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A STUDY ON IRON ORE DEPOSITS OF INDIA, PRESENT STATUS AND FUTURE PROSPECTS – A REVIEW

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Abstract: **Iron ore is the most important metal in this Industrial age. It occurs all over the world, majorly it occurs in USA, Australia, Russia, Chile, Venuzula and India. In India, it occurs as banded ferruginous fromations, sedimentary iron-ores of sideritic or limonitic, lateritic iron-ore, titaniferous and vanadiferous magnetites, fault and fissure fillings of hematite. In India Iron ore occurs in five major states of Karnataka, Goa, Chattisgarh, Orissa, Jharkhand and minorly in Andhra Pradesh, Uttar Pradesh, Assam etc.. Production of Iron ore in India is carried out in different grades as lumps (high, low grades), fines (high and low grades), beneficial grade of Hematite and metallurgical, coal washery of Magnetite etc..production is carried out by public and private sectors like National Mineral Development Corporation, Steel Authority of India, Tata Steel Ltd etc..production in India is undulating over the years but from last 4 years its production is increasing to meet its demand to the industries and consumption of Iron Ore in India increases at a maximum rate majorly in steel and other industries. India produces 192.08 million tonnes (as per 2017) and having reserves of 28.52 billion tonnes for the future.**

Keywords: *Iron Ore, Occurrence, Distribution, Production, Reserves, Resources, Future*.

I INTRODUCTION

Iron is the fourth most abundant element in the earth's crust after oxygen, silicon and aluminium and second most abundant metal in the earth, the character of its natural compounds prevented its use as early as some other metals. It was known by 4000 B.C., and the Egyptian Pharaohs regarded it more highly than gold, but this probably was the rare meteoritic iron. Apparently by 1200 B.C. iron was manufactured but was still rare, and its industrial use did not commence before 800 B.C., which dates the start of the Age of Iron. Steel came into use about 800 years later and the blast furnace in the fourteen century. During the sixteenth century the forests of Great Britain were denuded to supply charcoal to smelt iron ore, but this waste became unnecessary when the great discovery was made about 1710 that coal could be used to reduce iron ore. This was the beginning of the great industrial age of iron that culminated in the steel age made possible by Bessemer's discovery in 1856. In the nineteenth century Great Britain with her resources of iron and coal became the first and greatest of the modern industrial nations

II INDUSTRIAL USES

Iron is the new backbone of modern civilization. When iron , is not suitable for certain uses, it is alloyed with other substances to make it suitable. To enumerate the various uses of iron would be to compile a history of the innumerable creations of modern civilization and industry. Each of the main types of iron – steel, cast iron, wrought iron and iron alloys – has its applications such as train tracks and other types of infrastructure which is one reason for great demand in many countries, and also used in medicine, cosmetics, engineering, construction, paint and a whole range of products

Commercially, iron is a very important metal. It is found in the form of chemical compounds with other elements in a number of minerals. Natural occurrences of iron

ore are abundant all over the world. Iron ore occurs most abundantly in the form of oxides. Other forms are carbonates, important minerals of iron are hematite and magnetite. Some of the major iron bearing minerals with Fe content and its hydroxides, sulphides and silicates. It is also found in association with titanium dioxide. But most commercial composition are given in the table 1.

Name	Formula	Wt % Fe
Hematite (alpha and martite) [oxide]	Alpha Fe2O3	70
Turgite [oxide]	2Fe2O3H2O	66.1
Magnetite [oxide]	Fe3O4	72.36
Goethite [oxide]	Fe2O3.H2O	62.58
Limonite [oxide]	FeO(OH) · n(H2O)	52 (n=1)
Ilmenite [oxide]	FeTiO2	36.8
Lepidocrosite [oxide]	Fe2O3.H2O	60
Maghemite [oxide]	Gamma-Fe2O3	69.9
Siderite [carbonates]	FeCO3	48.2
Pyrite [sulphides]	FeS2	46.5
Marcasite [sulphides]	FeS2	46.6
Pyrrhotite [sulphides]	FeS2	61.6
Chamosite [silicates]	(Mg, Fe, Al)6 (Si,Al)4 (OH)8	33.42

Table-1: representing different Fe bearing minerals their composition and Fe content.

III GEOLOGY

Iron Ore formations occurring throughout the Geologic Time is illustrated in the following table.

Table-2 Representing the Iron Ore formations occurring throughout the Geologic Time

	Formation	Nature of ore	Occurrence
Quaternary		Laterite	Many states – derived from many formations including Deccan Traps.
Tertiary	Miocene and Eocene	Ironstones	South India – Travancore, Malabar, etc.; Assam – NE districts; U.P.-Kumaon
Jurassic	Rajmahal Trap (intertrapean beds)	Ironstones	West Bengal; Bihar – Rajmahal, Birbhum
Gondwana	Barakar Mahadeva Ironstone shale Triassic	Ironstones and siderite Siderite Ironstone and siderite Hematite and goethite	West Bengal – Birbhum; Bihar-Auranga coalfield; West Bengal – Ranjganj coalfield; Kashmir
Cuddapah	Bijawar Gwalior	Hematite and Ferruginous quartzite	Madhya Pradesh – Gwalior, Indore, etc.; Andhra Pradesh-Cuddapah
	Basic and ultra basic rock	Titaniferous and Vanadiferous magnetite's	Bihar-S E Singhbhum Orissa-Mayurbhanj
	Granodiorite Granite	Apatite-magnetite rocks Magnetites (residual)	Singhbhum Assam-Jaintia Hills; Karnataka-Kudremukh.

