebble in the middle, and of thick

Geological Map of Wakkatasappu Iron Mine.

Scale 1 : 40,000.



yellowish brown clay in the upper part. The iron deposit is interbedded in clay layers and has a varying thickness of 5 to 25 feet, in rare cases reaching 50 feet and more. It is bedded almost horizontally, sometimes parted into two by a clay layer. It is scattered in three areas, the extent of which has been ascertained by numerous borings as well as by outcrops. The northern area is the largest, occupying a space of not less than 67.8 acres. The thickness of the deposit there is mostly from 10 to 30 feet,

though it sometimes attains a thickness of 79 feet. The quantity thus calculated is roughly 3,950,000 tons. The two other areas lie in the southern part, near each other on an east-west line. Their extensions are smaller than the former, the western one being 37.8 acres, the eastern 14.6 acres. The thickness varies mostly from 10 to 25 feet, with 50 feet in the thickest part. The quantity thus estimated is roughly 2,519,000 and 840,000 tons respectively.

The ore is a loose and porous bog iron ore, dark reddish brown, or yellowish brown in colour. It is generally of inferior quality, the result of analysis being as follows:

	SiO ₂	Fe	Al ₂ O ₃	Mn	CaO	S	P	Loss Ign.	Sp. gr.
	%	%	%		%	%	%	%	
Northern	3.48	50.41	6.95	trace	0.48	0.11	0.153	16.97	2.825
„	7.08	51.63	1.90	„	—	0.13	0.027	17.05	2.799
„	1.44	51.56	0.92	—	—	0.78	0.045	22.98	2.582
Southern									
Eastern	1.34	52.58	2.36	—	—	0.68	0.022	20.91	2.858
„	1.91	50.75	6.13	—	—	0.18	0.064	19.73	2.459
Western	3.76	53.86	0.66	—	—	0.32	0.055	18.57	2.713
„	1.06	52.77	1.01	—	0.42	0.89	0.054	21.35	2.728
„	3.06	52.84	4.92	—	—	0.11	0.048	16.77	2.715
„	2.44	50.14	5.51	—	—	0.21	0.077	22.11	2.303
„	2.34	43.32	3.70	—	—	0.06	0.096	13.83	2.660
„	6.84	49.74	—	—	—	1.41	0.020	27.05	2.300

IRON DEPOSITS ON THE PE-EPENAI RIVER, PROVINCE OF IBURI.

The deposits consist of loose dark brown bog iron ore of inferior quality, being the sediment of mineral springs, encrusted on the liparite. They are found on the upper Pe-epenai, about 10 km. northeast of Higashi-Kutchan. The extent is very limited and the thickness is only from 2 inches to 2 feet.

IRON DEPOSITS ALONG LAKE TōYA, PROVINCE OF IBURI.

Along Lake Tōya, lying at the north of the volcano Usu, bog iron ore deposits occur in several places, of which three will be mentioned here.

1. Bog iron ore deposits along the Poropet river, running down to the northern part of the lake, are found on the liparite, encrusting its surface and cropping out in a narrow area of 5 to 20 feet into 150 to 160 meters. The thickness is 2 to 5 feet.

2. Bog iron ore deposits are found along the valleys of the Akagawa and Kutchanpet rivers, which flow into the lake from the east. That found on the Akagawa is interbedded in the terrace deposits and has a thickness of about 3 feet. The extent examined by wells and outcrops is 66.8 acres. The calculated quantity is thus roughly 147,000 tons. That found on the Kutchanpet is quite limited in area, the thickness being only 1 to 2 feet. The ores are of a loose yellowish brown variety.

3. Bog iron ore deposits scattered in the terrace deposits on the western shore of the lake. The two larger deposits have a length of only 300 and 130 meters respectively and are covered by superficial clay 1 to 3 feet thick. The thickness of the deposits is 3 feet on an average. The ores are of a porous yellowish brown variety.

ABUTA IRON MINE, PROVINCE OF IBURI.

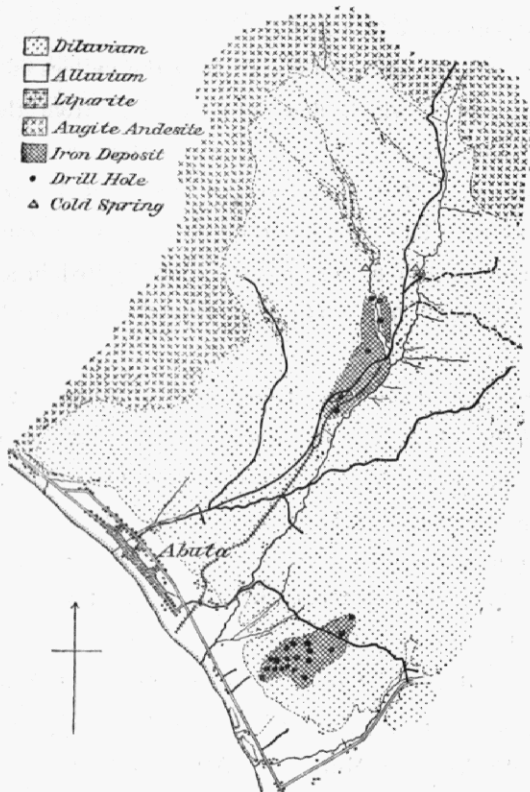
This mine is conveniently situated near the coast in the small town of Abuta. It was discovered in 1892, and since 1906 has been worked on a small scale, shipping the ore to the Imperial Steel Works and Wanishi Iron Works near Muroran. After three years the work was stopped, when the Imperial Steel Works began importing cheaper and better ore from Chōsen. Two years ago it was reopened, shipping the ore to the Wanishi Iron Works. The ore mined since 1906 has been 35,468 tons.

