

CHAPTER 4

INDIAN BAUXITE DEPOSITS

India produced 4.8 million tonnes of bauxite during the year 1990 and ranked at 5th position among the world producers during the year. The production comes from a number of Indian states namely Orissa, Bihar, Maharashtra, Madhya Pradesh, Gujarat, Tamil Nadu, Karnataka, Uttar Pradesh, and Goa.

The Indian deposits are mostly associated with laterite cappings occurring as blankets on the plateau and hill ranges of the coastal and peninsular regions. However occurrences of bauxite at lower levels are also common and increasing number of them are being brought to light from the west coast and central India.

The major bauxite deposits of India occur in the following four regions of coastal belt and central dissected table lands.

- (1) Deposits associated with the eastern coast line (Orissa and A.P.)
- (2) The deposits associated with plateaux bordering Bihar and M.P.
- (3) Deposits associated with Maikala range of M.P.
- (4) Deposits aligned along western ghats.

Besides the above, smaller and isolated deposits of bauxite also occur at -

- (1) Shevaroy hills, Kolli Hills and Kodaikanal in the Nilgiri - Palni hill ranges of Tamil Nadu.
- (2) Seoni, Kaimur and Malwa Plateaux and Kaskal-Bailadila range of M.P.
- (3) Vindhyan Plateau bordering U.P. - M.P.
- (4) Khadagpur hills on Bihar - West Bengal border
- (5) Kumbla in Kerala
- (6) In the eastern peninsular region high grade diasporic bauxite occur in Jammu region of J & K state.

The massive deposits of east coast belt now account for major part of Indian bauxite resources. The east coast bauxite belt comprising widely scattered and highly dissected bauxite deposits of Orissa & Andhra Pradesh states are located in Koraput, Kalahandi, Bolangir, Sambalpur, Sundergarh, Phulbani and Keonjhardistricts of Orissa and Vishakhapatnam and East Godavari districts of A.P. The discovery of vast deposits of bauxite in east coast belt has enabled India to make a quantum jump on the resources front. These deposits have relegated Bihar and M.P. to secondary positions. The central dissected tablelands extend over Ranchi & Palamau districts of Bihar and Surguja, Raigarh, Bilaspur, Durg, Mandla, Sahadol, Balaghat, and Seoni districts of M.P. and form the major sources of bauxite. Excepting the occurrence at Katni (Jabalpur) and Satna district of M.P., all the other deposits of this vast area are associated with laterites occurring on tops of plateaux. Significant deposits of bauxite also occur in the dissected tablelands and plateaux of Maharashtra and extend into parts of Karnataka. The major deposits of Maharashtra are known from Kolhapur, Satara, Sindhudurg, Kolaba and Thane districts. Here the low lying ranges parallel to the coast and running to 250 - 300 mtrs. above the sea level, show bauxitic segregations in the laterite capping. The bauxite bearing lateritic areas also occur on the hill ranges in Belgaum, Chitradurg and Chikmaglur and coastal areas of North & South Kanara districts of Karnataka. Bauxite occurrences in Kerala are known in Kannanur district where they occur over small plateaux & hillocks rising to heights of 50 - 220 meters. Isolated and small segregation of aluminous material are also known in the lateritic cappings of Thiruanandpur, Kollam and Allapuzha districts of Kerala.

Gujarat is reputed to be the prime bauxite bearing area producing significant quantities of high grade (chemical, refractory and abrasive grades) bauxites. The bauxite deposits in Gujarat are located in following areas:-

- (1) Coastal tracts of Jamnagar and Bhavnagar districts.
- (2) South & South-Western tracts of Kutch district and
- (3) Isolated areas of Kheda, Sabarkantha, Valsad and Surat districts.

The **high** hill ranges of Palani-Nilgiri in Tamil Nadu show bauxite deposits associated with laterite cappings and are major sources of supply to the alumina plants of MALCO. Workable deposits of bauxite have been located on the Vindhyan plateau extending from Satna (M.P) to Banda, Mirzapur and Varanasi in Uttar Pradesh.

A detailed state-wise discussion on the important bauxite deposits of India is furnished in the following paragraphs : -

4.1 EAST COAST BAUXITE BELT (ORISSA & A.P.) (1,2,3,4,5,6,7,8,9,10)

The bauxite deposits of Andhra Pradesh and Orissa discovered and explored in recent years, are referred to as the 'East Coast Deposits' by virtue of their proximity to the eastern sea coast of India. The East Coast Bauxite deposits, though a recent entrant on the bauxite map of India, have brought about a spectacular boost to the bauxite resources of the country.

4.1.1 Distribution

The East Coast Bauxite belt of Andhra Pradesh and Orissa is bound within the north latitudes $17^{\circ}47'$ and $19^{\circ}45'$ and the east longitudes $81^{\circ}55'$ and $83^{\circ}30'$. They occur scattered over a length of 400 km and width of 30 km, in approximately NE-SW alignment in the southern part and North-South in the Northern part. The bauxite deposits in the East Coast are classified as follows :⁽⁶⁾

Table 4.1.1 Classification of deposits of East Coast Bauxite belt.

Andhra Pradesh State		Orissa State	
Group	Deposits	Group	Deposits
(A) Gurtedu	Katamrajkonda	(A) Southern	i) Pottangi
(B) Chintapalli	i) Sapperla		ii) Ballada
	ii) Gudem		iii) Maliparbat
	iii) Jarrela	(B) Central	i) Panchpatmali
(C) Anantagiri	i) Galikonda		ii) Kodingamali
	ii) Raktakonda		iii) Karnapadikonda
	iii) Katuki	(C) Northern	i) Baphlimali
iv) Chittamgaudi			ii) Sijimali
			iii) Karlapat
			iv) Lanjigarh

Apart from these deposits, bauxite deposits have also been reported from Kashipur, Polingpudar Plateau, Gandhamardan Plateau and Khariar highlands. An inventory of reserves prepared by Indian Bureau of Mines for East Coast belt include many other deposits viz. Anamini-Parbat, Taldih, Tanjri, Dongar, Kutrumali, Sasbahumali, Pasanmali, Taljhir, Korakhpur, Marji-mali, Dandiwali, Chandigiri, Khariar Plateau, Kisamali, Kharke-jiguda, Sunger, Gusarmali, Hatimali, Indragiri and Kakirimali. The distribution of individual bauxite pockets and deposits of East Coast belt is depicted in plate Nos - 4.1.1.(A), (B) & (C).

4.1.2 Stratigraphy, Geology and Age.

The East Coast bauxite belt consists of a number of deposits located at elevations of 900 to 1450 m above sea level. These contain a thick blankets of lateritic bauxite which directly rest above khondalites and charnockites. A generalised ^{Latebitic} bauxite profile of east coast comprises bauxite zone with intercalated laterites ranging in thickness from 2 to 52 m. This zone is in turn underlain by partially lateritized and kaolinised khondalite/charnockite, and unaltered khondalite/charnockite, which form the base. (6,10)

The bauxite mineralisation (mainly gibbsitic) starts in partially lateritised zones. The East Coast bauxite deposits directly overlie the oldest Archaean rocks. Based on the evidence of lateritisation of the Mio-Pliocene sediments extending upto the adjacent khondalite, Raman (1976) has assigned a post Mio-Pliocene age to these deposits:

4.1.3 Bauxite Characteristics :

These bauxites are hard and massive in the top 1-3m thickness and moderately hard and spongy below. The common types include reddish brown, pink, cream and yellowish brown coloured bauxites with crystalline, cryptocrystalline textures where dense gibbsite occurs in varying proportions. The pink, cream, ash and yellow types are invariably of good quality and are characterised by high alumina and low iron. Deepening of the colour to red and allied shades signifies decrease in alumina and increase in iron content. Vesicular Vermicular and spongy textures are very common. Spongy texture is common in all