Precambrian	Banded Iron Formation (BIF)	Hematite Massive Shaly, Powdery etc,	Orissa – Sundergarh, Keonjhar, Mayurbhanj; Karnataka-Shimoga, Bellary-Hospet, Dharwar etc.; Bihar- Singhbhum (west); Maharashtra-Ratnagiri, Chandrapur; Madhya Pradesh-Bastar (Bailadila), Durg, Jabalpur
	Banded Iron Formation (metamorphosed)	Magnetite - Quartzite	Tamil Nadu – Salem, Tiruchirapalli; A.P.-Guntur; Karnataka-Shimoga, Chikmagalur; Himachal Pradesh - Mandi

IV OCCURRENCE OF IRON ORES

In world context:

Iron ores of multi – origin deposits are widely distributed under various geologic conditions. They occur in different nature as basins of sedimentation, with eroded, deep – seated intrusive, and where deep tropical weathering prevails.

In North America magnetite deposits occur in the deeply dissected regions of plutonic intrusions, such as the north-eastern states and the Cordillera. Hematite deposits outcrop around the margins of the great sedimentary basin from Alabama to New York to Wisconsin and in Newfoundland. They are abundantly and richly concentrated in the Lake Superior region. Residual deposits occur in the eroded Appalachians and in Cuba.

In Central Europe great sedimentary deposits underlie parts of Lorraine, Luxembourg, France, Belgium and Germany. There are rich oxide deposits of igneous and metamorphic origin in Sweden. Farther east and north are extensive deposits of the Ukraine and European Russia.

In Africa good – quality ores lie near the Mediterranean in Morocco and Algeria and large bodies of low – grade magnetite lie to the south in the Transvaal.

In South America some extensive deposits in Brazil, Chile, and Venezula. Asia has stupendous resources in India and minor ones in China.

Indian context:

Banded iron formation has given rise to vast accumulations of iron ore deposits in India and more than 90% of the iron ore supplied to the industry comes from the Banded Iron Formation. All the iron ore deposits of India belong to Dharwar group composed of metavolcanics and metasediments. Major iron ore deposits in India occur in Singhbhum district (Jharkhand), Keonjhar district (Orissa), Bellary district (Karnataka), Bastar district (Chhatisgarh) and Goa. Thedifferent textural types of iron ore within the deposits are (a) massive ore (b) laminated ore and (c) blue dust.

Based on their association with rock formations, iron ore deposits in India can be broadly classified into two groups:-

1. High-grade region of southern Karnataka, Kerala, Tamil Nadu and Andhra Pradesh.
2. Archaean greenstone belts of Madhya Pradesh, Chhattisgarh, Bihar, Orissa, Goa and Karnataka.

Iron Formations in the high-grade metamorphic regions are older formations (3500- 3000 million years) and have been subjected to deformation and metamorphism. Minor bands of intimately folded and metamorphosed iron-rich beds occur in such an association. Iron formations in the younger (2900-2600million years) Archaean greenstone belts form continuous bands and contain rich concentrations of iron.

The major iron ore deposits of India are described in the followng sections.

Jharkhand:

In Jharkhand iron ores are majorly of hematite and magnetite. Precambrian sedimentary rocks are being intruded by basic intrusive of iron ore group in the host rock of iron formations. These rocks are folded which occur as a series of ridges capped with thick deposits of hematite ore. Alternate bands of hematite and jasper occur exhibit a variety of textures and contain varying proportions of iron as massive, compact ores occures as capping ridges contain 66% to 70 % iron, shaly ore exhibiting laminated texture that is composed of hematite contain less than 50% iron, lateritic ore contain

56-58 % iron, blue dust, grayish blue in color that occuring in pockets contain 65-68 % iron.

Iron ores occurs in several areas of Singbhum and Palamau districts of Jharkhand. In the Singbhum district, important iron ore deposits that occurs as hematite in a number of prominent hills in the south and west parts of the district and continued into the Keonjhar and Sundergarh districts of Orissa and forming the famous Singhbhum-Keonjhar-Bonai group of deposits. Titaniferous magnetite ores that are consisting of ilmenite and magnetite as major and minor haematite, rutile and goethite occurring as thin veins, lenses and pockets in gabbroid and ultrabasic rocks. The Precambrian formations in the area are the older Iron Ore Series and younger Kolhan Series. The rock formations have undergone multiple episodes of deformation. The iron ore group of rocks are broadly divided into three types based on their mode of origin

i) Iron Ore Group of clastic facies
ii) Iron Ore Group of Transitional chemogenic facies
iii) Iron Ore Group of volcanogenic facies. The iron formation, which overlies the volcanic pile, consists of beds of jaspilite and haematitic rock and contains varying proportions of iron oxide and silica.