The northern part of the district is composed of and site and forms an

undulatory plateau, about 300 meters in height. To the south of it a wide terrace gradually slopes toward the coast until it ends in cliffs a few meters in height. The plateau consists mainly of pumiceous sand layers in the lower, and gravel layers in the upper horizon. These layers rest directly

Geological Map of Abuta Iron Mine.

Scale 1 : 40,000.



on augite-andesite and are covered by volcanic ashes, generally to a depth of 2 feet. The total thickness of these layers varies from 40 to 100 feet. The iron deposits are found in two places intercalated in gravel layers, or resting on them. The northern one lies about 300-400 meters northeast

of Abuta and is interbedded in the gravel layers or directly covered by volcanic ashes. The extent is estimated to be 9.7 acres and the average thickness 12 feet, being 15 to 20 feet in the outcrops. Thus the estimated quantity is 282,000 tons. The quality of the ore varies in places, the better part being dark gray and hard with submetallic luster. The common run is yellowish brown, granular, brittle and somewhat porous, with no luster and mixed with clay. The inferior variety varies from yellowish brown to dark reddish brown, and is porous and brittle, with abundant admixtures. The result of analysis is as follows:

SiO ₂	Fe	Al ₂ O ₃	Mn	CaO	S	P	Loss	Ign.	Sp. gr.	Cu	H ₂ O
	%	%			%	%		%			
3.98	50.49	1.42	—	trace	0.75	0.057	23.00	2.535			
1.61	52.63	1.39	—	„	0.65	0.003	22.05	2.593			
3.11	53.00	1.84	trace	„	0.64	0.0031	9.10	2.561			
2.81	39.74		0.62%		0.80	0.049				%	%
2.13	39.80		0.18		0.93	0.030				0.014	12.15
4.43	39.56		—		0.30	0.014				0.005	14.28
2.48	37.53		—		0.12	trace				trace	—
										„	—

The southern deposit is found in the plateau near the coast, about 600 to 700 meters southeast of Abuta. It rests on the gravel layers and is covered by soil. The area is only 7.8 acres, with an average thickness of 6 feet, from which we have estimated the quantity to be 113,600 tons. The ore is of the common variety, being yellowish brown and granular.

IRON SAND IN SHIRIKISHINAI, PROVINCE OF OSHIMA.

The small village of Shirikishinai lies about 40 km. east of Hakodate, a port in the province of Oshima. Iron sand is found along the sea coast from Shirikishinai, westwards to Kobui. The deposits may conveniently be divided into three sections. The eastern section extends from the mouth of the Shirikishinai river southwards to the post-office, about 6,000 feet in length, and from 60 to 200 feet in breadth,—400 feet in the north. The middle section extends south from the mouth of the Kobui river, the

length being about 5,000 feet and the breadth 70 to 300 feet. The western section lies along the sea coast south of the mouth of the same river, with a length of about 2,700 feet and a breadth of 80 to 400 feet. The thickness of the iron sand layer is less than 4 feet, usually from 6 inches to 2 feet 3 inches. Its extent and average thickness are given below.

	Area	Thickness	Quantity
	sq. ft.	ft.	tons
Eastern Section.....	1,121,234	1.48	96,247
Middle Section.....	999,702	1.88	109,007
Western Section.....	662,548	1.33	51,109
Total	2,783,484		256,363

The iron sand consists of magnetite grains mixed with quartz sands. The quantity of the quartz sand is so large that it is absolutely necessary to dress the ore for the smelter, otherwise the iron content is too low for smelting. The average of analyses of the ore collected in 28 localities shows 31.76% of iron and 2.94% of titanium. The total quantity of this iron sand given in my former report as 25,882 tons should be 256,363 tons.

IRON SAND ALONG THE SHORE OF VOLCANO BAY.

Iron sand is found along the coast between Yakumomura in Yamakoshi district, province of Iburi, and Numashiri in the Kayabe district, province of Oshima, i. e. along the southern and western shores of Volcano Bay. The length has been estimated to be about 52 km. and the breadth generally from a few feet to 50 feet or sometimes to 200 feet, with a thickness of from 7 inches to 3 feet. The extent and thickness of the iron sand layer are given below.

	Area	Thickness	Quantity
	sq. ft.	ft.	tons
Kayabe District	2,574,600	1.0-2.5	236,900
Yamakoshi District...	3,682,100	1.0-1.3	234,738
Total.....	6,256,700		471,638

The iron sand is quite similar to that in Shirikishinai, consisting of magnetite grains mixed with quartz. The result of analysis is as follows :

	Fe	Ti
	%	%
Kayabe District(Average of 11 specimens)	35.07	2.32
„ (Average of 4 specimens)	45.55	2.08
Yamakoshi District...(Average of 20 samples)	38.72	2.96

The quantity of iron sand which was estimated in my former report as 199,916 tons should be 471,638 tons.