

laterite very often pass into bauxite. The bauxite zone on western side is exposed for a thickness of 2 to 25 m overlain by a hard lateritic zone of 4 to 4.5 m thickness.

4.3.2.2 LOHARDAGA SECTOR : The deposits of this sector are typically represented by Bagru hill where 10-15 m thick section from Precambrian basement to the top of bauxite is well exposed. At Bagru Hill, laterites and bauxites with exposed thickness of 2 m, occur as cappings over infra-trappean beds. They are in turn underlain by Chota-Nagpur granite gneiss⁽⁵⁸⁾. The important bauxite deposits of this sector are described as below -

(A) Maidanpat Deposit : This plateau has an elevation of 1034 m above MSL. and is 2.24 kms long in north-south direction with a maximum width of around 0.8 km. in east-west direction. The concentration of bauxite is mostly on the escarpment side with an average thickness of 2-2.5 m., occurring as interlayered and boulder zones within laterite and morrum. The bauxite zone on the whole ranges in thickness from 1.5 to 3m.

The bauxite is found as boulders in lateritic matrix. The recovery is around 30 to 35%. The grade of the bauxite is around 42 to 45% Al_2O_3 .

(B) Birhnipat Deposit : This plateau is separated from Maidanpat plateau by a saddle and is located in the southern continuity of Maidanpat. It extends over a length of 2.25 km. The bauxite occurs in form of boulders as well as layers with patches of aluminous laterite. The boulders are generally embedded in laterite and morrum.

(C) Bagru Hill Deposit : The bauxite deposits of Bagru Hill presently under active exploitation, are located at an elevation of 1057 m above MSL on a flat topped hill with little relief. A generalised succession found on the hill is as given below^(56, 58).

Soil	4.5 to 6 m
Laterite & morrum	6 to 8 m
Bauxite zone	7 to 9 m
Lithomarge	bottom touched

The deposit shows bauxite outcrops at scarp faces which continue to the central part of the plateau. The bauxite is hard-compact, homogeneous and shows variegated colours with a thickness of 3 to 9 m.

Significant reserves of bauxite with the following average grade are found on Bagru Hill -

Al_2O_3	46.49 - 53.30%
Fe_2O_3	7.10 - 17.26%
TiO_2	8.92 - 9.39%
SiO_2	3.41 - 4.80%
LOI	23.72 - 25.55%

4.3.2.3 SHRENDAG SECTOR : Shrendag sector comprises the following deposits : (A) Shrendag (B) Jalim & Sanai and (C) Tuimu (D) Jillingsira. The Jillingsira deposit is situated to the south-west of Shrendag plateau while the other three deposits occupy the Shrendag plateau.

(A) Shrendag Deposit : This bauxite deposit occurs at an altitude of 1042 m above the MSL as lenses, pockets and interlayered zones associated with morrum and laterite. The profile shows the following sequence :

Soil & laterite	2.5 - 4 m
Bauxite	1.2 - 5.5 m
Siliceous laterite)	Base not seen
or)	
Lithomargic clay)	

The average thickness of bauxite horizon is 3 m while the average grade ranges are as follows : - Al_2O_3 - 54.52%, SiO_2 - 2.05%, Fe_2O_3 - 12.35%, TiO_2 - 8.4% and LOI - 23.64%.

(B) Jalim & Sanai Deposit : This is a small deposit situated to NW of Shrendag deposit. The bauxite occurs here as lenses and boulders along the scarp faces. The bauxite

succession is same as seen at Shrendag. The thickness of bauxite on an average is 2.5 m. The average analysis of the bauxite is given below : Al_2O_3 - 50.7%, SiO_2 - 2.82%, Fe_2O_3 - 12.57% TiO_2 9.65% and LOI 23.7%.

(C) Tuimu Deposit : The Tuimu deposit is situated in south at a lower altitude than the Shrengdag deposit, with repetition of the same bauxite profile. The thickness of bauxite zone ranges from 3.5 - 5.0 m.

(D) Jillingsira Deposit : This deposit is located in SW of Shrengdag deposit. Insitu bauxite is found at the top of the plateau and along scarp lines. The bauxite also occurs as boulders embedded in laterite matrix under a soil cover of 1 m. The average thickness of bauxite zone can be taken as 5 m.

4.3.2.4 NETERAHAT SECTOR : The Netarahat plateau is covered by laterite capping. Narma - Jobhipat, Amtipani, Chirodih and Gurdari are some of the prominent deposits occurring in Neterahat sector. These are described below -

<u>Bauxite Lithounit</u>	<u>Narma</u>	<u>Jobhipat</u>
Soil & morrum	10 m	0.6 - 2.5 m
Laterite with bauxite	2 - 6.5 m	1.5 - 4 m
Lithomargic clay	upto bottom	upto bottom

The bauxite occurs as boulders embedded in laterite which are quite erratic in distribution. The bauxite profile is seen in the scarp section.

(B) Amtipani Deposit : This deposit is located on a flat topped small plateau exposing laterite and bauxite cappings under a thin cover of 0.5 - 1.5 m of soil and morrum. The bauxite occurs as boulders and is embedded in laterites having 2.5 - 4 m thickness. Sometimes, interlayered bauxite with 1 - 2m thickness is underlain by 1 - 4m zone of laterite. The occurrence of boulders, pockets and lenses of bauxite in laterite is erratic.

(C) Chirodih Deposit : The Chirodih deposit lies at south and south west of Amtipani deposit at a distance of

about 3 kms. The southern deposit consists of a lateritic bauxite zone of 2 - 4 m thickness with a thin soil and morrum cover. The lateritic bauxite is underlain by a barren laterite zone followed by occasional lithomargic clay zone. The bauxite occurs in form of boulders embedded in laterite matrix with erratic distribution. The south western Chirodih deposit consists of 1.5 - 5 m. thickness. The laterite bauxite zone is normally underlain by hard laterite.

(D) Gurdari Deposit : This largest deposit of the Netarhat sector lies in the SW part of the plateau. The geology and bauxite characteristics of this deposit are similar to other deposits of the sector. Total thickness of the bauxite zone in the deposit is estimated to be about 7 m. The distribution of bauxite in laterites appears to be erratic.

4.3.3 IMPORTANT DEPOSITS OF PALAMAU DISTRICT (Sherwood)

4.3.3.1 Jamirapat Deposit : This deposit is located in Tamolgarh area adjoining eastern border of M.P. Mahuadadar the nearest town, is located 105 km from Daltonganj. The extension of this belt can be traced down in adjoining area of M.P., the details of which have already been given in paragraph 4.2.3.

The geological sequence in the area from top to bottom comprises a 10-20 m thick profile of pisolitic bauxite sandwiched between laterites. This is in turn underlain by 5 - 10 m thick lithomarge. The bauxite profile rests on basic Traps, infratrappean, sedimentaries and finally on Archaean metamorphics (59).

Laterite and bauxite form the youngest rock units exposed in the area. Laterite occurs as extensive cappings, about 20 m thick on the high ridges and plateaux and mostly appear to rest on the lithomarge overlying the infra-trappeans. Bauxite occurs as lenses and bands exposed mostly on the scarp faces, within the laterite cappings, which attain a height of 1036 m above MSL. The bauxite laterite zone is also encountered at lower levels. The laterite-bauxite zone shows relict, oolitic, brecciated and pisolitic textures. The bauxite is light

grey and massive. The thickness of bauxite zone varies from 2 to 2.5 m while the average grade of ore is 47.9% Al_2O_3 .