LOCATION MAP SHOWING THE BAUXITE CAPPINGS INVESTIGATED IN ANDHRA PRADESH

KILOMETRES 0 4 8 12 16 20 24 28 KILOMETRES

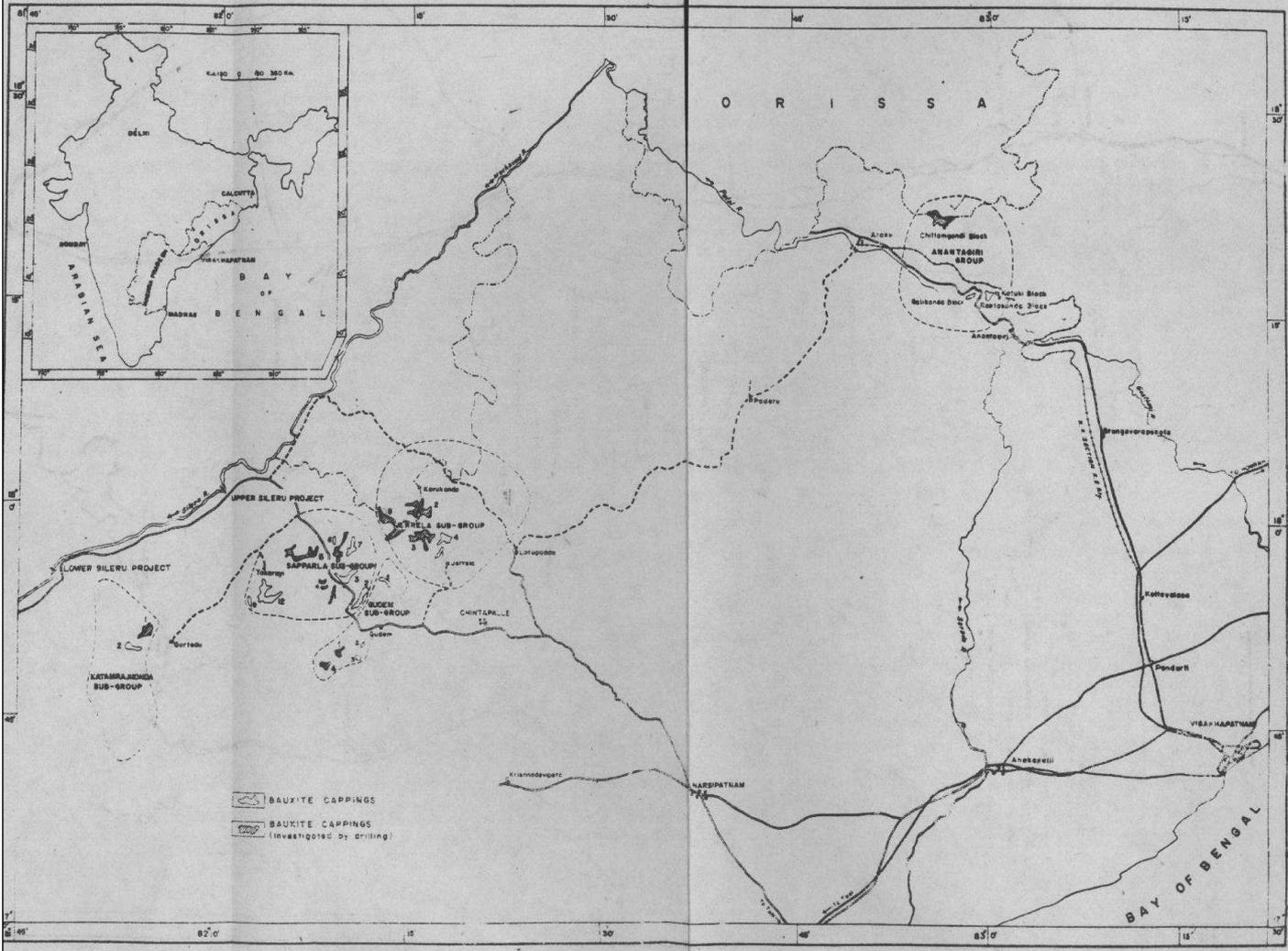


Plate 4.1.1(C) After G.S.I. reproduced from Bulletin A. No. 46

LOCATION MAP OF EAST COAST BAUXITE DEPOSITS

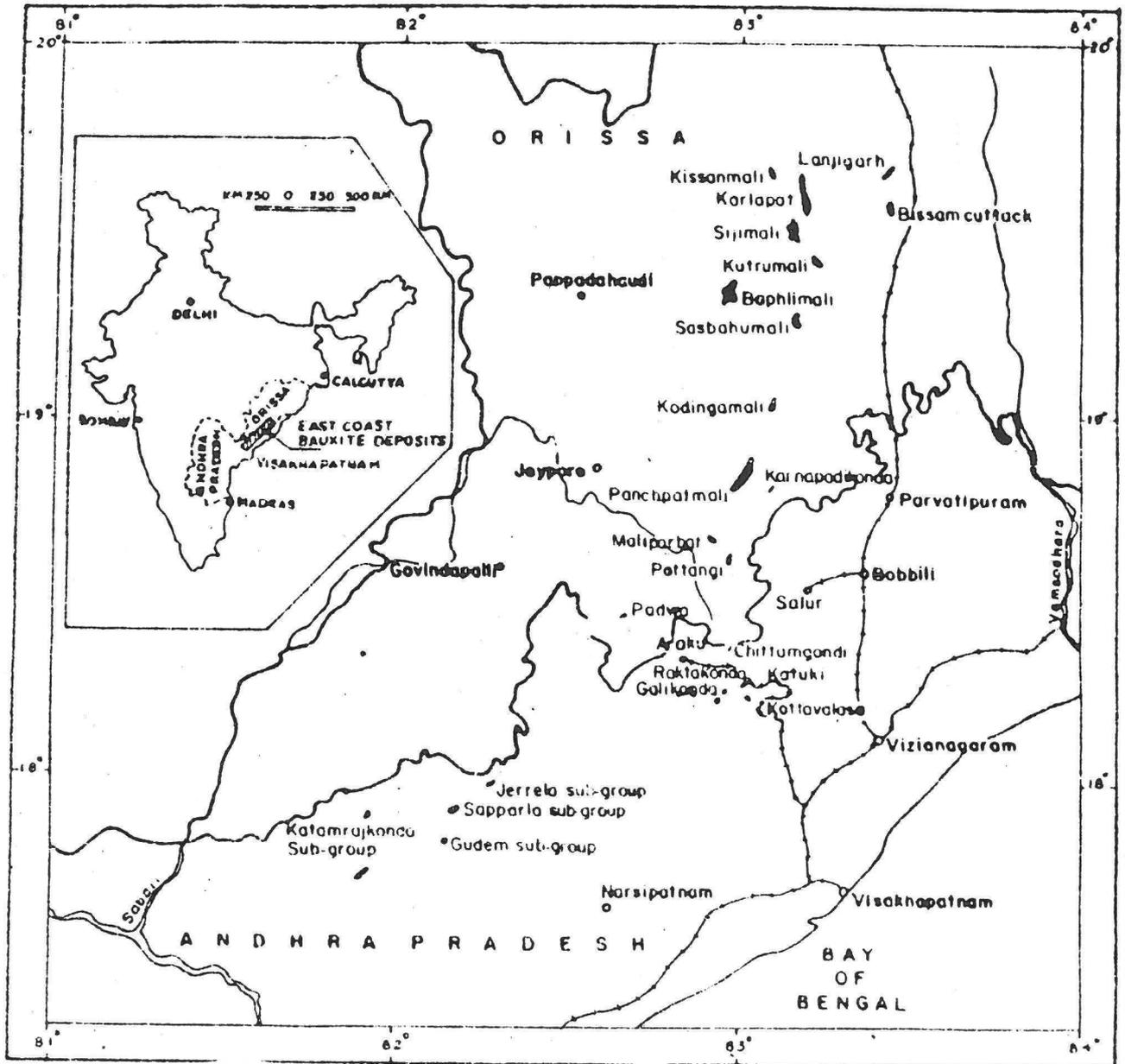
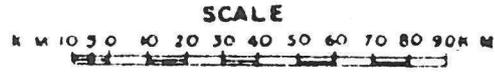


Plate 4.1.1(A) After G.S.I. reproduced from Bulletin A. No. 46

sections of the profile whereas the other textures are restricted to the top sections (3-5m) in general. Bauxite/ laterites derived from the charnockite are usually vuggy, hard and dark red coloured with no trace of any relict structure of the parent rock. Bauxite capping overlying charnockite are relatively flat whereas those on khondalite are slopping. Dense gibbsite is in greater proportion in the bauxite overlying the charnockite whereas crystalline and partly crystalline gibbsite is common in the khondalitic bauxite. Vermicular and spongy textures are very common and outlines of relict garnets are discernible even to the naked eye in bauxite derived from the khondalitic gneisses. The specific gravity of bauxite ranges between 2.1 and 2.3 while the porosity and moisture contents are highly variable.

4.1.4 BAUXITE DEPOSITS OF ANDHRA PRADESH. (3,6)

4.1.4.1 Gurtedu Group of Deposits

This deposit comprises a cluster of hillocks attaining a height of 1287m., situated about 185 km. west of Visakhapatnam via Chintapalli. The most important of these is Katamrajkonda deposit which is spread over about 1.87sq.km. area and has an average thickness of 14.62 m. The deposit has been investigated by Geological Survey of India (GSI) which have proved sizeable reserves of metallurgical 'I' grade. bauxite analysing Al₂O₃ 44.5 to 50%, SiO₂ 1.77 to 4.16%, Fe₂O₃ - 19.52 to 22.5% & TiO₂ 1.61 to 3%.

4.1.4.2 Chintapalli Group of Deposits :

The deposits in this group can be approached from Chintapalli which is situated about 145 km. by road, WNW of Visakhapatnam district. Chintapalli group of deposits are the largest deposits in Visakhapatnam district, which include following three main deposits.

(A) Sapparla Deposits : This deposit consist of 12 major cappings which form block I to XII. The cappings in blocks I to VIII & XII together cover an area of 12sq.km. The deposit is situated at an elevation of about 1200 m above MSL. GSI has estimated a sizeable reserve of bauxite with an average Al₂O₃ 46.4 to 47.75%, SiO₂ 1.13 to 3.30%, Fe₂O₃ 20.22 - 23.89% and TiO₂ 1.56 - 3.14%.

(B) Gudem Deposit : Gudem is situated 16 km west of Chintapalli. It is a deposit spread over 6 blocks totalling about 2.627 sq.km. area which have bauxite capping ranging from 3-13 m in thickness. The Geological Survey of India has undertaken exploration in this deposit and have estimated sizeable reserves of metallurgical I Grade bauxite analysing Al_2O_3 - 45.9-49.5%, SiO_2 1.07-3.11%, Fe_2O_3 12.7 to 25.4% and TiO_2 1.9 to 2.47%.

(C) Jarrela deposit : Jarrela deposit lies north west of Chintapalli at a distance of about 24 km by road. It is divided into four blocks. Bauxite is investigated here mainly by GSI which has estimated sizeable reserves of metallurgical grade I, with a capping thickness varying from 2 to 12 mtrs. The bauxite analyses as below Al_2O_3 45.27-46.03%, SiO_2 2.30 to 3.02%, Fe_2O_3 22.52 to 24.39% and TiO_2 1.33 to 1.81%.

4.1.4.3 Anantagiri Group of Deposits :

These Deposits are located about 85 km from Visakhapatnam by road and are close to Kirundul - Kottavalasa - visakhapatnam broad gauge section of the South-Eastern Railway. Bauxite deposits of Galikonda, Raktakonda & Katuki together are better known deposits from Araku valley. Chittamgaudi deposit is the only deposit in this group which falls outside Araku valley area, GSI/MEC have carried out exploration in these group of deposits and estimated reserves of metallurgical grade-I. The average thickness of bauxite capping ranges from 10-20 m.