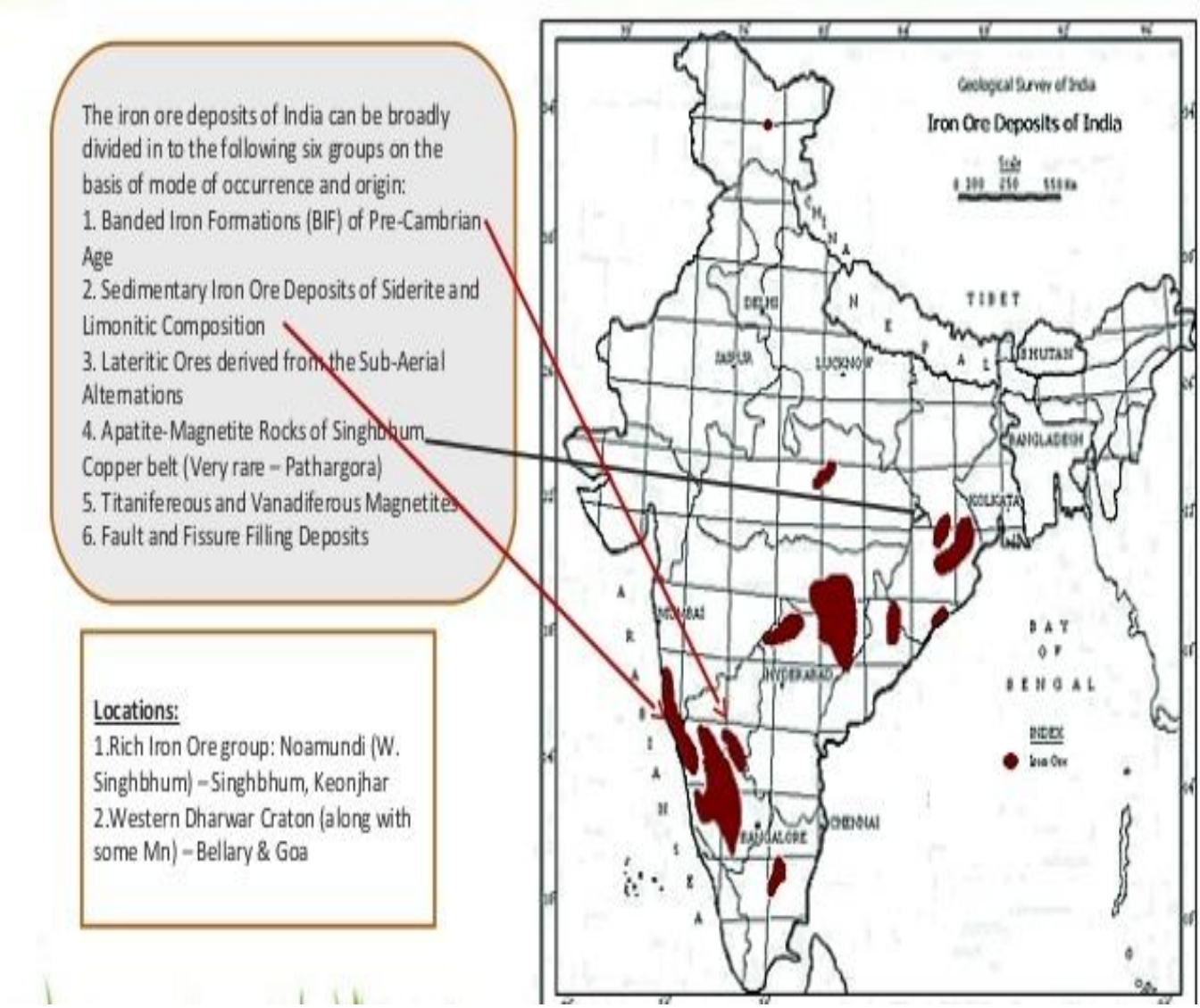

Figure 1 Map showing Iron Ore deposits in India (source– Geological Survey of India

In the Palamau District, iron ores occur in three types

i) Magnetite occurring as bands in metamorphic rocks
ii) Siderite and hematite occurring as beds in shale of Barakar Formation
iii) Laterite ore on the plateaus, where magnetite ores occurring as fragments and lumps.

Orissa:

Iron ore deposits of Orissa occurs in five different zones majorly-

1. Bonai- Keonjhar
2. Gandhamardan
3. Tomka- Daitari
4. Gorumahisani-Badampahar
5. Hirapur.

Iron ore deposits of this region are occuring as Banded Haematite Jasper, Banded Haematite Quartzite and ferruginous shales. These banded iron ores are composed of magnetite, goethite and magnetite-haematite. These Banded Hematite Jasper consists of alternate layers of dark bluish-grey haematite and red coloured jasper and thickness of these bands that may vary of range 0.5 - 1.15 cm. These deposits are considered as products of surface alteration of Banded Hematite Jasper. Iron content of these unaltered Banded Hematite Jasper is around 20%-30% while iron content of some enriched Banded Hematite Jasper ranges from 55%-70%.