4.3.4 IMPORTANT DEPOSITS OF SAMTHAL PARGANAS DISTRICT (Theohard)

4.3.4.1 Rajmahal Hill Deposit : The Rajmahal Hills comprise a plateau of low elevation (max. 520 m) which extends from Sahibganj in the north to Dumka in the south. The plateau comprises 500 m thick pile of differentiated lava flows with fossiliferous agrillaceous and araneaceous intertrappean beds. In Rajmahal Hill area, laterites and bauxites form a capping over rocks of Rajmahal volcanics. These are in turn underlain by rocks of Gondwana and Pre-cambrian gneisses and schists (60).

The bauxite occurrences are of insitu or transported origin mixed with lateritic boulders. The complete laterite/bauxite profile developed in the area is as follows :

Brown soil	--	at times concretionary
Laterite	--	Scoracious & pisolitic
Bauxite	--	massive
Laterite	--	massive
Lithomargic clay	--	-

The laterite occurs as capping over the plateau tops overlying the youngest lava flows of Rajmahal traps. They are commonly pisolitic, vesicular, laminated, cellular and brecciated in forms. Massive laterites upto max. 10 m, thickness have been noted at places but their average thickness can be taken as 0.5 to 2 m.

Bauxite is generally greyish white to pinkish white in colour and occurs in massive, pisolitic and brecciated forms. Important occurrences are located at following places.

- (i) Banspahari - hill
- (ii) Kotarbahil - Fusarkaipu - Marikatro
- (iii) Jamia Jamri - Bara Jamri
- (iv) Chotta Adro - Bara Jhari

The bauxite analyses Al_2O_3 from 46.36 to 60.25%, SiO_2 1.04 to 5.23%, Fe_2O_3 4.00 to 18.80%, TiO_2 5.00 to 6.00% and LOI from 25.51 to 29.58%.

4.4 MAHARASHTRA (61, 62)

Bauxite occurs in Kolhapur, Raigad, Satara, Sangli, Sindhudurg, Ratnagiri and Thane districts of this state. The occurrences are confined to the top of different plateaux of Western Ghats. Their altitude varies from 182 m to 243 m in Raigad district and 912 m and above in Kolhapur district. All over they are associated with laterite cappings & owe their origin to lateritisation of Deccan Traps. In Kolhapur the deposit is blanket type where as in other districts it is pockety and lense type. The thickness of Bauxite ranges from 0.3m to a maximum of 10.6m. The regional geology corresponds to be geology of the Deccan Trap of Upper Cretaceous to lower Eocene age. Districtwise description of the deposits is as follows.-

4.4.1 KOLHAPUR DISTRICT

The deposits in this district are confined to the plateau tops at about 1100 m above MSL forming parts of the Western Ghats. Important deposits are located at Kasarsada, Nagartswadi, Dhangarwadi, Radhanagari, Rangewadi and Udgiri. Other deposits of lesser importance are located on Girgaon plateau, Kalkawadi plateau, Kitnawadi, Manbet, Inderganj, Gargoti, Mogalgad, Mahipatgad, Kalandigarh fort, Gandharavgarh, Bavda area and Panhala fort.

The description of some important deposits of Kolhapur district is as follows :

4.4.1.1 Kasarsada Deposits

Kasarsada plateau is located in Chandgad tehsil of Kolhapur district and is situated 9.6 km SSE of Nagartswadi village. The deposit is leased out to M/s INDAL . The plateau forms a part of 4.8 km long north north-east trending ridge. The main plateau at the southwest end of the ridge has a length of 2 km and varies from 30 to 364 m in width. The elevation of the plateau ranges from 1041 m at its eastern and 1057 m at the western end. The thickness of the bauxite deposit averages to 4.4 m with a range of 3 to 9 m and that of laterite overburden averages to 3 m (ranging from 0.00 m to 6 m). The average chemical analysis of the bauxite is as

given below :- Al_2O_3 52.4%, SiO_2 2.6%, Fe_2O_3 13.0%, TiO_2 5.5% and LOI 26.4%.

4.4.1.2 Nagartswadi Deposit

This area too forms a part of Chandgad taluka. An area of 284 hectare is leased out to M/s INDAL. The regional geology and the lithological formations are similar to that of the Kasarsada deposit. On the plateau bauxite occurs above 1010 m. and the bauxite/laterite horizon has an average thickness of 5 mts. The strike length is 2900 m along NNE-SSW with an average width of 185 m. Substantial reserves has been proved in the area by the lessee. The average chemical analysis of the ore is as given below : Al_2O_3 52.1%, SiO_2 2.7%, Fe_2O_3 12.2%, TiO_2 6.1%, LOI 26.9%.

4.4.1.3 Dhangarwadi Deposit

This plateau is situated south of the Kolhapur Ratnagiri highway which is 46 km west of kolhapur and 20 km from Malkapur. Here the area covered by bauxite is 2,312,500 sq.m and is developed along the south-eastern parts. The average thickness of bauxite is 3.50 m. Substantial proved reserves have been estimated in the deposit whose chemical analysis is as given below : Al_2O_3 53.42%, SiO_2 3.20%, Fe_2O_3 11.22%.

4.4.1.4 Udgiri

The deposit is about a km NW of Udgiri village. Here bauxite forms a saucer shaped continuous body of variable thickness below the overburden of laterite. The average thickness of the ore is about 5 m. Bauxite is of good quality and the samples on analysis showed Al_2O_3 51.77%, SiO_2 2.19%, Fe_2O_3 11.47%, TiO_2 4.8%.

4.4.1.5 Radhanagarfi

This plateau is situated approximately 86 km SE of Kolhapur and is located approximately 8 km north of Iderganj plateau. The main laterite capping extends over a length of about 3.2 km with a width varying from 152 to 608 m. The plateau actually comprises two blocks with average elevation of about 988 m. Out of the total plateau area of about 121 Hect.

about 100 Hect'are capped by bauxite. The average thickness of bauxite is 4-8 m. The chemical analysis of the bauxite is given below :

Al_2O_3 52%, SiO_2 3.30%, Fe_2O_3 12.9%, TiO_2 5.1%, LOI 26.7%.

4.4.1.6 Rangewadi

This deposit is located at a distance of 48 km NW of Kolhapur and it consists of a group of discontinuous plateaux south of village Rangewadi. The south-western scarp section shows 3.6 to 4.5 m of massive bauxite which attains a thickness of 7 m south of Kadakawadi. The average thickness of bauxite is 3.6 m. The average composition shows Al_2O_3 51.25%, SiO_2 14%, Fe_2O_3 10.78%, TiO_2 5.92% and LOI 30.52%.

4.4.2 Ratnagiri District

The bauxite deposits of Ratnagiri district are contiguous with the deposits of Kolhapur district and their mineralogy, chemical composition and physical characteristics are also similar. The deposits occur at an elevation of about 150 m and above from the MSL. The deposits are located in Dapoli taluka and Mandangarh Mahal. In Dapoli taluk deposits are found in Anjarle, Chikalgaon, Kavdoli, Umbershet, Uttamber, Bargarh, Male, Vansoo, Valne and Dabhol. In Mandangarh Mahal it is found at Velas Sakhri.