(A) Galikonda deposit : Situated at an elevation of 1418 m⁽⁶⁾ above MSL, the Galikonda deposit occupy a NE to EW trending plateau-top with no vegetation but dense forest growth on the slopes. This deposit is sub-divided into three sectors, two of them (sector I & II) are continuous and spread out over an area of 0.46 sq.km. and third one with 0.15 sq.km spread is separated by about 0.5 km. distance. The average thickness of bauxite profile in sector III of Galikonda is 10.72 m. Higher alumina content is noted in the lower part of bauxite profile. The bauxite ranges in composition as below.

Al_2O_3 - 48.5%, SiO_2 - 2.5 to 3.4%, Fe_2O_3 - 19.2 to 20% & TiO_2 2.2-2.3%.

(B) Raktakonda deposit : The Raktakonda deposit occupies a flat topped laterite/bauxite bearing plateau and is located along the eastern side of Vaizag-Araku road. The mineralised area is 0.42 sq.km. and has a single bauxite capping with an average thickness of 11.4 m. The preliminary investigation by GSI & MEC, have estimated bauxite reserves with the following chemical composition: Al₂O₃ 47%, SiO₂ - 2.6%, Fe₂O₃ 22% and TiO₂ 2.4%.

(C) Katuki deposit : Katuki is a very small (0.14sq.km.) deposit occupying a flat-top plateau capping at a height of about 1296 m. above MSL and is situated on the eastern side of the Vaizag-Araku Road, further east of Raktakonda deposit. Preliminary exploration in the two blocks A & B jointly done by GSI & MEC have established sizeable reserves of metallurgical grade I with the following average analysis: 49% Al₂O₃, 2.9%, SiO₂, 19.5%, Fe₂O₃, and 1.9% TiO₂. The average thickness of bauxite zone is 10.5 m.

(D) Chittamgaudi deposit : Located close to Orissa border NNW of Anantagiri town, the Chittamgaudi deposit is situated at a height of about 1419 m above MSL. The average thickness of the capping is about 20 m. Investigations carried out by GSI/MEC have proved metallurgical grade-I bauxite in the area which analyses Al₂O₃ 46.04%, SiO₂ 2.60%, Fe₂O₃ 22.50% and TiO₂ 2.0%.

4.1.5 BAUXITE DEPOSITS OF ORISSA (3,6)

4.1.5.1 Gandhamardan Deposit : (8)

Gandhamardan, the second largest single bauxite deposit of India has impressive reserves though not forming part of it, the Gandhamardan deposit is akin to East-Coast bauxite in its geological characteristics. The deposit is about 10 km. long and about 0.7 kms wide. This has been divided into 10 blocks of which only block 8 has been explored in sufficient details and possess significant mineable reserve. Part of block 7 and blocks 8,9 & 10 have been leased out to BALCO. The deposit is located near Poikal, the nearest township. Poikal is situated 5 km away while the major township of Padampur is 42 km away (8)

The Gandhamardan hill forms a part of the NE-SW trending Khondalite hill in Bolangir - Sambalpur district. It occurs on the plateau top of a hill that rises conspicuously from the surrounding planes with a relief of about 600 m. The plateau-top has an altitude of 940 to 1005 m. The generalised bauxite profile occurring in the area is given below :

- Thin soil with pisolitic laterite (earthy brown)
- Hard cavernous (at places pisolitic) ferruginous laterite.
- Hard, cavernous gibbsitic bauxite
- Soft spongy bauxite with relict foliation.
- Kaolinised Khondalite
- Partially Kaolinised Khondalite.

Following four types of bauxite occur at Gandhamardan deposit :

Type-I Blanket type with moderate grade occurring on plateau top.

Type-II High grade bauxite occurring on dissected plateau edges & scarp incursions.

Type-III Ridge zone with lenses and bands of partially lateritised khondalite (PLK)

The normal plateau edge shows lower grade bauxite (Type-I). The bauxite is hard cavernous, fine to medium grained, and dark brown to light brown in colour. The bauxite shows relict texture and vesicular texture. The major minerals in the bauxite comprise gibbsite, boehmite (sporadic), hematite and goethite, while the minor minerals comprise kaolinite, rutile and sillimanite. The alumina content in the bauxite zone ranges from 41.83 to 53.29%. The average mineralogical composition in case of Block 8 shows gibbsite 63.3%, boehmite & other monohydrates 4.2%, hematite 17.2% and goethite 5.7%. At cut-off of 40% Al_2O_3 and 5% SiO_2 the thickness of bauxite zone ranges from 1.17 m to 33 m.

4.1.5.2 Pottangi Deposit : Pottangi deposit is located on 'Sirimanda Parbat' which is situated north of the Pottangi village in Navdapur taluka of Koraput district, Orissa. This plateau, also known as 'Pottangi plateau' occupies a mineralised area of 4.5 sq.km. It rises to a height of 1415 m above MSL

and 450-600 m, above the ground level (2).

The bauxite deposits are flat and bald and occur as blankets capping the hill tops. They are often stringed around peripheries with scarp faces exposing the bauxite. The deposit is divided into four blocks from E to W of these North and Extension blocks were explored by Geological Survey of India (GSI) in December 1975.

The Pottangi north block with its mineralized area of 2.30 sq.km. and an average bauxite capping of 21 m. thickness, possesses metallurgical I grade bauxite which analyses: Al_2O_3 38.79%, SiO_2 1.99%, & Fe_2O_3 21.13%. The Pottangi Extension block with its mineralised area 1.00 sq.km expose a bauxite profile of 15.0 m thickness. The block possess met. grade I bauxite analysing Al_2O_3 46.00% and SiO_2 5%.

Bauxite deposit in both the areas rest over the khondalites. Lenses and patches of weathered khondalite are found on the surface within the bauxite. The bauxite is reddish brown, brick red to dark brown, earthy and uneven and stains the fingers. The colour of the bauxite gives a rough indication of the grade of the bauxite, the high grade ones being paler and the low grade ones being darker in colour. The alumina show gradual increase with depth.

4.1.5.3 Ballada Deposit : The Ballada deposit with its mineralized area of 0.86 sq.km ^{and} 7.7 m thick bauxite capping, attains a height of 1300 m. The deposit has been investigated by GSI which has proved bauxite reserves of met. I grade analysing Al_2O_3 46% and SiO_2 5%.

4.1.5.4 Maliparbat Deposit : Maliparbat deposit with mineralised area of 1.09 sq.km is a bauxite capping having thickness of 14.6 m. It is located at the height of 1300 m. The deposit has been investigated by GSI and DGM Orissa which have proved considerable reserves of met.-I grades bauxite analysing Al_2O_3 46.61%, SiO_2 2.30%, Fe_2O_3 23.40% and TiO_2 1.44%.

4.1.5.5 Panchpatmali Bauxite Deposit (3,5,6)

The Panchpatmali Bauxite deposit is located in Koraput district of Orissa, bounded between latitude $18^{\circ}46'$ and $18^{\circ}55'$ North and longitude $82^{\circ}57'$ and $83^{\circ}04'$ East. At present this

is the only deposit of East Coast bauxite belt which is under active exploration. The Panchpatmali hill extend, in length for 16 km along NE-SW direction, attaining a maximum width of 2000 m in the NW and average width of 800 m. The deposit attains a height of 1360 m from the main sea level. It is divided into North, Central and South blocks. Of these, the central block (Sector I) is under development and active mining by M/s National Aluminium Company Ltd., as a captive open cast mechanised mine with a annual production capacity of 2.4 million tonnes. The typical succession of bauxite profile found in Panchpatmali area comprises from top to bottom, an average 1-2m thick soil zone and 14.6 m thick bauxite zone which is underlain by partially lateritised khondalite and fresh khondalite.

The bauxite ore body occurs in Panchpatmali as a gently sloping or nearly flat blanket capping of laterite, which has been formed by an insitu chemical weathering of Khondalite. The average thickness of bauxite profile in sector 1 and 2 of the central block is 14.6 m. The bauxite in these 2 sectors qualitatively falls under metallurgical grade II, with the following average composition: Al₂O₃ 42.5 percent, SiO₂ 2.5 percent, Fe₂O₃ 27.5 and TiO₂ 2.10 percent. The North and South blocks, also included in the leasehold of NALCO, have mainly metallurgical grade I bauxite with the following average grade: Al₂O₃ 46.6-46.7 percent and SiO₂ 2.3 - 2.4 percent. The bauxite of Panchpatmali block is generally medium to fine grained showing cavities and fracture filling.

4.1.5.6 Kodingamali Deposit⁽³⁾: The Kodingamali deposit occurs over an area of 5.33 sq.km with a bauxite capping of 12.44 m thickness which attains a height of 1300 m. The deposit has been investigated by MEC and GSI which have proved huge reserves of Met-I grade bauxite analysing Al₂O₃ 46.7% and SiO₂ 5%.

4.1.5.7 Karnapadikonda Deposit⁽³⁾: The Karnapadikonda deposit covering an area of 1.72 sq.km. occur at an altitude of 1487 m above MSL⁽⁶⁾. The bauxite capping on an average is 5 m thick. It has been investigated by DGM Orissa and GSI who have established reserves of Met.-I grade bauxite analysing Al₂O₃ 40.55% and SiO₂ 4%.

4.1.5.8 Baphlimali Deposit ⁽³⁾ : Baphlimali deposit spreads over an area of about 8.6 sq.km. and has a bauxite capping of 11.51 m thickness. The deposit has been investigated by MEC who have proved huge reserve having Met. I grade bauxite analysing Al_2O_3 45% and SiO_2 1.9%.

4.1.5.9 Sijimali Deposit ⁽⁴⁾ : Sijimali deposit covering an area of 13 sq.km was initially investigated by GSI which proved a mixed grade reserves. The deposit has a bauxite capping of 4.84 m thickness. GSI subsequently proved huge reserves of bauxite with an average 43.17% Al_2O_3 ⁽⁴⁾. During the investigation a 20.31 m thick bauxite zone was identified.