Northern part of Orissa is covered by the cratonic block of Singbhum and it is also a store of iron ore. The rich iron ore occurs in Keonjhar, Sundergarh, Jajpur, Mayurbhanj, Nawrangpur and Sambalpur districts.

Chattisgarh:

Huge deposits of higher quality iron ores are found in Bastar, Durg, and Dantewara districts of Chhatisgarh. Minor deposits occur in Raigarh, Raipur, Bilaspur, Rajnandgaon, Kanker and Jashpur districts. Majority of the iron ore deposits of Bastar and Durg districts are associated with Bailadila Iron Ore series of Archaean age. This Bailadila iron Ore Series of rocks resembles iron ore series of Singhbhum-Keonjhah- Bonai of Orissa and Jharkhand.

The Bastar craton of the central Indian peninsular shield comprises high grade metamorphic rocks which include metasediments, metabasites, charnockites and gneiss-migmatite complex referred to as the Bengpal group. This Bengpal group is overlain by Banded Iron Formation - greenstone sequencewhich is referred as Baildiala group. The Bailadila iron ore series occur as a synclinorium with N-S axis and a central eroded anticline flanked by two synclines, which form ridges with important bands of iron ore. Most of these iron deposits are composed of haematite ore and few are small deposits of magnetite ore. The iron formations having similarities in lithological association and tectano-metamorphic history with the iron formations of other belts. The Bailadila group which contains bulk of the iron formations comprises of quartz sericite schist, arkosic quartzite at the base, followed by Banded Iron Formation associated with shale-siltstone carbonaceous shales and interbedded tuffs, intruded by greenstones and granites.

The Kauchar iron ore deposit is the largest in the Durg district. This deposit occur in association with Dharwarian banded hematite quartzite belongs to Bailadila iron-ore series. The Banded hematite quartzite is overlain and underlain by ferruginous shales and phyllites. The Banded Hematite Quartzite formations forming prominent ridges and having folded into anticlines and synclines. Many ore bodies comprising of massive and laminated hematite are found at or near the top of the ridges; earthy-limonitic, brecciated and lateritic type iron ores are present in smaller quantities.

Karnataka:

The major iron ore deposits of Karnataka occur in the Sandur hills of Bellary-Hospet sector in Bellary District and Bababudan hills and Kudremukh-Gangamula range in Chikmagalur district. Chitradurga, Shimoga, Bijapur, North Kanara, South Kanara , Hassan districts contain smaller iron deposits. The principal ore minerals occur in various types of deposits are magnetite, haematite, limonite, siderite and pyrite. Iron ores of Karnataka may be classified besed on their mode of occuring as below.

1. Sedimentary type occurs in the form of banded haematite quartzite and magnetite quartzite rocks of Archaean greenstone belts of Karnataka in three district horizons: Greywacke association in parts of Ranibennur, Haveri, Gadag, Chikkanayakanahalli, Chitradurga, Kudremukh and Sandur areas.
2. Metamorphic type occurrs in association with granulites as Magnetite- Quartzite encountered in high grade metamorphic rock formations referred to as Sargurs
3. Magmatic type consists of Vanadium and titanium bearing magnetite bands associated with gabbroic-ultramafic layered complex forming a component of the ancient in Sargurs.

In Bellary-Hospet area, the Sandur schist belt comprises of a thick pile volcanic rocks with minor amount of sedimentaries where these volcanics are of basic to acid varieties and sedimentaries are mechanically transported and chemically precipitated type The following types of iron ores are reported:

(1) Primary ore : Hard massive ore with Fe content 62% - 68%

(2) Secondary ore :

a) Lateritic ore with 50% - 55% Fe

(b) Thickly and thinly laminated ore with 62%-68% Fe

(c) Shaly ore with 55%-58% Fe

(d) Biscuity ore and blue dust with 60%-69% Fe

In Chikmagalur district, major iron ore deposits occur in Bababudan hill range and Kudremukh-Gangamula range. Magnetite and haematite quartzite ore bands occur an area covering of 400 sq km in the Bababudan belt consisting almost Dharwar Supergroup rocks.

The Kudremukh-Gangumala range consisting of metasediments and metavolcanics of Dharwar Super-group. Two main types are recognized as cherty type and shaly type. This iron ore formations have been lateritized where depth of

weathered zone varies, where it is thicker in ridges and thinner in valleys. The weathered zone varies about 30-50 m.

Apart from the residual concentration of iron ore over the sedimentary banded iron formation, there is another class of ore deposits associated with mafic and ultramafic rocks in many parts of Karnataka. The major in these occurrences are those forming in the Nuggihalli schist belt, titaniferous ore occurs as continuous beds in association with anorthositic gabbro and contain titanium and vanadium with magnetite.