The description of some of the important deposits is as follows :-

4.4.2.1 Deposits in Dapoli Taluka.

4.4.2.1.1 Anjarle

It is an extensive wedge-shaped plateau trending NW-SE and stretches to about 5 km in length, which is located about 1.5 km NE of Anjarle. Irregular but conspicuous development of bauxite in the form of lenses and pockets is noticed forming four isolated horizons between north of Birwadi and west of Lonavadi. The area covered by these four bauxite bearing horizons is 0.82 million sq.m. Assuming the thickness of bauxite to be 2 m significant reserves of high grade bauxite can be expected here. The samples on chemical analysis show

Al₂O₃ 56.96%, SiO₂ 2.36%, Fe₂O₃ 5.43%, TiO₂ 4.11%.

4.4.2.1.2 Kavdoli

A small rectangular plateau situated about one km. SE of the village Kavdoli about 5 km east of Kelshi is capped by laterite. The thickness of the zone is about 10 m and contains occasional bauxite horizon in the form of pockets and lenses. Significant reserves of all grades of bauxite are estimated in this deposit. The chemical analysis is as below :- Al₂O₃ 58.19%, SiO₂ 2.06%, Fe₂O₃ 5.11%, TiO₂ 3.20%.

4.4.2.2 Deposits in Madanqarh Mahal

4.4.2.2.1 Vetas Sakhri

The extensive parallel plateau separated by a valley are noticed south of Bankot. The one immediately to the south of Bankot is a broad plateau capped by laterite, which is high ferruginous and does not contain conspicuous horizons. The villages Sakhri & Ranvali show a fairly good development of fawn grey bauxite along the eastern and northern slopes. The bauxite area comprises 0.328 million sq.m. The samples on chemical analysis shows : Al₂O₃ 55.99%, SiO₂ 1.84%, Fe₂O₃ 7.51% and TiO₂ 3.20%.

4.4.3 Raigad District (61, 62)

In this district bauxite is generally found on the plateau top under a thick cover of laterite, which occur as capping on Deccan Trap lava flows. The deposit consists of irregular patches, pockets, thin lenses and pods of white, grey, purple and pink coloured. They may be amorphous, pisolitic, brecciated and conglomeratic and are found below laterite cappings. Their origin is attributed to an insitu supergene alteration of Deccan Traps. They are found in Shrivardhan tehsil, Murud tehsil & Pen tehsil. In Shrivardhan tehsil they are found at Velas-Harvet, Hunnerveli - Devkhol, Adgaon-Kudgaon, Maneri - Manvali area, Khujare, Madgarh - Gavaliwadi Walalghar - Shekhadi, Dandguri - Kondevali, Punir-Kherdi Walwati, Jivana Bandar, Maral-Kurawade, Kalinga-Saigaon and Adi-Dharwali-Kariwane areas.

In Murud tahsil it is found in Chikhalgaon - Phansad-Kashid, Usroli-Surve, Fargan - Ambegaon, and Saigaon, Mahalvi areas.

In Pen tehsil, it is found in Mirya Dongar, Khemawade-Tadgaon and Matheran Hill. In all these deposits the Al_2O_3 percent ranges from 47% to 50%.

4.4.4 Satara District

The bauxite deposits of this district are confined to high plateau ridges of the Western Ghats capped by thick blanket of laterite. The deposits are restricted to a narrow strip of 10 km in width and 80 km in length covering western portions of Wai, Mahabaleshwar, Javli & Patan Talukas. The deposits are found at Eruli in Wai taluka, Ambral, Khangral, Kajpuri in Mahabaleshwar mahal and Maradmura and Marli-Savili in Javli taluk. The deposits occur at an elevation of 1100 m above MSL. The lithological succession is as follows :

Alluvium

Laterite with bauxite seggregation

Deccan-traps (basaltic lava flows).

The bauxite occurs in the form of lenses and pockets which show thickness ranging from 3-6.3 m. The ores are hard, compact and vesicular in nature and the textures found are pisolitic, bouldery, clayey and concretionary. The average analysis of sample shows Al_2O_3 43.24% - 56.68%, SiO_2 0.06-3.96%, Fe_2O_3 7.12-7.79%, TiO_2 3.75-7.79% and LOI 26-29.96%.

4.4.5 Sanqli District.

The deposit here is located in Randive-Javli Area of Shirola mahal of this district. The plateau is 'E' shaped and is situated about 85 km NW of Kolhapur. The N-S trending plateau is about 3.8 km in length while the width varies 200 to 1050 m. The average thickness of laterite is found to be 18 m to 30 m where as the thickness of bauxite horizon ranges from 1 to 3 m. The samples on chemical analysis showed : Al_2O_3 54.07% to 61.71%, SiO_2 0.92% to 1.10%, Fe_2O_3 3.29% to 7.58%, TiO_2 4.07% to 8.52% and LOI 23.44% to 30.82%.

4.4.6 Sindhudrag District

The bauxite deposit in this district occur as pockets and irregular masses around Ajgaon, Khanoli, Banda, Vijaydurg and Deogad areas of Sawantwadi, Vengurla and Deogad tehsils. The area has not been investigated in detail. Bauxite found here is of blanket type. This deposit is a part of Nagartaswadi bauxite deposit of Kolhapur district.

4.5 GUJARAT (63, 64, 65, 66, 67)

4.5.1 Gujarat is one of the leading producers of high grade and metallurgical grade bauxite in the country. The bauxite deposits of Gujarat particularly those occurring in Jamnagar and Kutch districts, are known for their superior quality which is specially suited for the refractory, chemical and abrasive industries. A sizeable quantity of bauxite produced from Jamnagar district is exported to Middle East and East-European countries.

The Bauxite deposits occur in Kutch, Jamnagar, Junagadh, Amreli, Bhavnagar, Sabarkantha, Surat, Valsad and Ahmedabad districts. However high grade bauxite is confined to Jamnagar, Kutch, Sabarkantha and Kheda districts only. Other districts namely Junagarh, Bhavnagar, Amreli and Valsad mainly produce metallurgical and lower grades (67).

All the bauxite deposits of Gujarat are distributed in three separate areas :-

- 1) Coastal tracks of Jamnagar, Junagadh, Amreli and Bhavnagar
- 2) South and south-western tracks of Kutch district.
- 3) Ahmedabad region comprising Sabarkantha, Kheda, Surat and Valsad districts.

The laterite belt in Kutch and Jamnagar districts extend for about 250 kms with a width varying from 100 mtr. to about 6 kms. The thickness however ranges from 2 to 5 metre.

Bauxite deposits of Gujarat can be categorised into the following types : (1) Bauxite formed by insitu alteration of pyroclastic facies of Deccan Traps flows, which have to

some extent retained the original textural features of the parent rock namely volcanic agglomerates, breccia and tuffs.

(2) Bauxite deposits formed by reworking and transportation of insitu bauxites formed as above. The deposit of this category can be sub-divided as :-

(a) Those close to the source area, resulting in the pseudo-brecciated bauxites and preserve depositional features.

(b) Those far from the source area as indicated by bauxitic conglomerates and grits with well recorded pebbles and grits of bauxites.