4.1.5.10 Karlapat Deposit ⁽³⁾ : Spread over an area of 6.59 sq. km., the Karlapat deposit attains a height of 1000-1100 m above MSL. The two bauxite cappings are encountered in this deposit each having 17.12 m. & 13.16 m thickness. The deposit was investigated by GSI which has proved huge reserves of Met. I grade bauxite analysing Al_2O_3 46.30% and SiO_2 2.50%

4.1.5.11 Lanjigarh Deposit :

The Lanjigarh deposit comprise bauxite capping of 5.4 m thickness attaining a height of 1300 m above MSL. The capping is spread over an area of 5.54 sq.km. The Geological Survey of India carried out investigations in this deposit and proved reserves of Met. I grade bauxite analysing Al_2O_3 46 to 48.55% and SiO_2 2.32 to 3.72%.

The detailed account of individual bauxite pockets and deposits of East Coast belt is tabulated below: -

4.2 MADHYA PRADESH

Madhya Pradesh was considered to be the biggest repository of bauxite deposits in India before the discovery of East Coast bauxite. It still ranks among leading bauxite producing states of India. Major bauxite occurrences are located in Bilaspur^{Ch}, Balaghat^{MP}, Surguja^{MP}, Rewa^{MP}, Bastar^{Ch}, Jabalpur^{MP}, Raigarh^{Ch} and Satha^{MP} districts.

TABLE 4.1 SALIENT FEATURES OF EAST COAST BAUXITE DEPOSITS IN ANDHRA PRADESH AND ORISSA

Sl. No.	Name of Deposit	Freehold/Leasehold (Sq.km./Hect.)	Av. thickness of bauxite	Grade	Average chemical analyses %					Exploring Agency
					Al ₂ O ₃	SiO ₂	Fe ₂ O ₃	TiO ₂		
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
ANDHRA PRADESH										
VISHAKHAPATNAM DISTT.										
(A) Anantagiri Group.										
1.	Chintamgandi	Freehold (1.52 Sq.km)	20.50 m.	Met-I	46.04	2.60	22.50	2.00		GSI/MEC
2.	Katuki block A & B	- " - (0.043+0.097 sq.km.)	10.50 m.	Met-I	49.00	2.90	19.50	1.90		GSI/MEC
3.	Galikonda I & II	- " -		Met-I	48.50	2.60	20.00	2.20		GSI/MEC
4.	Galikonda III	- " -	0.72 m.	Met-I	48.50	3.40	19.20	2.30		GSI/MEC
5.	Rakta Konda	- " -	11.40 m.	Met-I	47.00	2.60	22.00	2.40		GSI/MEC
(B) Chintapalli Group										
1.	Chintapalli	Freehold	NA	Met-I	46.50	2.20	-	-		GSI
2.	Sapparla block I	- " - (1.223 Sq.km)	4.65 m.	Met-I	47.60	3.30	21.60	1.90		GSI
3.	- " - block II	- " -	12.00 m.	Met-I	47.60	2.50	21.80	2.24		GSI/MEC
4.	- " - block III	- " -	13.35 m.	Met-I	47.75	1.88	21.50	2.20		MEC
5.	- " - Block IV	- " -	7.65 m.	Met-I	46.40	3.30	22.40	2.16		MEC
6.	- " - block V	- " - (1.45 Sq.km)	5.16 m.	Met-I	46.50	2.94	23.89	3.14		GSI

..Contd.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
7.	Sapparla block VI	Freehold (0.585 Sq.km)	4.00 m.	Met-I	46.50	4.30	20.22	2.42	GSI
8.	"- block VII	"- " (1.41 Sq.km)	3.00 m.	Met-I	46.81	1.13	22.60	1.56	GSI
9.	"- block VIII	"- " (2.58 Sq.km)	8.00 m.	Met-I	46.77	2.69	22.64	2.57	GSI
10.	"- block XII	"- " (3.83 Sq.km)	6.00 m.	Met-I	46.00	1.92	24.60	1.50	GSI

(C) GUDEM GROUP

11.	Gudem block 1	Freehold (1.250 Sq.km)	8.60 m.	Met-I	46.76	3.11	21.52	2.47	GSI
12.	"- " 4	"- " (0.877 Sq.km)	13.18 m.	Met-I	49.50	2.21	18.13	2.01	GSI
13.	"- " 2,3,6 (A&B)	"- "	N.A.	Met-I	45.90	2.07	25.40	1.90	GSI
14.	"- " 5	"- " (0.50 Sq.km)	3.00 m.	Met-I	47.00	2.12	12.70	1.90	GSI
15.	"- " 5 A & B	"- "	N.A.	Met-I	45.90	1.07	25.40	1.90	GSI

16.	Gudem Dharkunda	Freehold	3.00 to 10.00 m.	Met-I	45.00	5.00	25.00	3.00	GSI
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JERRELA GROUP

17.	Jerrela block 1	Freehold (0.855 Sq.km)	2.00- 10.00 m.	Met-I	46.03	3.02	23.16	1.45	GSI
18.	"- " 2	"- " (4.902 Sq.km)	10.79 m.	Met-I	46.84	2.88	24.39	1.33	GSI/MEC
19.	"- " 3	"- " (4.40 Sq.km)	11.99 m.	Met-I	45.60	2.30	22.30	1.70	GSI
20.	"- " 8	"- " (3.334 Sq.km)	12.00 m.	Met-I	45.27	2.80	22.52	1.70	GSI

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

II EAST GODAVARI DISTRICT

		3.	4.	5.	6.	7.	8.	9.	10.
1.	Dhunkonda block A <u>GURTEDU GROUP</u>	Freehold	N.A.	Met-II	44.50	4.00	22.50	3.00	GSI
2.	Katamaraja Konda block 1	- " - (1.060 Sq.km)	14.62 m.	Met-I	46.40	4.16	21.20	2.80	GSI
3.	Katamaraja Konda block 2	- " - (0.808 Sq.km)	- " -	Met-I	50.00	1.77	19.50	1.61	GSI

ORISSA

I. PHULBANI DISTRICT

1.	Anamini Parbat	Freehold	6.00 m.	Met-I	46.00	5.00	-	-	DGM
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II. SUNDERGARH DISTRICT

1.	Taldih	Leasehold (117.00 Hect)	N.A.	Met-I	46.00	2.00	-	-	RSP
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III BOLANGIR & SAMBALPUR

DISTRICTS

GANDHAMARDAN DEPOSIT

3.	Gandhamardan Block 1	Freehold (7.00 Hect)	12.60 m.	Met-II	43.85	3.45	23.25	2.58	DGM
4.	-----"----- 2	- " - (47.00 Hect)	19.63 m.	Met-I	45.16	2.18	23.25	2.50	- " -
5.	-----"----- 3	- " - (100.00 Hect)	18.51 m.	Met-I	45.51	2.18	23.25	2.58	- " -

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
6.	Gandhamardam Block	Freehold (105.00 Hect)	17.82 m.	Met-I	45.90	2.12	-	-	DGM
7.	"	" (120.00 Hect)	17.88 m.	Met-I	45.20	2.26	-	-	DGM
8.	"	" (63.00 Hect)	13.20 m.	Met-I	46.24	2.65	-	-	DGM
9.	"	" (36.00 Hect)	17.38 m.	Met-I	46.64	2.18	-	-	"
10.	"	" (64.00 Hect)	4.50 m.	Met-I	46.91	2.32	-	-	"
11.	"	Freehold + Leasehold	N.A.	Met-I	46.91	2.60	-	-	"
12.	"	Leasehold (933.00 Hect)	N.A.	Met-I	46.70	2.70	23.60	2.70	"

IV. KALAHANDI DISTRICT

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13.	Dandiwalli	Freehold (0.63 Hect)	4.50 m.	Mixed + Chemical	46.60 to 59.50	0.30 to 6.10 m.	-	-	DGM/GSI
14.	Changiri	" (3.00 Sq.km)	3 to 8.00 m	Met	46.00	5.00	-	-	-
15.	Kalapat	" (6.59 Sq.km)	17.12 & 13.16 m.	Met-I	46.30	2.50	-	-	DGM/GSI
16.	Kharlar plateau	"	3.00 m	Met-II	40.00	2.50	-	-	GSI
17.	Kisanmali	" (1.57 Sq.km)	6.00 m	Met-II	44.25	2.23	28.66	1.83	DGM/GSI
18.	Kharkajiguda	"	-	N.A.	-	-	-	-	-
19.	Sunger	" (0.316 Sq.km)	1.25 m.	Abrasive	55.00	5.00	-	-	DGM
20.	Lanjigarh (part in Koraput also)	" (4.50 Sq.km)	9.00 m.	Met-II	40.00	5.00	21.00	2.70	GSI

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
21.	Sijimali (Central Block)	Freehold (13.00 Sq.km)	4.84 m.	Mixed	40.00 to 50.00	N.A.	20.00 to 30.00	3.00	GSI
22.	Sijimali (other block)	"-	4.84 m.	Low	42.00	12.00	-	-	GSI

V KEONJHAR DISTRICT

23.	Dholkata Pahar	Freehold	N.A.	Uncla- ssified	40.00	6.00	-	-	DGM
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VI KORAPUT DISTRICT

24.	Lanjigerh	Freehold (5.54 Sq.km)	5.60 m.	Met-I	46.00 to 48.55	2.22 to 3.72	-	-	GSI
25.	Ballada	"-" (0.86 Sq.km)	7.70 m.	Met-I	46.00	5.00	-	-	GSI
26.	Bophlimali	"-" (8.60 Sq.km)	11.51 m.	Met-I	45.00	1.90	-	-	MEC
27.	Gusaramali	"-" (5.50 Sq.km)	5.00 to 10.00 m.	Met-I	46.00	5.000	-	-	DGM
28.	Hatimali	"-"	5.00 to 10.00 m.	Met-II	45.00	5.00	-	-	DGM
29.	Indragiri	"-" (4.80 Sq.km)	8.00 to 11.00 m.	Met-II	45.00	5.00	-	-	DGM
30.	Kakirimali	"-"	5.00	Met-I	46.00	5.00	-	-	DGM
31.	Karnapadikonda	"-" (1.72 Sq.km)	5.00 m.	Met-II	40.00 to 55.00	4.00	-	-	DGM/GSI
32.	Tangri Donger	"-" (5.54 Sq.km)	1.00 m	Met-I	46.00	5.00	-	-	DGM
33.	Kodingamali	"-" (5.23 Sq.km)	12.44 m	Met-I	46.70	5.00	-	-	MEC/ GSI