Goa:

Iron ores of Goa are the northern most extension of Chitradurga Group of Dharwar Supergroup in Karnataka, they range from Archaean to Proterozoic era. Precambrian formations of Goa consisting of quartzite, quartz-sericite-schist, metavolcanics, metagreywacke, conglomerate, pink phyllite with lenticular bodies of banded ferrugineous quartzite and limestone intruded by ultrabasic and basic sills and dykes. Such of these formations are intruded by the younger granite, pegmatite and vein quartz. Iron ores of Goa have been differntiated into 4 types:

1. Lateritic ore derived from weathering of ferruginous phylllite with 48-50% Fe.
2. Lumpy hard ores, massive and laminated, cherry red in color with about 60 % Fe.
3. Friable or biscuity ore, derived by extensive leaching which is porons, soft and crumples easily, containing about 60% Fe.
4. Blue dust or powdery ore consisting essentially of skeletal, flaky, loose hematite or sometimes magnetite, with occasional fragments of hard ore or siliceous bands, containing 63-68% Fe.

Lateritic iron ores are the main source of iron which is of two types- lumpy ore made up of haematite and powdery ore made up of magnetite majorly. Goethite and limonite occurs as alteration products.

Reserves/Resources:

Hematite and Magnetite are major important iron ores in India where 79% hematite ore deposits are found in Assam, Bihar, Chattisgarh, Jharkhand, Odisha and Uttar Pradesh while 93% magnetite ore deposits occur in Andhra Pradesh, Goa, Karnataka, Kerala and Tamil Nadu. Karnataka only contributes 72% of magnetite deposit in India. Out of these, hematite is considered to be superior because of its higher grade. Indian deposits of hematite belong to the Precambrian Iron Ore Series occurring as massive, laminated, friable and also in powdery form.

Reserves and Resources are carried out by exploration, these reserves/resources classification is shown in the figure 2. The total reserves/resources of hematite as per 2015, it has been estimated as 22,487 million tonnes of which 5,422 million tonnes (24%) are under 'Reserves' category and the balance 17,065 million tonnes (76%) are under remaining resources category. By grades, lumps are about 56%, lumps with fines (17%), fines (16%) and the remaining 11% are black Iron Ore. In the table 3 hematite deposits are of all grades and states wise reserves and resources are given in tonnage from the source of IBM annual reports.

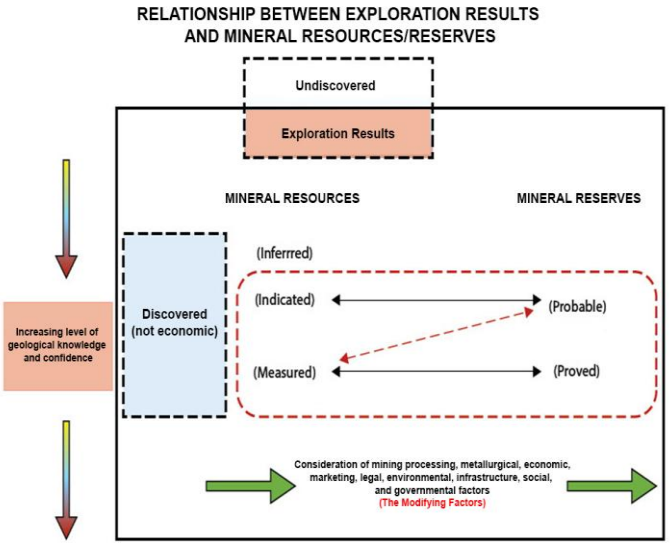

Figure 2: showing the classification of Reserves/Resources (source- google images)

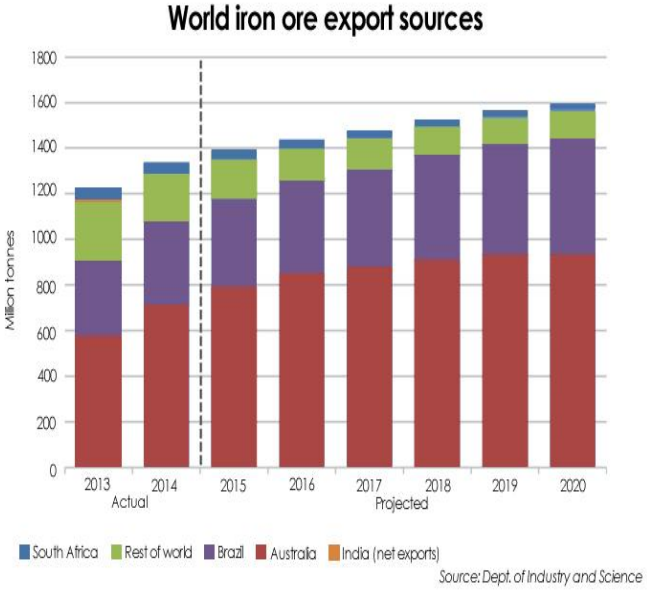

Figure 3: Production of Iron Ore in the world (source: Department of Science and technology, Australia).