(3) Those formed by lateritisation and bauxitisation of supratrappean limestone.

4.5.2 Jamnagar District (67)

The bauxite mineralisation in Jamnagar district is confined to a NE-SW trending bauxite belt near Arabian sea in the western part of the district. The belt is 52 km long and extends from Mota Asota near Gulf of Kutch in the north to Gandhvi village near Arabian sea coast in the south. The average width of belt varies from 1 to 6 kms.

The bauxite in Jamnagar is associated with the laterites of Lower Eocene to Lower Miocene age which are overlain by rocks of Gaj Series, meliolic limestone and alluvium. The stratigraphic succession established by GSI in Jamnagar district, includes 0.4 to 12 m thick zone of laterite and bauxite which is underlain by hybrid clays followed by basalts and pyroclastics of Deccan Trap facies. In many areas the laterite and bauxite horizon are underlain by a moderate to thick overburden comprising Gaj Series (lower Miocene) followed by meliolic limestone (recent to Pleistocene) and alluvium (63)

The laterite/bauxite horizon in Jamnagar district consist of two zones both of which show characteristic vermicular texture. The upper zone comprising hard iron rich crust, red in colour, spongy, powdery and consist chiefly of ferruginous material. The lower one is a softer mottled clay bed 1 to 10 m in thickness which is variegated and irregularly shaped with grey coloured bauxitic material and deep red lateritic mass. The bauxite here occurs in two distinct modes of occurrence.

(1) Insitu Occurrence : Here the bauxite occurs on the gentle slope of laterite ridges and show gradation to the underlying supratrappeans and overlying ferruginous hard pans. These deposits are lenticular. The ore in this type of deposit show a characteristic uniformity in grade.

(2) Secondary Type or Redeposited Bauxite : This type of bauxite comprises talus and scree type accumulation of eroded and transported bauxite which do not show any relationship with the slopes of lateritic mounds. They occur very near to insitu deposits. They are irregular and pockety and consists of unassorted mass of bauxite pebbles of different sizes, embedded in a clayey matrix. There is no gradation either to lithomarge or tuffaceous rocks. The grade is highly variable.

The bauxites of Jamnagar district are believed to have formed as a result of chemical weathering of pyroclastics which are associated with the Deccan Traps.

4.5.3 KUTCH DISTRICT (67)

The regional set up of bauxite mineralisation in Kutch district is quite similar to that of Jamnagar. Here individual pockets of bauxite are scattered for about 200 km strike length mainly following the coast line. The south eastern boundary of bauxite belt is defined by Ravamia village while the north western boundary is located near Fulra village. The width of bauxite belt ranges from 50 m to 2 kms. The stratigraphic succession as established by GSI in Kutch area includes from top to bottom, recent to sub recent alluvial deposits, Upper Tertiary rocks and fossiliferous Eocene rocks. They are in turn underlain by pyroclastic and volcanoclastic sediments and stratified Deccan Trap which rest on fossiliferous sequence of Jurassic age (64,67)

The bauxite deposits in Kutch are associated with the laterites of Sub-Nuvulitic group of rocks which form a continuous horizon separating the underlying Deccan Traps and the overlying Tertiaries. The laterites are porous, pitted, clayey and are red, yellow, brown, grey and mottled in colour, often appearing pseudobrecciated, concretionary and conglomeratic.

The laterite is 3 to 4m thick and passes on to clayey zones ranging from 2 to 10 m in thickness.

The important deposits of Kutch district are located in Abdasa, Lakhpat, Nakhtrana and Mandovi talukas. Both insitu and transported or reworked bauxites are found in Kutch district. Some 270 individual pockets have been demarcated in the district by DGM Gujarat during its investigation from 1963 to 1970.

4.5.4 Sabarkantha District (67)

In Sabarkantha district bauxite deposits are associated with the laterites of Pleistocene age. Here they are overlain by a thick to very thick profile of soil, blown sand and alluvium, thus restricting the workable exposures of bauxite only in lateritic terrains of (1) Ambal-iyara - Tenpur belt and (2) Sultanpur - Harsol belt located in Bayad and Prantij tehsils. The generalised stratigraphic succession in Sabarkantha district includes from top to bottom, laterite, which is underlain by argillaceous and calcareous sandstone, limestone and clays and finally by Deccan Traps.

The bauxite profile in this district can be classified from top to bottom into pebbly, Kankary and clayey zones. They are associated as small pockets of irregular dimension along with the laterites and emery grade bauxite. Thickness of bauxite and laterite in this area varies from 0.6 to 8.81 m (average 3.25 m). The incidence of higher grade bauxite in this area is rather limited as the recovery of such material is very poor. The bauxite from this district is acceptable for the manufacture of ferric alum, abrasive and emery industries.

4.5.5 KHEDA DISTRICT (67)

The bauxite deposit of Kheda district occur in association with the laterites of Pleistocene age and Calcareous sandstone, Marl and Limestone beds. They are found as narrow belts and cappings over Deccan Traps mainly to the south of Dakor and Kapadvanj towns. In Kheda district the geological succession includes from top to bottom, alluvium, laterite (Pleistocene age), followed by sandstone, limestone and clays of Early Eocene age and Deccan Trap (Cretaceous to Eocene).

In the area south of Dakor and Salod villages high grade bauxite occurs while in other areas in and around Kapadwanj mainly low grade bauxite occurs along with aluminous laterite which is locally used in the cement plants. A total of 14 mining leases have been granted in 111.28 hect. area in this district.

4.5.6 VALSAD DISTRICT (67)

In Valsad district, erratic distribution of bauxite and associated laterites are found near Pathri and Ajrai villages in Gandhvi taluka. The geological set up, mode of occurrence, age and nature of bauxite in this district is similar to that of Kheda.

4.5.7 Bhavnagar, Junagadh and Amreli Districts (67)

In these districts bauxite occur in association with the laterite of Eocene age. The stratigraphic succession in Bhavnagar district as established by ONGC, includes alluvium and fluvio-marine deposits underlain by Miocene limestone and rocks of Gaj Series. They are in turn underlain by laterites, lithomargic clays and bentonite of Eocene age which form part of supratrappeans. They finally rest on Deccan Traps.

Significant deposits of bauxite in Bhavnagar district are found in a 25 km long laterite belt exposed between Bhavnagar and Talaja and also at north of Mahuva near Talgajarda. The bauxite here is soft, clayey and friable associated with white bentonite and lithomargic clay. The bauxite horizon analyses 52 to 55% Al_2O_3 , 8 to 9% TiO_2 , 1.5 to 3.5% Fe_2O_3 and 2 to 4% CaO .

In Amreli district, aluminous laterites are found near Donger and Kagvadar villages, While those in Junagadh district are actually ferruginous laterite upto 5 m thick. In Junagadh district between Jamnagar and Junagadh, deposit of low grade aluminous laterites are found mainly near Keshav, Palakheda, Visavada and Tukada villages of Porbandar sub-division.