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
34.	Kutrumali	Freehold (5.50 Sq.km)	2.50 m.	Met-I	40 to	5.00	-	-	DGM/GSI
35.	Maliparat	"- (1.09 Sq.km)	14.60 m.	Met-I	46.61	2.30	23.40	1.44	GSI/DGM
36.	Pottangi Plateau (North block)	"- (2.30 Sq.km)	21.00 m.	Met-I	48.79	1.99	21.13	-	GSI/MEC
37.	"- (South block)	"- (0.65 Sq.km)	17.00 m.	Met-I	46.11	2.30	23.22	-	GSI/MEC
38.	"- (Central block)	"- (1.00 Sq.km)	18.00 m.	Met-I	46.13	2.05	24.50	-	"-
39.	"- (Extension) (1.00 m)	"- (1.00 Sq.km)	15.00 m.	Met-I	46.00	5.00	-	-	"-
40.	Sasbohumali Pasanmali	Freehold (12.74 Sq.km)	6 to 21.00 m.	Met-I	56.00	5.00	-	-	GSI/MEC
41.	Taljhir Koranpur	"-	4 to 15 m.	Met-I	46.00	5.00	-	-	DGM
42.	Chittamguri	"- (1.52 Sq.km)		Mixed	50.45	2.13	-	-	DGM
43.	Marjimali (part in Kalshandi)	"-		Not known	-	-	-	-	DGM
44.	Panchpatmali Central Block	Leasehold (4692.00 Hect)	14.60 m.	Met-II	42.5	2.50	27.50	2.10	GSI/MEC DGM/NAICO
45.	"- Sec. 1 & 2	"-	"-	Met-II	"-	"-	"-	"-	"-
46.	"- North Block	"-	N.A.	Met-I	46.60	2.30	-	-	"-
47.	"- South	"- (2612.00 Hect)	N.A.	Met-I	46.70	2.40	-	-	"-

Laterite caps covering an area of more than 1,500 sq.km are known in Madhya Pradesh. The bauxite deposits and occurrences located in those cappings are enlisted below⁽¹³⁾ -

1. Extension of Bihar plateau region into the districts of Surguja, Raigarh, and Bilaspur.
2. The plateau region forming the Maikala hill range in the districts of Shahdol, Bilaspur, Rajnandgaon, Mandla and Balaghat.
3. The Katni area of Jabalpur district.
4. Simaria, Sohawal-Nagod-Maihar areas in the districts of Rewa, Satna and Panna.
5. Malwa plateau in Bhopal, Guna, Shajapur and Shivpuri districts and
6. Keskhal and Bailadila Ranges of Bastar district.

All these bauxites lie over Basaltic or upper Vindhyan rocks. About 20% of these laterite caps have been systematically investigated. Bauxites occur in laterites as irregular and discontinuous lenses. They are mostly of metallurgical, chemical & refractory grades. District-wise description of important bauxite deposits of M.P. is given below :

4.2.1 Balaghat district : (MP)

Bauxite deposits are reported from Kotapahar at an elevation of 807-814 m above MSL and at Sipkar area of Balaghat district.

4.2.1.1 Kotapahar (12,13) :

In Kotapahar area laterite cappings occur on the top of Deccan trap. The laterite contains pockets of bauxite which are in turn sandwiched between pisolitic laterite on the top and ferruginous laterite followed by lithomarge at the bottom. The thickness of bauxite zone ranges from 0 - 4.2 m. Other stratigraphic formations found in the area below the Deccan Trap, include Lametas, Sausar group and older metamorphics⁽¹²⁾.

Bauxite occurs here as discontinuous lenses and pockets in the upper horizons of laterite profile. Bauxite invariably occurs below pisolitic ferruginous laterite with a sharp and undulatory contact. Thickness of bauxite varies from 0-4.20 m with an overall average of 1.75 m (12,13).

Bauxite is hard and compact, with grey and pinkish grey in colour. Pisolitic bauxite is less common. Other less common varieties are brecciated, spongy & nodular. Minerals which are found in the bauxite zone are boehmite, goethite, & kaolinite. The average chemical composition of the bauxite is as follows (12,13):

S.No.	Constituents	Chemical	—	Composition
1.	Al ₂ O ₃	40.00%	—	56.17%
2.	SiO ₂	0.85%	—	11.13%
3.	TiO ₂	3.5%	—	13.75%
4.	Fe ₂ O ₃	4.00%	—	28.60%
5.	LOI	22.73%	—	30.10%

The laterite and bauxite here have been derived from Deccan Traps by an insitu chemical weathering.

4.2.1.2 Supkhar area (13)

This area is situated about 100 km NE of Balaghat and comprises 6 plateaux. The regional stratigraphy of Supkhar area includes from top to bottom, laterite and bauxite horizons which cap the Deccan Traps. The Deccan Traps are in turn underlain by Lametas, Chilpi ghats and Archean genesis and schists. Bauxite occur here as pockets, lenses and irregular segregations within the upper part of laterite profile. Gibbsite and clinochite constitute major minerals.

4.2.1.3 Chatrapur area (14)

In Chatrapur area lava flows at places are capped by laterites and bauxites. The generalised laterite profile of the area is as given below :

- Soil
- Pisolitic laterite
- Bauxite and aluminous laterite
- Laterite
- Ferruginous laterite
- Lithomarge

Bauxite occurs in form of pockets and lenses in the laterite profile. The colour of bauxite is grey to greyish white. Bauxite belongs to pisolitic and massive varieties. Pisolitic varieties are essentially composed of closely spaced pisolites of aluminous material while the massive variety is hard and compact.

4.2.2 Bilaspur District (Chattogarah)

4.2.2.1 Phutkapahar area (13,16,17) Phutkapahar
 is 32 km. N of Korba and is western most part of a dissected laterite-capped plateau bordering M.P. and Bihar. Here laterite associated with bauxite and lithomarge occurs on a 'y' shaped plateau, above an MSL elevation of 980 m. In Phutkapahar area the geological succession includes a 20 - 25 m thick bauxite profile developing at the top of Deccan Trap. The Deccan Trap are in turn underlain by Lametas, Barakars, Supra-Barakars, Talchirs and metamorphics.

The laterite profile which has developed at Phutkapahar shows the following lithological variation from top to bottom: pisolitic laterite (0.- 0.91 m.), upper aluminous laterite 0.91 to 1.8 m and bauxite 2.7 to 3.6 m in thickness.

The succession in turn is underlain by a zone representing second and first stages of bauxitisation.

In Phutkapahar, the high level occurrences of bauxite are associated with laterite and occur at an elevation of 980 m over Deccan Traps. Bauxite occurs here as pockets ranging from 1-3.5 m in length and 1-2.5 m in width in the N, W, Central and E Phutkapahar blocks. On the N Phutkapahar, bauxite occurs in form of blankets. The thickness of bauxite ranges from 0.5 to 3m. Bauxite is hard, compact, massive, light grey and pinkish white in colour⁽¹⁶⁾.

Phutkapahar bauxite is a mixture of Gibbsite (major constituent), boehmite (in good amount) with traces of diasporite and minor amounts of haematite and titania minerals. Two grades of bauxite namely above 50% Al_2O_3 and above 45% Al_2O_3 were established by GSI⁽¹⁶⁾.

There is considerable controversy regarding the origin of Phutkapahar bauxite. Earlier workers like Fox (1923), Ghosh (1941), Chatterjee (1951), Roychoudhury (1958) & Valetan (1972) believed these to have derived from Deccan Traps. But the work by K.P. Ghosh & B.C. Dutta (1978) assume that bauxite deposits occur as residual sedimentary pockets formed by the process of weathering and leaching of arkosic sandstone/shale of Gondwana age⁽¹⁵⁾.

4.2.2.2 Paunakhera Pahar^(17,18); It is situated at a distance of 8 km from Patrapale and is around 980 m above MSL. Here coarse feldspathic and variegated sandstone interbedded with coal beds represent Barakars, the main rock formation.

Bauxite is mostly massive and of characteristic greyish white colour. Occasionally, bauxite is of pisolitic variety. The thickness of bauxite horizon varies from 1-3m and strike length ranges from 200 to 600 m. The grade of ore is also high with around 59 percent Al_2O_3 , less than 1.48 percent SiO_2 and 8.33% TiO_2 . Bauxite is believed to have been derived from Deccan Traps.

4.2.2.3 Kerela Pahar⁽¹⁸⁾; The area exposes both Deccan Traps and Kamthi Sandstone (Gondwana) which alternates in laterite horizons sometimes. Here the bauxite belongs to massive variety and has pisolitic structure. It is dull grey to cream coloured. The thickness of bauxite ranges from less than a meter to 1.5 m. High percentage of titanium (9.4%) is present in the bauxite. The chemical composition of bauxite is Al_2O_3 57.83 percent, SiO_2 0.36 percent, Fe_2O_3 4.27 percent, TiO_2 9.41 percent and LOI 27.62 percent.

4.2.3 Surjuja district⁽¹³⁾ (Chhatigarh) (Ambikapur); In Surjuja district bauxite occurs in the vast cappings of laterite on the plateaux and ridges in the northern part of the district.

4.2.3.1 Jamirapat area : It is located near the eastern boundary of Surguja district in Jamirapat area^(11,12). The prospecting carried out by GSI has established bauxite deposits in following 13 blocks (1) Chutai, (2) Serangdag, (3) Samri (4) Tatigharia (5) Charhat, (6) Kudag, (7) Jamirapat, (8) Birapat, (9) Kudipat, (10) Amrath, (11) Joka, (12) Asanpani and (13) Gopatu. The Jamirapat belt is about 40 Sq.km. in extent and is named after Jamirapat village.^(19,20,21,22,23,24,25)

The geological succession of Jamirapat belt includes laterite with associated bauxite which occurs as a capping above Deccan Traps. The Deccan Traps are in turn underlain by rocks of Lametas and Archaean metamorphics⁽¹³⁾.