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Table-3: Reserves and Resources of Iron Ore (Hematite) as on 1.04.2015 by grades/states. source-IBM anual report 2017

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	Total Resources (A+B)
		STD121	STD122			STD221	STD222						
All India	**4053032**	**449917**	**918801**	**5421751**	**3444103**	**1573822**	**1496674**	**1762741**	**1798557**	**4498142**	**2491176**	**17065214**	**22486965**
By Grades													
Lump, high grade	1207974	2751	213649	1424375	458544	40887	144840	198115	37065	195774	74865	1150092	2574466
Lump, medium grade	1021112	94231	325808	1441151	1726230	737324	645733	912442	997496	1141891	6039	6167154	7608306
Lump, low grade	122710	50314	89654	262679	195265	78584	132621	39796	127858	925985	225687	1725796	1988474
Lump, unclassified grade	204	28	16	248	56654	-	8791	16969	34488	152248	22800	291951	292200
Fines, high grade	271459	-	79169	350628	18995	1889	4849	146969	11174	25567	4890	214334	564962
Fines, medium grade	120083	62207	6571	188862	50161	265570	49801	337543	286918	494180	932	1485104	1673967
Fines, low grade	237700	31006	41557	310263	196422	119619	120401	11163	94702	401756	6094	950157	1260420
Fines, unclassified grade	389	-	593	982	343	669	130	8624	12908	118978	15200	156851	157833
Lumps & fines high grade	195566	12720	-	208286	84292	94614	67894	9748	8561	61307	112375	438791	647077
Lump & fines medium grade	440515	73933	84121	598568	134534	56987	101242	994	15969	201152	241259	752136	1350705
Lump & fines low grade	166999	5718	37294	210012	270249	73244	87740	27296	64404	431242	160391	1114567	1324579
Lumps & fines unclassified	123828	94850	26131	244809	73134	10373	21754	44082	100360	100693	4088	354485	599293
Black iron ore	-	-	-	-	7017	3014	1355	-	1059	6661	-	19106	19106
Lump low & medium grade	9529	5259	-	14788	-	13865	-	-	-	-	-	13865	28653
Beneficiable grade	31307	11183	714	43204	115078	44183	88181	1538	1003	64982	63708	378673	421877
Others	28413	-	2521	30934	19712	60	10861	708	1432	5197	745	38715	69649
Unclassified	60225	3356	8750	72331	36845	10699	8263	4746	3006	12094	27252	102905	175236
Not-known	2673	614	1148	4434	629	20000	1659	-	151	158432	1524850	1705721	1710155
Lump & fines & blue dust unclassified grade	12345	1746	1106	15197	-	2241	560	2009	-	-	-	4810	20007
By States													
Andhra Pradesh	17664	273	11832	29768	40595	49589	68425	377	4666	147628	13	311293	341062
Assam	-	-	-	-	-	-	-	-	8600	4000	-	12600	12600
Bihar	-	-	-	-	-	-	-	-	-	55	-	55	55
Chhattisgarh	1067636	78071	241730	1387437	255074	61735	47394	921139	613433	801086	770827	3470687	4858124
Goa	297271	34709	26259	358239	301806	214187	134955	15286	11535	141558	11747	831075	1189313
Jharkhand	365111	29238	45022	439372	1081242	458866	457724	207324	597413	673009	1371468	4847045	5286417
Karnataka	416684	46169	87394	550247	518155	48231	211632	248299	44094	669239	176956	1916607	2466854
Madhya Pradesh	44203	3635	14225	62063	48412	3650	36774	23243	9008	146803	10	267900	329963
Maharashtra	11283	3032	2926	17241	9028	6673	8858	75724	71806	72588	32185	276862	294103
Meghalaya	-	-	-	-	-	-	-	-	-	225	-	225	225
Odisha	1830569	252615	489034	2572217	1180055	704302	530440	271349	426493	1773077	100730	4986447	7558664
Rajasthan	2103	2175	380	4658	8764	6105	471	-	11510	6897	-	33745	38404
Telangana	509	-	-	509	973	483	-	-	-	23977	27240	52673	53181
Uttar Pradesh	-	-	-	-	-	20000	-	-	-	38000	-	58000	58000

Figures rounded off.

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Table- 4: Reserves and Resources of Iron Ore (Magnetite) as on 1.04.2015 by graades/states. Source- IBM annual report 2017

Grade/State	Reserves				Remaining Resources								
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	Total Resources (A+B)
		STD121	STD122			STD221	STD222						
All India : Total	**30352**	**2311**	**20037**	**52699**	**223388**	**15494**	**64091**	**1513195**	**1984566**	**6351286**	**584436**	**10736455**	**10789155**
By Grades :													
Metallurgical	8355	-	3308	11663	165948	-	21530	690596	342792	964399	255	2185521	2197183
Coal washery	16782	-	15847	32629	265	675	11001	411	318	37512	15455	65636	98265
Foundry	-	-	-	-	330	125	-	-	-	381	-	836	836
Others	749	-	443	1192	3796	985	62	-	-	1791	-	6633	7826
Unclassified	4099	2311	196	6606	52978	13709	31493	822188	1641456	5066948	568677	8197449	8204056
Not-known	366	-	243	609	71	-	6	-	-	280254	48	280379	280989
By States													
Andhra Pradesh	-	-	-	-	43105	-	-	13800	1266666	68527	-	1392098	1392098
Assam	-	-	-	-	-	-	-	-	-	15380	-	15380	15380
Bihar	-	-	-	-	-	-	-	-	-	2659	-	2659	2659
Chhattisgarh	8087	-	3096	11183	-	-	42	-	-	-	-	42	11225
Goa	4364	-	626	4990	59509	14516	33512	-	-	151811	1997	261345	266336
Jharkhand	-	-	-	-	-	518	1986	411	3948	3722	82	10667	10667
Karnataka	319	127	-	446	120022	-	18375	1498957	479372	5345018	340000	7801744	7802190
Kerala	-	-	-	-	-	-	-	-	59912	23523	-	83435	83435
Maharashtra	359	-	225	583	149	-	63	-	-	90	-	302	885
Meghalaya	-	-	-	-	-	-	-	-	-	3380	-	3380	3380
Nagaland	-	-	-	-	-	-	-	-	5280	-	-	5280	5280
Odisha	74	-	-	74	8	-	-	27	-	43	-	79	152
Rajasthan	17148	2185	16090	35423	595	460	10113	-	-	554904	15422	581493	616916
Tamil Nadu	-	-	-	-	-	-	-	-	169388	110728	226921	507037	507037
Telangana	-	-	-	-	-	-	-	-	-	71500	14	71514	71514