4.5 TAMILNADU (68)

Bauxite occurrences and deposits are known in Salem, Madurai and Nilgiri districts of Tamil Nadu between an altitude of 1400 m - 2400 m. These deposits are resting on the Archaean metamorphic rocks belonging to charnockite suite, which occupy the hills while the coastal planes are partially covered by tertiary sediments. Main group of deposits are located at Nilgiri hills, Palni hills, Shevaroy hills and Kollimalai hills in Tamil Nadu. Laterites are widespread over the entire area. A generalised bauxite profile in Tamil Nadu includes from top to bottom, a soil zone 0 - 2 m thick, duricrust 0 - 2m thick followed by 0 - 20 m thick bauxite zone. The bauxite zone ranges from brownish red to yellow-orange colour with relict texture and foliation of parent rock. The best grade bauxite is generally compact and pale coloured. The bauxite zone is in turn underlain by saprolite 0 - 10 m in thickness, followed by charnockite (pyroxene granulite) which form the base (68).

The high level bauxites of Tamilnadu have the following chemical composition - Al_2O_3 40 - 55%, SiO_2 1 - 10%, Fe_2O_3 15-25%, TiO_2 2 - 3% (exceptionally upto 12%), LOI 20 - 29%. The main ore mineral is gibbsite, locally with small amount of boehmite. Haemetite and goethite are the main iron minerals while the kaolinite, quartz and anatase, occur in all deposits.

According to Subramaniam and Mani (1978) the bauxite might have formed intermittently throughout tertiary as the paleoclimatic conditions were favourable for laterite and bauxite formation in South India since Paleocene. In the coastal plains bauxite formation ended in the Middle Miocene with the burial of the deposits. On the high plateaux where the climatic and leaching conditions remain favourable, the process probably continues upto the present.

The depositwise description of major bauxite occurrences in Tamil Nadu is given as below :-

4.6.1 Salem District : Several small bauxite deposits are reported from Salem district, of which the most important ones are Shevaroy hills and Kollimalai hills.

(A) Shevaroy Hills Bauxite Deposit (69) :

This deposit is situated nearly 8 km North of Yercaud town and 30 km north of Salem town and forms a chain of 6 high hills trending NE-SW with peaks rising to heights of over 1650 m. This deposit is also known as Yercaud deposit which is leased out and mined by the M/s Madras Aluminium Company Ltd. (MALCO) for its captive consumption in the alumina and aluminium plant located near Mettur dam. The important bauxite bearing hills in the deposit are (1) Hill 1. (Sholakkardu I) (2) Hill 2. (Sholakkardu II) (3) Hill 3 (Shevaroy Hill) and hill Nos. 4, 5 & 6. The hills support luxuriant vegetation with a range of species varying from silver oak to coffee plantation.

The geological succession of Shevaroy Hill comprises a laterite and bauxite zone covered below black humus soil and underlain by rocks of Pre-cambrian age comprising dolerite, charnockite and garnetiferous gneiss.

The bauxite of Shevaroy Hill has a pale yellow to brick red colour and is soft to medium hard depending upon its gibbsite content. The bauxite rich in iron oxide, tends to be very hard. The softer bauxites are rich in SiO₂. It is interbedded with a zone of yellow clay (Lithomarge) about 10 - 15 m wide. The bauxite zone has a thickness ranging from 1.5 m to 10 m. The bauxite column ends up in a light pink lithomargic zone on a charnockite parent rock base at depth.

(B) Kollimalai Bauxite Deposit (Kolli Hill) (70)

These deposits are located in Namakkal taluka of Salem district. They form a chain of low topped hills rising to heights of over 1064 - 1415 m from the surrounding plains. Karavallikombai-Senmedy Ghat road is the only route of communication between the hills and plains. The hills have a thick forest cover having plentiful timber, forest cultivation and orchards. The geological succession in Kollimalai area is similar to that of Shevaroy hills.

The bauxite deposits in the area are leased out to MALCO which has 3 lease blocks namely (1) Selur Nadu (2) Ariyur

Nadu (3) Vazhavandi Nadu. The bauxite in the area is associated with laterites. The bauxite is believed to have formed due to alteration of charnockite under alternating dry and wet conditions. The variation in chemical composition and thickness of bauxite are too wide. The bauxite has cappings on the peak and floats along the flanks. The thickness of bauxite varies from 3 to 14 m. These deposits contain 40 to 45% Al_2O_3 with 25% Fe_2O_3 and less than 10% silica. Gibbsite is the major constituent mineral while boehmite, kaolinite, goethite and limonite are the other minerals formed in bauxite.

4.6.2 Madurai District (71)

Bauxite deposits are reported from Palani Hills near the Kodai Kanal town in Madurai district. The deposits are distributed between milestone 4 and 9 on hills bordering Berijam Lake, Konal Ar area and hills lying to the North of Kodai Kanal-Munnar road. The deposits occur at height of 2134 m above MSL except at the southern part of Palani hills, where they are found at lower elevation also. The regional rocks types are charnockite and leptynites. The bauxite deposits are developed only on leptynite which exhibit N-S strike and westerly dips. The bauxite profile comprises from top, a laterite capping followed by brown clay, nodules and lumps of gibbsitic bauxite, pale yellow and brown clays with nodules and lumps of bauxite etc. The base of the deposit has not been exposed. The ore greatly varies in composition Al_2O_3 32 to 48%, SiO_2 18 - 38% and Fe_2O_3 1 - 18%. M/s MALCO has an lease in the area covering Konal Ar deposit which is spread over 5 hillocks. The expected thickness of bauxite in the area varies from few cms to a maximum of 9.5 m.

4.6.3 Nilgiri District : Several bauxite occurrences are recorded in Nilgiri district. Of these the deposits near Matorai, Kathgiri, Kerkom-Bai and Illiyada are of significance. Four deposits near Illiyade and two near Belthal were investigated by GSI.

In this area, the insitu bauxite has developed over Charnockites of Archaean age while the hill slopes contain detrital bauxite. The laterite bed is porous and bauxite occurs as streaks and pockets. The extent and quality of the bauxite deposits are not known.

4.7 KARNATAKA STATE (64, 73)

In Karnataka the deposits of bauxite occur on the hill ranges of Belgaum and Chikmagalur districts and on the coastal tracts of North and South Kanara districts. Of these bauxite deposits, those located in Belgaum district have maximum economic importance in view of their regular exploitation for captive consumption in the alumina plant of M/s Indian Aluminium Company Ltd.

The bauxite deposits in Karnataka can be broadly categorised under two types (1) those associated with Deccan Traps (2) those associated with the sedimentaries. The sedimentary deposits show chemical characteristics similar to those found all along the West Coast, whereas the bauxite deposits associated with the Deccan Traps (high level deposits) are generally smaller compared to deposits of Madhya Pradesh, Maharashtra etc. The detailed description of these individual deposits is given as below.

4.7.1 Belgaum District (64) The bauxite deposits of Belgaum occur with high level laterite cappings forming continuous blankets on flat plateau tops. The laterite/bauxite bearing plateaux rise to heights over 1000 m above MSL. The deposits in Belgaum district are in fact the southern extension of the deposits identified in Kolhapur district of Maharashtra. Most of the deposits fall under the jurisdiction of Khanapur taluka of Belgaum district, forming part of the Malprabha Valley. In Malprabha Valley, the deposits occur in Dharwarian meta-sediments which are intruded into by granite gneiss and are exposed along the lower elevation of the valley. They are unconformably overlain by the Deccan Trap lava flows which are in turn capped by laterites. Among the promising deposits of Malprabha valley are the deposits located in plain areas which cover comparatively large areas and occupy the plains at the foot of the ridges. The geological succession in Belgaum area includes soil, and ferruginous gravel which overlie the zone of granular laterite and laterites with segregations of bauxite. These are in turn underlain by Deccan Traps, dolerite dykes and quartz-sericite schist etc (73).