Bauxite occurs as irregular discontinuous lenses and pockets in the upper part of laterite profile. Gibbsite and cliachite are the major minerals of bauxite zone while boehmite is invariably present. Bauxite is nearly 2 meter in average thickness.

4.2.3.2 Joke-Lahsunpat (Samripat area)^(19,20)

In this area located on Joke-Lahsunpat plateau (Semripat area) in Jamirapat block of Surguja distt., bauxite occurs as lenses & pockets within the laterite blanket. The geological succession is same as given under 4.2.3.1.

Bauxite pockets occur in size from few cm to 2 mtrs. embedded in ferruginous matrix. Three varieties of bauxite are seen (i) pisolitic (ii) Massive or compact (iii) Brecciated or conglomeratic. The colour of bauxite is grey & pink. Pisolites vary in size from 1mm to 2 cm.

4.2.3.3 Charhatpat and Birharpat areas^(19,21)

These areas are located 20 km N of Kusmi in Semri tehsil of Surguja district. In this sector of Jamirapat block, GSI has carried out proving for bauxite. Bauxite is grey to pink in colour having pisolitic to massive texture. The main aluminous mineral is gibbsite. Following is the average chemical analysis of the ore -

Al₂O₃ - 52%, SiO₂ (reactive) 3%, LOI - 23%, Fe₂O₃ - 13%
TiO₂ - 8%, V₂O₅ - 0.18%, P₂O₅ - 0.04%, non reactive SiO₂ 0.12%.

Grade II Bauxite occurs in 1.64 sq.km area of Charhatpat where the average thickness of bauxite zone is 2.16 m. In Birharpat area Grade II (Al_2O_3 51.78%) bauxite mineralisation occupies 0.28 sq.km area with an average thickness of 0.86 m⁽¹⁹⁾.

4.2.3.4 Serangdag Village^(19,22) : This area is located 10 km N of Kusmi in the extreme NE part of Surguja district bordering palamau district of Bihar. Bauxite mineralisation occupies 4.20 sq.km area with an average thickness of 1.9 m. Following is the average chemical composition of bauxite in the area:

Al_2O_3 - 51.75%, SiO_2 (reactive) 2.85%, SiO_2 (non reactive) 0.12%,
LOI - 22.65%, Fe_2O_3 12.86%, TiO_2 8.20%.

4.2.3.5 Bainsakanapat and Kudipat^(19,23)

These are small projections of plateaux SSE & ESE of Chutai, both located 100 m apart. Laterite with lensoid and bouldary enrichment of bauxite and aluminous laterite occur at the top of Deccan traps. Bauxite occurs as bouldary concentrations and has pisolitic nature in the upper one-third part of the laterite profile. The thickness varies from 0.83 meters to 2.50 metres. Gibbsite and clachite are major minerals⁽¹⁰⁾. The average chemical analysis of bauxite of Kudipat area is given below.

Al_2O_3 - 53.32%, SiO_2 - 1.81%, Fe_2O_3 - 11.05%, TiO_2 8.77%, LOI-26.40%

In Bainsakanapat area, the chemical composition of bauxite is as follows : Al_2O_3 - 51.20%, SiO_2 - 1.49%, Fe_2O_3 -10.19%, TiO_2 - 9.22% LOI - 25.64% .

4.2.3.6 Kudag sector^(10,15) : Kudag sector is located N of Jamirapat and includes four blocks namely Dumarkholi, Puranpani, Saraipat and Kudag. Good grade bauxite occurs here as pockets all along the margins of plateaux. The geology of the area is same as described under para 4.2.3.1. Bauxite zone in the sector varies in thickness from 1.92 to 2.32 m., occupying 0.25 to 0.68 sq.km area under mineralisation⁽¹⁹⁾.

4.2.3.7 Kutku sector^(19,24) : This sector is named after village Kutku situated 1 km NE of Semri in continuation to semri sector. Nearly half of the area in this sector is bearing high grade bauxite. The thickness of bauxite zone varies from 0.45 to 3 m (av.1.66 m) The alumina in bauxite varies from 46.92 to 56.6% (av.52.72%).

4.2.3.8 Tatiharua block (19, 25)

This block is situated 16 km from Kusmi village in Jamirapat belt. The area of mineralization in this block is 3.92 sq.km having an average thickness of 1.77 m. A detailed proving in the area by GSI, has established bauxite reserves belonging to lower/ marginal grade I or higher/marginal grade II.

4.2.3.9 Mainpat (26, 27, 28)

The Mainpat deposit is located 30 kms from Ambikapur in Surguja district (M.P.) on the extension of a plateau on MP-Bihar border and extends E-W to a length of 40 km while the N-S width ranges from 10-14 km. The nearest township is Ambikapur located 75 km from Mainpat. The deposit is connected to Ambikapur and Korba through a road. This area lies in toposheet No.69 N/1 & 64 N/5.

The DGM, M.P. which carried out extensive exploration & proving in the area around village Kamleshwarpur has divided the Mainpat plateau into following 12 blocks. (1) Sapnadand (2) Nagardand (3) Kudardih (4) Kesara (5) Narbadapur (6) Kamleshwarpur (7) Sarbanja (8) Dankasara (9) Barima (10) Kadrinjan (11) Parpattya and (12) Lalya. Of these the first 4 blocks are promising which were later explored in detail by MECL. At present MPSC is mining bauxite from Sapnadand block and supplying to BALCO (27).

The Bauxite deposit occurs in lensoid form within the laterite horizon at an altitude of 1060 m. The generalised lithological sequence of bauxite profile of Mainpat area is as given below :

- Soil Zone with pisolites of bauxite
- Zone of pisolitic bauxite & Aluminous laterite
- Massive bauxite
- Aluminous laterite
- Soft concretionary bauxite
- Ferruginous laterite

Base not known.

Bauxite occurs at Mainpat in following forms (1) As boulders and pisolites embedded in lateritic soil at the uneven cavernous top portion of aluminous laterite horizon. (2) As sheet like bodies of hard, compact, massive, pisolitic type. (3) As sheet like bodies locally developed, soft, concretionary

type and (4) As cavity filling, void filling and fracture filling in aluminous laterite. Two varieties of bauxite are seen namely pisolitic and massive. Pisolitic bauxite consists of closely packed pisolites ranging from few mm to 5 cm in diameter which occur in upper horizon of bauxite⁽²⁶⁾. Bauxite exhibits various colours ranging from grey, greyish white to pink. The average thickness of bauxite horizon in first four blocks varies from 2 to 3 metres. The contact of bauxite with overlying pisolitic laterite is sharp but other contacts are gradational. The major ore forming mineral in the bauxite is gibbsite. These ore bodies have a vertical thickness of 10-12 m. The intensity of bauxite is more in the central part of plateau which decreases towards scarp.

4.2.4 Rewa district. (MP)

4.2.4.1 Simaria area (13,29)

Simaria area is situated near MP-UP border about 45 km from Satna. The Simaria area occupies the northern part of Rewa - Satna plateau comprising Kaimur, Rewa and Bhandar Groups of Upper-Vindhyan rocks. Bauxite deposits occur within the laterite cappings which overlie the upper, Rewa sandstone. The laterite profile in Simaria area shows from top to bottom a zone of re-worked bauxite which include pisolitic laterite and low grade bauxite. These are in turn underlain by a zone of residual bauxite which comprise from top to bottom an exclusive bauxite zone, low grade bauxite zone, massive laterite zone and lithomarge. The sequence in turn, is underlain by Ganurgarh shales or Upper-Rewa Sandstone (Vindhyan)⁽²⁹⁾.

Bauxite occurs as discontinuous lenses or tabular bodies within the laterite. Thick high grade bauxite zones are located along the minor drainage channels in which the shape of bauxite lenses corresponds to the shape of valley. The bauxite occurs in form of disconnected blocks on account of the presence of joints and irregular cracks which are usually filled with pisolitic laterite⁽²⁹⁾. It occurs in various shades of pink and grey. Both bauxite and laterite are hard, and massive, often upper parts have clayey & pisolitic forms. Gibbsite is the principal mineral of bauxite zone with minor amounts of anatase, haematite and cliachite. Bauxite exhibits variable textural features like massive, pisolitic, vesicular, vermicular,

brecciated etc. The Bauxite contains high amount of Fe_2O_3 and TiO_2 . The average thickness of bauxite varies from 2 to 4 m⁽²⁹⁾.

4.2.5 Jabalpur district (MP)

The Bauxite deposits occur in spreads of large laterite outcrops which occupy a narrow strip of country 80 km in length running in approximately NE-SW direction. The laterite is spread over a low undulating area in between two high ranges of hills viz. Bhitrigarh hill range of Bijawar rocks to the south & the Kaimur & the Bhanders comprising upper vindhyan rocks to the north.

A generalised geological succession in Jabalpur area includes laterites which are found as cappings over Deccan Traps. These are in turn underlain by Lametas, Gondwanas, Upper and Lower Vindhyan and Dharwars from top to bottom.

The bauxite bearing laterite here is associated with Jabalpur Group of rocks (Gondwanas) which consists of sandstone, shale, conglomerate & carbonaceous shale. Thicker cappings of laterite which have apparently formed low mounds & hillocks, contain seggregations of bauxite and aluminous laterite. The bauxite occurs as detached clusters of boulders varying in size from a pea to a boulder, a few metre in diameter. At Tikuri-Tekaria, the bauxite zone rests directly on Vindhyan Limestone. The laterite is conspicuously bouldery and irregularly caps various formations. These features indicate a detrital origin for laterites of the area.