Figures rounded off.

Table – 5 : Principal Producers of Iron Ore 2016-17 (source- IBM annual report 2017

Name & address of producer	Location of mine	
	State	District
National Mineral Development Corporation Ltd, 10-3-311/A, Khanij Bhavan, Castle Hills, Masab Tank, Hyderabad –500 028,	Karnataka Chhattisgarh	Ballari Dantewada
Steel Authority of India Ltd, Ispat Bhavan, Lodhi Road, New Delhi – 110 003.	Jharkhand Chhattisgarh Odisha	Singhbhum (West) Durg Kendujhar, Sundergarh
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai –400 001, Maharashtra.	Jharkhand Odisha	Singhbhum (West) Kendujhar
Rungta Mines (P) Ltd, 8A Express Tower, 42A-Shakespeare Sarani, Kolkata – 700 017, West Bengal.	Jharkhand Odisha	Singhbhum (West) Kendujhar
Serajuddin & Co., P-16, Bentink Street, Kolkata-700 069, West Bengal.	Odisha	Kendujhar
Vedanta Ltd., Sesa Ghor, EDC complex, Patto, Panaji, Tiswadi-403 001 Goa.	Goa Karnataka	North Goa South Goa Chitradurga
Rungta Sons (P) Ltd., 8A Express tower, 42A- Shakespeare Sarani, Kolkata-700 017, West Bengal.	Odisha	Sundergarh
Odisha Mining Corporation Ltd, OMC House, Unit-5, P.B. No.34 Distt. Khurda, Bhubaneswar-751 001 Odisha.	Odisha	Kendujhar Sundergarh
Kamaljeet Singh Ahluwalia, Near MMTC Weigh Bridge P.B.No. 3, Barbil-758 035, Distt. Kendujhar, Odisha.	Odisha	Kendujhar
Indrani Patnaik, A/6, Commercial Estate, Civil Township, Rourkela - 769 004 Odisha.	Odisha	Kendujhar
Mysore Minerals Ltd, No. 39, M.G. Road, Bengaluru - 560 001, Karnataka.	Karnataka	Ballari
Kaypee Enterprises, Near MMTC Weigh Bridge, P.B. No.3, At/PO-Barbil-758 035, Dist. Kendujhar, Odisha	Odisha	Kendujhar
Jindal Steel & Power Ltd., O.P. Jindal Marg, Delhi Road, Hissar-125 005 Haryana.	Odisha	Sundergarh
Aryan Mining & Trading Corpn. (P) Ltd., 61, Strand Street, Kolkata-700 006, West Bengal.	Odisha	Sundergarh
Essel Mining & Industries Ltd. Industry House, 18th Floor, 10, Camac Street, Kolkata- 700 017 West Bengal	Odisha	Sundergarh
Khatau Narbheram & Co., N.V. Ram Complex, Barbil-758 035, Distt. Kendujhar, Odisha.	Odisha	Kendujhar
Usha Martin Ltd, Mangal Kalash, 2A Shakespeare Sarani, Kolkata-700 071, West Bengal.	Jharkhand	Singhbhum (West)
Bonai Industrial Co. Ltd. Rungta Office, Main Road, P.O. Barbil-758035, Dist.Kendujhar, Odisha.	Odisha	Sundergarh
Mideast Integrated Steels Ltd, Mesco Tower, H-1, Zamrudpur Community Centre, Kailash Colony, New Delhi-110 048.	Odisha	Kendujhar
Feegrade & Co. (P) Ltd., 8A.Express Tower, 42A- Shakespeare Sarani, Kolkata- 700 017, West Bengal.	Odisha	Sundergarh

(Contd.)