The important bauxite deposits situated in Belgaum district are described below :

(A) Boknur-Navge Hills : This deposit is situated 13 km south west of Belgaum. A North-South trending part of the plateau exhibits cream to pale yellow coloured, massive to pisolitic bauxite. This pocket is about 3 m in thickness at the northern part. However to the western part, it assumes a thickness of 6 m. These deposits have given rise to float ore to the south of Boknur, west of Bijarny and south-west of Hangirge. These deposits range in chemical composition from Al_2O_3 47.63%, SiO_2 1-5%, Fe_2O_3 2-18%, TiO_2 4-11% and LOI 25-32% (64).

(B) Karle Hill : These deposits are located 6 km SW of Nevge on Belgaum-Jamboti Road, 20 km from Belgaum. The two plateaux with a saddle in between have been capped by laterites. The eastern part exhibits escarpments with 6 m thick grey bouldery bauxite. Outcrop of massive bauxite are also found in western fringe which exposes aluminous laterite with mottled earthy bauxite. The north fringe exposes pisolitic bauxite. Considerable float ore is noticed on the saddle and western slopes. The thickness of bauxite ranges from 5 to 8 m. The grade of bauxite on east and west crest ranges from 52 to 55 percent Al_2O_3 1.8-2.4%, SiO_2 7-13%, Fe_2O_3 6-8%, TiO_2 and 26-27% LOI.

(C) Bailur Hill : This deposit is located 8 km north-north-west of Jamboti near the Belgaum-Jamboti road. Here yellowish grey to cream coloured bauxite is noticed in the central part of a knoll covering an area of 40,000 sq.m. The hills are divided into eastern and western knolls, with a narrow saddle in between. In the western knoll, massive grey bauxite is conspicuous. The average thickness can be taken as 1 m. The insitu occurrences have also given rise to float ores on the slopes of the eastern knoll. The grade of the float ores from north and south slopes assay Al_2O_3 53-91%, SiO_2 1.28%, Fe_2O_3 8.83%, TiO_2 7.80% and LOI 24.25%.

(D) Kiniyi : In this deposit the thickness of laterite capping is about 16 m measured from the base of Deccan Traps. The thickness of bauxite is around 6 m and its grade is generally good (51).

(E) Kirvale : Here, in this deposit, M/s INDAL has carried out extensive exploration, thus proving reasonable reserves of good grade bauxite. Here the laterite capping, 16 to 25 m thick

lies on a thin basaltic flow which in turn overlies a mass of gneissose granite. The distribution of bauxite in laterite is sporadic mostly occurring as boulders ⁽⁵¹⁾.

(F) Jamboti Ridge : This E-W trending ridge, located South and SSW of Jamboti village, parallel to the Belgaum-Kankunbi road, is situated 26 km from Belgaum. The crest of the plateaux is covered by laterite. However considerable float ore is noticed along southern slopes at many places, some of which show good concentration of bauxite ⁽⁶⁴⁾. The important individual deposits include Ghose, Chikla and Betna. The thickness of these bauxite pockets ranges from half a metre to 1.7 m. The grade of bauxite varies as follows : Al_2O_3 51.44% to 56.8%, SiO_2 0.75% to 2.44%, Fe_2O_3 4.20% to 13%, TiO_2 4.20% to 7% and LOI 25.75% to 32%.

Apart from these deposits, small and isolated patches are also found in Kalardigarn, Nanalgadda and Mahipatgadh where grey-coloured, pisolitic bauxite and aluminous laterite upto 1.5 m thickness are concealed by ferruginous laterite ⁽⁶⁴⁾.

4.7.2 North Kanara District ^(51, 73, 75)

A number of small disconnected bauxite deposits occur in the laterite here which cap the low rising Precambrians occupying the vast coastal tracts between Kumta in North Kanara district and Mangalore. The state DGM has carried out prospecting in most of these prospects. In North Kanara district Swarnagadde, Kumta plateau, Haldipur, Nittadgi, Bhatkal and Mandalli-Talgod have shown promise with sizeable reserves. Later, GSI has also carried out exploration for bauxite in coastal Karnataka mainly on Apsarakond, Chikankod, Kabri, Ramtirth plateau (Honavar), Tadri Gokarn and Melin - Idagunji areas. However many of these prospects may not be of economic importance as they contain a high percentage of silica. In spite of that, their economic potentiality as future sources of bauxite-based industries merit consideration.

The bauxite deposits of North and South Kanara occupy an area between Arabian Sea in the west and Western Ghat in the east. The geological succession in North Kanara district includes beach sand clays and laterites of Sub-Recent age. These are underlain by Pre-cambrian metamorphics ⁽⁵¹⁾.

Here the laterite forms a thick mantle (18 to 20 m) on the plateaux. It occurs widespread at different elevations and forms a predominant formation in the area giving rise to mounds, knolls and extended plateaux. The laterite is found to cap different formations and is generally reddish brown in colour. It is hard and compact to generally concretionary and cavernous. In North Kanara, scarp sections, saddles and the trench channels show concentrations of bauxite.

The generalised bauxite profile in North Kanara district includes reddish brown lateritic soil on the top, underlain by hard laterite concretions and pisolitic laterite. These are in turn underlain by 0 to 3 m thick aluminous laterite and 0 - 4 m thick bauxite zone. Finally these overlie a zone of lithomargic clay (51).

The bauxite and aluminous laterite are found as irregular and discontinuous pockets and lenses within laterite. The bauxite is absent on scarps and cliffs and is limited to narrow gentle slopy portions of the plateaux. The bauxite is found to occur in 3 forms: 1. As discontinuous segregations and irregular masses of boulders and pockets in laterite, 2. small lenses and narrow vertical bands, fillings in joints and fissures of massive laterite and 3. Float ore. Occasionally a thin layer of pisolitic laterite overlies the bauxite horizons which is characteristic of high-level laterite. The patches and lenses of bauxite follow generally ENE-WSW or NNE-SSW direction, probably following the major joint system. Individual patches are 400 to 600 m long and 100 - 300 m wide with around 4 m average thickness. The bauxite occurring in this area is hard, massive and compact occasionally clayey, white cement grey, cream to pale pink and dull lusted. The hard and massive bauxite shows granular texture with pink and white granules. Gibbsite is the predominant mineral, which is associated by kaolinite, goethite, haematite, anatase and quartz (51).

4.7.3 South Kanara District (51, 74, 76, 77, 78, 79)

The bauxite deposits occurring in this district are located at Guppipare Plateau, Paduvare, Nagankalbare, Mudugal, Kallamandkuru, Badgamir plateau in Moodbidiri-Sampayea area, Kuddarka, Belmana, Manipal, Kadambadi Padavu, Pajir-Parna, Kambula Padavu, Merian-Padavu, Benjamin Padavu, Shedde Padavu.

and Gandimat-Bajpe plateaux.