In Jabalpur district, important bauxite deposits are located near Katni, Bakarwara, Sleemanabad and Dundi which are described below: -

4.2.5.1 Katni area (30,31) (MP)

Katni is the most developed & exploited bauxite area of M.P. In this area bauxites are associated with low level laterites which are underlain by Archaean, Vindhyan and Upper Gondwana rocks and occurs varying in thickness from few cms to many metres.⁽¹³⁾

Following is an established sequence of the area⁽³⁰⁾ -

- Soil and Murrum	Recent
- Laterite	
- Bauxite, Bhabhar and earthy clay) Upper } tertiary)
- Reddish or yellowish clay (lithomarge)	
-----Unconformity-----	
- <u>Limestone and shale</u>	Vindhyan (lower)

The average thickness of bauxite in the leasehold of A.C.C. varies from 2-12 m. with an overburden cover of 1 to 13 m. The laterite is bouldery in nature and occurs as irregular cappings on the underlying rocks. Trap is not known to be associated with the laterite of Katni area. The laterite and bauxite occur mostly as segregated patches in the thicker cappings of laterite, forming low mound, and hillocks. Patches of good quality pisolitic bauxite occur in the alluvial depressions such as Tikuri and Padarwara.

Katni bauxite has good percentage of refractory grade. However some quantity of metal and chemical grades are also produced. The main ore mineral is gibbsite. At times intense weathering gives rise to loose pisolites e.g. at Padawara, Imalia, Chapra etc. The bauxite has creamish grey & reddish colour. The important bauxite bearing localities in Katni include Tikuri, Tikaria, Bargawan and Padarwara.

4.2.5.2 Bhakarwara deposit (32) : Occurrences of low level bauxite are present near the village Bhakarwara in Sihora tehsil of Jabalpur district. Bauxite/laterite here lies over the sediments of Vindhyan super-group. A distinct feature observed here is that lateritic bauxite is not associated with Deccan Traps. The lateritisation has mainly effected the Dharwar Quartzite and Vindhyan Sandstones. Bauxite invariably occurs as isolated pockets and the best varieties are light pinkish to creamy white. The predominating ferruginous varieties are brown in colour and characterised by pisolitic texture. The massive variety laterally grades into pisolitic variety. The bauxite is underlain by white kaolinite horizon with a gradational contact. These bauxites have perhaps formed due to desilication of existing clays. The bauxite has low Al_2O_3 & Fe_2O_3 and hence unsuitable for refractory use (32).

4.2.5.3 Niwar : This area lies N of Katni where bauxite occurs as fairly extensive laterite capping. The bauxite is friable, massive to pisolitic in nature, grey in colour and is of superior quality (high grade). Important bauxite bearing areas in Niwar area include Tikaria, Khajuri, Kusmi, Baghai and Tharka. At Khajuri metal-grade bauxite also occurs along with refractory grade ⁽¹¹⁾.

4.2.5.3 Sleemanabad ⁽¹¹⁾ : In this tehsil of Jabalpur district the thick over burden cover of laterite covers bauxite deposits. The thickness of ore zone is around 1 m. and the recovery is quite poor.

4.2.5.4 Dundi : Good seggregations of bauxite are present in small and erratic cappings of laterite over the ridges of Bijawar rocks. Bauxite is of refractory grade and is utilised in the local plants. Bauxite occurrences are noticed in five sections namely (i) Mihgawan (ii) Hatbai, (iii) Dhangawa (iv) Chapre and (v) Amoch. The bauxite is massive grey or pink, bouldery to concretionary. The maximum thickness at Mihgawan is 3 m.

4.2.6 Raigarh district ⁽³³⁾ (Chhatuigarh)

In Jashpur subdivision of Raigarh district, falling on the western border of M.P., the primary laterite directly overlies the gneissic rocks. Minor occurrences of the bauxite deposit are located in most areas of Jashpur. Bauxite deposits are reported from Khuria high lands, Pandrapat, Tendpat, Jeletpat, Sinduarpat, Murakona, Kadampat, Daitunpani, Rauni, Chichli, Rokarapat, Sukhma, Thakiapat, Gaibura, Gardhapat, Murhi, Bijaghat, Nonpani Pahar, Sulesa, Garanjdara, Garh Pahar, Thutapani Pahar, Bhoorapat, Dulum hill, Madmapahar, Jatradaapat, Gajma, Hari, Chikpat, Daunapat, Paiku, Pakritoli, Burha hill, Kusang hill, Kirindha Pahar, Deopani, Bhairamurio hill and Kadra Pahar. Bauxite occurs here in both vermicular and pisolitic forms. The average thickness of bauxite is 3m. The average chemical composition of bauxite in this district is given below:-

Al_2O_3	-	51.19-59.91 %
SiO_2	-	0.20- 2.34 %
Fe_2O_3	-	2.12- 6.21 %
TiO_2	-	9.15-14.12 %
CaO	-	Traces-0.78 %
MgO	-	0.18- 0.48 %

4.2.7 Satna district (mp)

4.2.7.1 Naugama area (34) : Naugama area lies to the SW of Rajhuan deposit. The bauxite deposit are reported from Digrahat Amirti, Silha, Chanihara, Kasigohi and Kararia areas. The deposits overlie Rewa sandstone & Ganurgarh shales of Vindhyan formation. Bauxite occurs as small irregular blankets over hill tops. A typical bauxite profile developing south east of Karavia, includes 1 m thick laterite at the top, followed by 2 m thick bauxite. This zone is in turn underlain by a thick succession of various deposits of kaolinitic clays, yellow ochre and red ochres.

Bauxite is grey, light pink and cream coloured. Massive, pebbly, pisolitic, concretionary and brecciated textures are commonly found. It is mostly composed of gibbsite. Bauxite occurs in association with clay-ochre sequence.

4.2.7.2 Naro hills (35,36)

Naro hill is about 18 km SE of Satna. Bauxite deposits here are associated with the laterites, capping the fine grained sandstone of Vindhyan age. The stratigraphic column in Naro hill includes from top to bottom, zones of soil, laterite and bauxite which are in turn underlain by upper Bhandar sandstone and Sirbu Shales of Vindhyan Formation.

Two types of bauxite namely ash grey and earthy brown varieties are identified. Bauxite occurs as irregular blankets, lenses and pockets below the pisolitic laterite. Two grades of bauxite namely Grade A (50% Al_2O_3) and Grade B (45% Al_2O_3) are found. The generalised laterite profile in Naro hill is given below (37).

	Top Soil	- Upto 0.20 m
Reworked	(- Pisolitic Laterite	- Upto 2.00 m
	(- Pisolitic laterite with lumps of bauxite	- Not detected
	(
Residual	- Bauxite	- Upto 2.5 m

Major aluminous minerals found in the ore include cliachite and fine grained gibbsite. The chemical composition of bauxite is given below :-

Al_2O_3	-	52.6%	to	58.00%
SiO_2	-	4.00%	to	9.84%
Fe_2O_3	-	4.00%	to	6.80%
TiO_2	-	5.90%	to	8.00%
CaO	-	0.00%	to	0.50%
LOI	-	25.30%	to	27.30%

4.2.7.3 Jaitwara area (38): Jaitwara area is located on Survey of India Toposheet no. 63 D/13. Bauxite deposits are situated on plateau, mostly concentrated around Jaitwara railway station. The geological succession in Jaitwara area includes from top to bottom a residual zone comprising laterite, bauxite, white clay, lithomargic clay and ochre. They are in turn underlain by felspathic sandstone, shales, glauconitic sandstone, olive shales etc belonging to Vindhyan Formation.

The bauxite deposit is horizontally bedded and covered by lateritic soil of about 1 metre thickness. The average chemical analysis of bauxite is as given below. Al_2O_3 - 56.78%, TiO_2 - 6.65%, Fe_2O_3 - 3.06%, SiO_2 - 3.45%, LOI - 29.60%. Two grades of bauxite are found in the area namely Metal grade, & Chemical grade.

4.2.8 Mandla and Shandol districts. (M)

4.2.8.1 Amarkantak area (13,42)

In Amarkantak area bauxite deposit occurs on irregular and dissected plateaux rising above 1070 m from MSL which form E part of Maikala range. These bauxite occurrences were first reported by Fermor and were studied in detail by later workers. Important deposits are located at Umargaon, Jamuna dadar, Rakti dadar, Nanhu dadar, Hazari dadar, Kabir dadar, plateau

west of Baoli, Bangla dadar, Chakmi dadar, Pondibahera pahar, Daikibanda pahar, Siriapondi --- pahar and Khamera deposit. Nanhudadar forms the eastern limit of the extensive laterite bearing plateaux, comprising the Maikala range. Among the 12 dissected bauxite deposits in Amarkantak group Hazaridadar and Rakti dadar deposits are most extensive. BALCO has captive mines at Putkapahar and Amarkantak and ^{plant} is 30 to 40 kms away from the deposit. Small deposits found about 20 to 40 km south west and west of Amarkantak area are commonly known as 'B' group of deposits which are located about 70 kms from the Korba plant of BALCO.

Gneissic rocks form the core of the range and are exposed on lower slope of Amarkantak plateau. Extensive Gondwana rocks of the South Rewa coalfield lie to the south of the area. The geological succession exposed in Amarkantak area includes a 20 to 30 m thick bauxite bearing zone of laterites. This profile rests on Deccan Traps forming a capping, which in turn is underlain by Lametas, Gondwanas and Archean metamorphics.

The laterite-bauxite profile in the area includes from top to bottom a soil zone, followed by pisolitic laterite ranging in thickness from 0 - 5 m, upper low grade bauxite (aluminous laterite) ranging in thickness from 0 - 3 m, bauxite zone ranging in thickness from 0 - 6 m, aluminous laterite zone 0 to 2 m, thick, ferruginous laterite zone ranging in thickness from 4 - 15 m and finally the lithomarge at the base which ranges from 1 m to 22.6 m in thickness⁽¹³⁾.