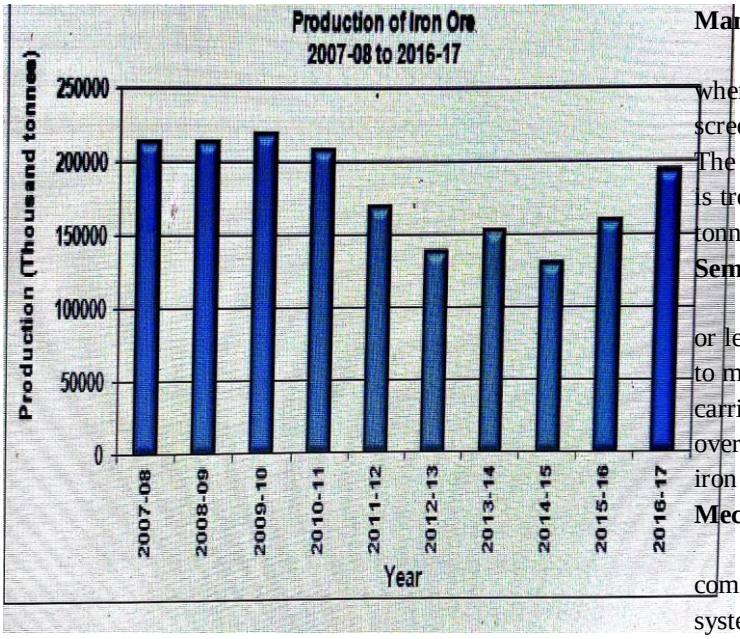

Figure 4: Production of Iron Ore in India over last ten years (source: IBM annual report 2017)

Magnetite occurs in the form of oxide, either in igneous or metamorphed banded magnetite – silica formation of sedimentary origin. The total reserves/resources of magnetite as on 2015 has been estimated at 10,789 million tonnes in which reserves alone has 53 million tonnes while 10,736 million tonnes are resources. On the basis of grade 20% resources are of metallurgical grade and 80% resources belong to unclassified, not-known and coal washery. In the table 4 magnetite deposits are of all grades and states wise reserves and resources are given in tonnage from the source of IBM annual reports.

Production:

In India, production of Iron ore is 192.08 million tonnes in the year 2016-17, over the last ten years production is undulating, but from last three years, it is increasing and is shown in the figure 4 (IBM annual report 2017), principle producers, mine location and states of iron ore production are given in the table 5 (IBM annual report 2017), while world production is 1460 (app) million tonnes and represented in the figure 3 (Department of Science and Technology, Australia) showing a gradual increase every year when compared to that in the preceding year. As the basic neeeds for Iron are increasing in all industries so, as to meet the demand and supply graph it is being produced

Mining practices:

Usually mining of Iorn ore is open cast method all over the world and sometimes if it is high grade and economically viable then underground is also being operated. The mining methods can be classified on the basis of mechanisation, into three types.

Manual mining:

Manual mining is being done by digging manually where float ores are explored. Mined material is being screened manually and separating float ore for production. The over size is treated to plants or metallurgy and undersize is treated as waste. Output per man shift is normally 1.5 to 2 tonnes. Manual mines are mostly under private sector.

Semi – mechanised Mining:

If iron ore is occurring in the form of small pockets or lenses of boulder or as segregation in laterite, it is difficult to mechanise the mining operation, such of these deposits are carried out in semi-mechanised mining method. In practice, overburden is being removed by machine operations and then iron ore is handled manually to minimise wastages.

Mechanised Mining:

India's 90% iron ore production in the country comes under mechanised mines. Mining is carried out in a systematic benches on overburden and orebody. The mining of ore/overburden is done by the combination of shovel-dumper, drilling and blasting. The loading operations and transportation is carried out by mine haul roads. Ore handling, washing and screening operations vary with the material required to be handled in the mines. Most of the mechanised mines are in the public sectors and some mines in Goa, Jharkhand, Orissa and Karnataka are also operated by Privately.

The reserves of high-grade iron ore are limited. Therefore, it would be necessary at this stage to ensure conservation of high-grade ore by blending with low grade ores. Research and Development efforts are carrying out for developing necessary technologies for utilising more and more fines in the production of steel as a measure of conservation of iron ores.

Future Outlook:

Mining of iron ore, an essential raw material for Iron & Steel Industry is arguably of prime importance among all mining activities undertaken by any country. At present India produces 65 million tonnes steel, but as per the 'National Steel Policy' country is expected to raise this production to 180 million tonnes by the year 2020 With the total resources of over 28.52 billion tonnes of hematite (Fe_2O_3) and magnetite (Fe_3O_4), magnetite reserves could not be exploited due to the presence of these ores in the 'eco-fragile' zones mainly in Western Ghats. Iron ore is found as hematite and magnate in India in the ratio of 63:37.

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13. Figure 2, showing classification of Reserves/Resources: source-google pics.
14. Table 3, representing reserves/resources of Iron ore hematite by grades/states as on 2015: source-IBM annual report of Iron Ore 2017.
15. Table 4, representing reserves/resources of Iron ore magnetite by grades/states as on 2015: source-IBM annual report of Iron Ore 2017.
16. Figure 3, Production of Iron Ore in the world: source-Department of Science and Technology, Australia 2017.
17. Table 5, representing principal producers of Iron Ore 2016-2017: source-IBM annual report 2017.
    Figure 4, representing production of Iron Ore over last ten years: source-IBM annual report 2017