Balsubramanyam has established the following sections^s in Kuddarka, Belmana, Manipal and other places in Karkala and Udipi talukas of South Kanara districts which includes from top to bottom, sands, laterite, acid lava flows, dolerite dykes and Kanara granite. These are in turn underlain by other metamorphic rocks of Archean age. The mode of occurrences nature and mineralogy of deposits in South Kanara district, are the same as given in case of deposits of North Kanara district.

The important bauxite deposits of South Kanara district are described below -

1. Paduvare (Baindoor) bauxite deposit :

This is one of the important occurrences of bauxite in the area which is situated about 1.6 km N of Baindoor. The area has been explored by the DGM Karnataka in the past and at present it is being mined by M/s Mysore Minerals Ltd.

The bauxite bearing lateritic horizon forms a narrow ENE-WSW trending plateau. The escarp regions are partially covered with laterite boulders and comparatively thick vegetation. Paduvare appears to be remnant of once existing extensive blanket like laterite cover.

In Paduvare area, the laterite profile includes from top to bottom, a zone of 0.5 to 1.5 m thick ferrogenous laterite underlain by a zone of 5 to 7 m thick laterite bauxite, aluminous laterite. These are in turn followed by a thick zone of lithomarge resting on altered gneiss and granite gneiss.

The laterite zone is seen as a vast sheet like flat mass varying in thickness from 6 to 10 m and is characterised by hard compact tubular (vermicular) texture. The bauxite is composed of gibbsite, goethite, haemetite and minor amount of anatase and quartz. Within the laterite profile, the upper 6 m thick layer of laterite is comparatively rich in alumina and lower portion is ferruginous. The bauxite is exposed on the surface under a thin cover of ferruginous crust and at places is encountered at depth of 1 - 3 m from the surface having a gradational contact with the overlying laterite.

4.8 KERALA (68,82,83)

Bauxite deposits are reported from Thiruvananthapuram, Kollam, Allapuzha and Kannur districts of Kerala. The deposits of Kerala state are generally similar in geological set up, mode of occurrence, nature and type of bauxite. The bauxite deposits are confined to laterite over ancient plateaux comprising charnockite. Two types of deposits are formed in Kerala namely (1) In situ bauxite deposits which have originated from Archean rocks (2) Detrital and sedimentary bauxites which are covered by Middle Miocene marine limestone of Quilon Formation and Late Miocene to Pliocene sandstone of Warkali Formation with a thickness of 6 to 20 m. These include (a) Boulders consolidated in a ferruginous matrix occurring near primary in situ sources (b) Bauxites transported and redeposited in sedimentary basins and occurring above Kaolinized Archeans. No regular production of bauxite has been reported so far from Kerala.

The bauxite deposits of Kerala are located in the coastal plains between an altitude of 10 to 200 m. Field evidences support the view that the deposits were formed during the sub-aerial weathering of the Archaean khondalites, leptynites, migmatites, pyroxene-granulites and charnockites which are exposed throughout Kerala.

The bauxites of Kerala coast are characterised by low iron and titanium content. The range of chemical composition varies from Al_2O_3 45-57%, SiO_2 2-18%, Fe_2O_3 0.4-18%, TiO_2 0.4-2.3% and LOI 25-31%. As seen from the above the bauxite composition is highly variable and the mineralogy of these bauxites is same as that of deposits of Tamilnadu.

Regarding the age of these bauxites which have developed in the coastal plains of Kerala, it is suggested by Subramanyam and Mani (1978) that paleoclimatic conditions were favourable for laterite and bauxite formation in the area since the Paleocene. The bauxite formation ended in the Middle Miocene with the burial of the deposits. Therefore the bauxite deposits of Kerala are Miocene in age.⁽⁶⁸⁾

The GSI has recognised the following geological succession in the bauxite bearing area from top to bottom. The alluvium underlain by lateritic clays, ferruginous sandstone and carbonaceous clays of tertiary age cover the bauxite profile which comprises laterite, pockets of bauxite, bauxitic clay and lithomarge of Pre-Tertiary age. These are in turn underlain by metamorphic rocks of Archean age⁽⁸²⁾.

The important deposits of Kerala are located in the following region :

4.8.1 Kollam (Quilon) district :-

(i) Cherukad Vadakkamuri (ii) Chittavattam (iii) Pallikal

4.8.2 Thiruanandpur (Trivandrum) district :

(i) Mangalapuram Chilampil - Mudaparum (ii) Adicchanallur (iii) Adikkattukulangara (iv) Kudiravattamkunna

4.8.3 Allapuzha (Alleppey) district :

Chirayinkal taluk

4.8.4 Kannur (Cannanore) district :

(i) Anantpur Gudda (ii) Perla (iii) Narala (iv) Telakanam (v) Kanhan gad-Kumbla area : In this area, lateritic cappings are distributed in about 160 sq.km along the coastal belt of Kanhangad Kumbla area. Laterite occurs here as cappings on flat topped mounds and hillocks and as detrital or re-consolidated formation in low lying areas⁽⁸³⁾. It varies in thickness from a few cm to over 10 metres below which it grades into a pinkish white lithomargic clay. Bauxite is invariably found associated with laterite. Though the bauxite of possible economic importance are of very restricted occurrence, such occurrences are located mainly 8 km NNE of Kasargod, near Perla and west of Hosdurg.

Bauxite in this area occurs in three forms namely

(1) as massive bauxite in intimate association with laterite (blanket type) (2) as granules, pellets and nodules in white bauxitic clay (3) as semirounded pebbles, cobbles and boulders in psolitic laterite in depressions and water courses (detrital or re-consolidated deposit). The general sequence of the bauxite profile is as follows:

- (- Lateritised bauxite
- (- Lithomarge with nodules of bauxite and lenses of bauxitic clay.
- (- Lithomarge without any bauxite
- (- Highly weathered and kaolinised bedrock.
- (- Bed rock

The colour of the bauxite is very variable which ranges from white and greyish white, cream yellow, various shades of brown to dark brown. By texture, bauxite is massive cryptocrystalline or even earthy looking. Pisolitic and oolitic structures are very rarely seen. The lateritic bauxite zone varies in thickness from a few cm to nearly 7 m on the surface but more commonly it is restricted to top 2.5 m. zone.

It is believed that the bauxite in this belt was formed by the desilication of clay, derived from pyroxene granulites and gneisses and has been lateritised after the process of desilication or bauxitization ceased.

4.9 UTTAR PRADESH

In Uttar Pradesh bauxite occurrences have been noticed in Banda, Mirzapur and Varanasi districts. The bauxite bearing laterite cappings in Chandraprabha (Varanasi) and Rajhaun areas (Banda) occur over sediments of Vindhyan Super Group.

The districtwise description of bauxite deposits is as given below :-

4.9.1 Banda District (84,85,86) ,

In Banda district bauxite occurs on the top of Rewa sandstones of Vindhyan age along the border between Uttar Pradesh and Madhya Pradesh. The generalised laterite profile in Rajahaun area include a zone of reworked laterite on the top, which comprises pisolitic laterite and pisolitic laterite zone with lumps of bauxite upto 2 m thick. These are in turn underlain by a zone of residual origin comprising bauxite, aluminous laterite, laterite and lithomarge. These rest on weathered sandstone and shales (Vindhyan).