An extensive blanket of laterite overlying the Deccan trap is seen to occur on all the flat topped plateaux. Bauxite occurs as thin and discontinuous lenticular bodies within the laterite profile. The lower contact of bauxite is gradational. The mineralised area in Hazaridadar is 1.32 sq.km, Kabir dadar 0.33 sq.km, Siriapondi pahar 0.22 sq.km, Daikibanda Pahar 0.24 sq.km, Pondibahera pahar 0.3 sq.km ^{while} 0.51 sq.km is bauxite bearing in Bangla Dadar^(39,40,41,45).

The Bauxite is light grey, cream or light pink in colour. Massive non pisolitic variety occurs as irregular pockets. Major ore forming minerals are gibbsite, boehmite

and goethite with minor amounts of hematite, rutile, kaolinite and clinochlore. The average thickness of bauxite is 2.2 metres. Bauxite deposit in the area were formed by subaerial and supergene alteration of Deccan traps.

4.2.9 Rajnandgaon district ^(46,47) (Chhatisgarh)

4.2.9.1 Bodai-Daldali Area

The Bodai-Daldali plateau is situated in Kawardha tehsil of Rajnandgaon district. This area is divided into five blocks namely Bodai, Kesmarda, Semsata, Rabda and Daldali. The bauxite bearing laterite capping is found on the top of basaltic plateau (Deccan Basalts). Bauxite occurs in form of pockets in ferruginous-pisolitic laterite. The autochthonous bauxite of the Bodai-Daldali area forms discontinuous thin and flat lenticular bodies within the laterite. Bauxite is found sandwiched between the laterite.

The Bauxite is classified into 3 grades namely grade I (greater than 51% Al_2O_3), grade II (>48% to 51% Al_2O_3) and grade III (45-48% Al_2O_3). It is massive, hard and compact, light grey to pink in colour. Bauxite contains gibbsite in abundance along with kaolinite and goethite. The Al_2O_3 in the bauxite found in Daldali block ranges from 41.25% - 57.65%. Thickness of bauxite zone varies from 1.30 m to 4.80 m ^(47,48).

4.2.10 Bastar district (Chhatisgarh)

4.2.10.1 Abujhmar area ⁽⁵⁴⁾

Systematic mapping carried out by GSI in toposheet Nos. 65E/15, 6 and 65A/13 & 14 in the Abujhmar area revealed vast laterite caps overlying the basic volcanic rocks of basaltic composition. The thickness of laterite profile varies from 20 to 40 m. The laterites are red and brown in colour, pisolitic and brecciated in nature and contain pockets of bauxite. The bauxite is of grade II quality.

4.2.10.2 Bailadila range ^(50,52)

Occurrences of bauxite in the high level laterite from Taralimatta peak, which is 2.5 km west of Bailadila rest house and east of the watershed between sankari and Galli rivers are recorded. Here the laterite overlies banded magnetite quartzite

with the associated iron ore and ferruginous schist belonging to Bailadila iron ore series. A few analyses have indicated that the bauxite is of high grade around 60% Al_2O_3 with very little silica and titania⁽⁵¹⁾. No further details of these deposits are available.

4.2.10.3 Keskal Deposit :

Occurrences of high grade Bauxite were reported by GSI in Keskal - Amabera area in the year 1977 and in Pirhapal-Tarandul area during 1983 as a result of systematic mapping. The Keskal-Amabera area is approached from Keskal which is 160 km from Raipur and 135 km from Jagdalpur on National Highway No.43. Whereas the Pirhapal-Tarandul area can be approached from Kanker ($20^{\circ}15'$; $81^{\circ}30'$) which is situated on National highway No.43 connecting Raipur-Vizianagaram via Jagdalpur.

Large occurrences of high grade Bauxite were reported for the first time over the proterozoic Bamni sandstone of Indravati group. In both the areas segregations of high grade pisolitic bauxite are found in the upper part of the laterite profile. In Keskal-Amabera area bauxite deposits are found at Girgoli, Bamni, Raobera, Upal Bendi, Bermamori, Cherbera, Bandharipara, Kuye, Kuderwahi, Halekurum Oondri, Budhianari, Mamakonari and Pat Dongri. The bauxite deposits in Pirhapal-Tarandul area are located (1) North of Kumikakuram (2) On NE extension of Nangalmetta plateau (3) On Nangalmetta plateau, NE of Tarandul (4) On 2562 plateau west of Pusajhar (5) On Ghotulmetta plateau, NE of Bhainsgaon (6) On Kalpanjmetta plateau, NW of Dhobahverra (7) On Eastern spur of Nangalmetta plateau (8) On plateau NW of Marmakonari (9) West of Marmakonari (10) North of Kalmuchhe and (11) On plateau NW of Tarandul. All these occurrences are located in Survey of India toposheet No.64H/8.

Both the areas exhibit undulating topography controlled by geology. The area reveals Archaen basement rocks unconformably overlain by upper proterozoic Bamni sandstone. The tentative succession of formations in this area is as follows,-

<u>Age</u>	-	<u>Formations</u>
Recent/subrecent	-	Laterite/Bauxite
-----Unconformity-----		
Upper Proterozoic	-	Indiravati Group (Bamni Sandstone)
-----Unconformity-----		
Intrusives - Pegmatites, basic dykes dykes & quartz veins.		
Bengal Group - Granite gneiss and other metamorphics.		

Basement Gneiss :

The laterite capping has developed over the Bamni sandstone and the thickness of the cap varies from 5 to 20 m. The laterite profile is formed due to residual chemical weathering of the underlying feldspathic Bamni sandstone. The associated bauxite is massive, cavernous and vermicular in the lower part and pisolitic in the upper part. The thickness of bauxite exposures ranges from 2-4 m. There are two types of bauxite namely pisolitic and massive. The bauxite is in parts exceptionally high grade which is revealed from the following analysis Al_2O_3 58% to 68%, TiO_2 3 to 4%, Fe_2O_3 1 to 8%, SiO_2 4% and alkali traces (52,53). Parts of the area are under active mining by M.P. State Mining Corporation.

4.2.11 Bhopal District (11) (MP)

Minor occurrences have been located at (i) Bhoj Kalara field (ii) Bairasia field and (iii) Jhamar Bhilwari field.

4.2.12 Guna District (49) (MP)

Occurrences of bauxite are reported from Isagarh area. Bauxite occurs as boulders.

4.2.13 Shajapur District (11) ;

Minor occurrences of bauxite have been reported from parts of this district.

4.2.14 Shivapuri District (50) (MP)

Bauxite occurrences are found in Kolaras area, Hirapur, Mada Ganesh Kheda, Akhai Mahadeo and Barkhara areas.

4.3 BIHAR

4.3.1 In Bihar the laterites are found as cappings over Deccan traps and infra-trappeans. They are in turn underlain by Cuddapah and Archean metamorphics.

In Bihar, bauxite occurs in form of an extensive blanket lying below the laterite cover. The laterite cover occurs on the top of flat topped plateaux, with gently undulating topography. Bauxite is underlain by lithomargic clay followed by granite gneiss and is overlain by laterite, murrum and top soil successively⁽⁵⁷⁾. The thickness of the deposit ranges from 1 - 18 m. but averages to 6 m only. The thickness does not appreciably change except in a few areas. The general extension of bauxite belt is in north-south direction. Texturally, the bauxite exhibits oolitic, pisolitic, porous, spongy and massive texture. The colour of the bauxite varies from whitish grey to reddish brown and is hard and compact.

4.3.2 IMPORTANT DEPOSITS OF LOHARDAGA & GUMLA DISTRICTS (Charkhand)

4.3.2.1 RICHIGHUDA SECTOR :

In this area, two types of laterites are found i.e. plateau laterites and valley laterites. The plateau laterite occur as extensive blankets on the high ridges and plateaux and are locally known as pats⁽⁵⁵⁾. Valley laterites are found especially in valleys, formed due to detrital accumulation of the disintegrated parts of the plateau laterite. Lithomarge is occasionally exposed at the base of the laterite scarps of nearly 6 m thickness. Seggregation of bauxite is found in the laterites as pockets. These pockets vary from minute specks to persistent bands on the scarp face. The massive bauxite occurs within the vesicular and cavernous matrix of ferruginous laterite. Bauxite seggregations occupy the upper portions of the laterite scarps, usually with a thin overburden of pisolitic or gravelly laterite.

Some of the important deposits located in this sector are : (A) Banrobar (B) Manduapat (C) Pakhar and (D) Rudnipat.

(A) Banrobar Deposit : Bauxite occurs as wedge shaped bodies thinning inward away from the scarp faces. The thickness of bauxite normally ranges between 1-3m covered with a soil and morrum capping of 0 - 2 m. The average grade of bauxite varies from 40 - 50% Al_2O_3 . The recovery of float ore is about 20-30%. The deposit has been worked in the past but is now abandoned.

(B) Manduapat Deposit : Bauxite deposit occur at Manduapat at an elevation of about 1075 m above the sea level on escarpments in a layered form. The lateritic profile shows the following sequence :

Black soil
Red subsoil
Murrum
Ferruginous laterite
Bauxite
Lithomargic clay

The bauxite horizon here is about 3 m in thickness and the high grade material shows a patchy development⁽⁵¹⁾. The ore shows Al_2O_3 content ranging between 45 to 50%. The Manduapat plateau is divided into northern, Central and southern blocks. Of these, the southern and part of northern blocks have been mined out already⁽⁵⁶⁾.

(C) Pakharpat Deposit : The Pakharpat deposit occurs at an altitude of 1050 m above MSL. The plateau trends northwest-southeast and is flat topped with practically no vegetation. The laterite capping on the plateau is seen resting on granitic gneiss but is believed to be a product of residual weathering of the Deccan Traps originally present there. The bauxite occurs as boulders and also as continuous horizons. It shows gray to reddish-brown colour and contains 52 - 53% Al_2O_3 , and 2-3% SiO_2 . The escarpment side shows bauxite exposures without any overburden. The bauxite capping is about 1.4 m thick.

(D) Rudnipat Deposit : Concentration of bauxite on this plateau is seen only on the western side and occasionally exceed 12 m or more in thickness. The best development of bauxite is seen near the north-west corner where aluminous