The bauxite horizon is made up of heterogenous boulders, varying in grade and thickness. Bauxite is pisolitic to earthy,

massive, often spheroidal, and light grey to pinkish grey in colour. It is covered by a thick cover of laterite and overlies successively over lithomarge and ochreous clays. Gibbsite is the major mineral with minor amounts of hematite, goethite, kaolinite and boehmite.

In Rajhaun area bauxite lies over Ganurgarh shales (Vindhyan) Over 120 cappings are found in the area and the dimension of individual cappings ranges from 10-25 sq.km. whereas, the average thickness varies from 15 to 71 meters. The average chemical analysis of bauxite in Rajhaun area is as given below :-

Al_2O_3 - 49.38%, SiO_2 3.71%, Fe_2O_3 -12.96%, and TiO_2 7.26%

Trace elements present in the ore include Vanadium, Chromium, Gallium, Nickel, Copper, and Zirconium.

4.9.2 Lalitpur District (87) : Bauxite occurrences are noticed in the area between Deogarh and Lakhanjir in Lalitpur district. Isolated occurrences of laterite/lateritic bauxite occur here over the rocks of Kaimur Group (Vindhyan). The pebbles, cobbles and occasional boulders of bauxite/laterite are found strewn over the flat topped hills about 4 km SSW of Pathras north of Irptia Tal, South of Bijori, 1.5 km NW of Ranchorji mandir and near Kuchdon.

4.9.3 Mirzapur District (84) : Laterites containing pockets of bauxite occur in the Barela area on the top of Dhandraul quartzites on several hills. Exploratory work shows that the lateritic material analyses : 20.23 to 39.61% Al_2O_3 , 12.8 to 33.2% Fe_2O_3 , 7.56 to 37.03% SiO_2 and 2.01 to 9.3% TiO_2 .

4.9.4 Varanasi District (84, 86) : Bauxite bearing laterite caps occur over Dhandraul quartzite in Chandraprabha area. The generalised laterite profile developed in Chandraprabha area is similar to that of Rajhaun area except for variations in thickness.

The bauxite occurring in the area is pinkish to creamy white and is characterised by oolitic, pisolitic and brecciated textures. Gibbsite is the major mineral with minor amounts of hematite, goethite, kaolinite and boehmite. A

total of 71 cappings of bauxite are noticed in the area with an aerial extent of 25.1 sq.km and a maximum thickness of 10-20 m. The chemical composition of bauxite is SiO_2 3.78%, Al_2O_3 45.71%, Fe_2O_3 15.11%, TiO_2 10.19% etc.

4.10 GOA

4.10.1 Goa figures on the all India production map of bauxite contributing significantly to India's production. The Geological Survey of India has reported eleven occurrences of bauxite in Goa which are given below⁽⁸⁸⁾ :-

- i) Polem-Loliem - Galgibaga area
- ii) Dabolim - Consua area
- iii) Quelossem - Verna - Raia area
- iv) Belim - Porvorim area
- v) Porvorim
- vi) Mopa area
- vii) Calangute area
- viii) Taleigao - Bambolim area
- ix) Pernem area
- x) Morgim area and
- xi) Camorlim area.

Besides the above, laterite cappings are noticed practically in the whole of Goa and they offer a promising exploration target for locating bauxite deposits. Practically all country rocks exposed in Goa are covered by laterites which are sometimes up to 15 m thick. These are classified into pink ferruginous, limonitic, aluminous and bauxite types. Of these the last type evinces interest.

4.10.2 Deposits in Betul, Quepem and Canacona Talukas

Bauxite deposits in these areas lie over meta-basalts. Bauxite is derived from the alteration and lateritization of these rocks. Bauxite occurs as irregular patches within the laterite horizon. Bauxite outcrops are present along the scarp sections in Aradi, Mahavir, Siroli and Cola blocks. The thickness of bauxite horizon varies from 0 to 9 m with an average thickness of 3-5 m. Bauxite is medium hard and its colour varies from greyish white to milky white. Intercalated bands of aluminous laterite are present within the bauxite horizon.

A clay horizon underlies the bauxite horizon. Bauxite contain 53% Al_2O_3 . It is reported that substantial quantity of bauxite having Al_2O_3 52-56% has been mined and exported from this area in the past ⁽⁸⁹⁾.

4.10.3 Deposits in Pernem Taluka

In the leases granted in Tuem, Viruors and Pernem villages of Pernem Taluka, bauxite deposits lie over gray-wackes. It has been derived from lateritisation and bauxitisation of the rocks. The bauxite outcrops are exposed along the main road connecting Pernem and Moorjim. Pink ferruginous laterite and aluminous lateritic bauxite, greyish white to milky white in colour, occupy bulk of the area. The maximum thickness of bauxite zone recorded in the area is 1.5 m. The bauxite is medium hard to hard ⁽⁹⁰⁾.

4.11 JAMMU & KASHMIR

Important bauxite occurrences are located in Riasi tehsil of Jammu at Salal, Jangalgali, Sangar Marg, Guljar Kotla, Chappar Bari, Sukhural-gali, Lodara, Chakkar and Pannasa areas. Besides these deposits, bauxite is also reported at Mahagala, Triayath-Krul-Ransuh, Sersandhu and Kothri.

The bauxite deposits of Jammu province are unique in the country as they occur as isolated pockets on the northern slopes of Sirban Limestone inliers of Riasi extending from Chakkar in NW to Jangalgali in SW ⁽⁹³⁾. These bauxites are of high silica-diasporic type while the bauxite of Salal area show abundant boehmite and diasporic pisoids as well as anomalous enrichment of Cr & V. ⁽⁹¹⁾. This is suggestive of a Tikhvin type origin. The bauxite occurs as the topmost member of Bauxite Series which comprises a thick sequence of sedimentary rocks. The stratigraphic column in the area includes from top to bottom rocks of Nummulitic Series (Eocene age) and Bauxite series (Cretaceous to Eocene age) which rest on Sirban limestone. The Bauxite series comprise from top to bottom pisolite bauxite, nonpisolitic bauxite, grey aluminous clay, soft clay and carbonaceous shale associated with plant fossils and pisolitic bauxite followed by grey sandstone and shales etc. ⁽⁹³⁾.

In all these areas bauxite is of diasporic and boehmitic type and different from the other deposits of the country. Other minerals present in these bauxites are goethite, kaolinite, anatase and occasionally corundum. The general chemical composition of these bauxites is given below ⁽⁹²⁾ -

Al₂O₃ 40-70%, SiO₂ 8-30%, TiO₂ 5%, Fe₂O₃ 10%, LOI 14-16%

Bauxite profile has three distinct facies namely pisolitic, semi-pisolitic and non-pisolitic. The pisolitic and semi-pisolitic bauxite which forms the top most member of the Bauxite Series is hard and dense and varies in colour from grey and pinkish grey to cream ⁽⁹²⁾.

Pisolitic bauxite is composed of oval to spheroidal pisolites varying in diameter from a few millimeters to one cm. Pisolites are seen in greater concentration at the upper part of the rock and consists of white to grey core of kaolinite and silica. These are enveloped by alternating dark grey concentric rings belonging to diasporic and brown iron oxide ^(92,93). Field study indicates that bauxite has resulted from insitu transformation of aluminous clays.

Recently, the presence of plant fossils (angiosperms) has been recorded in the black carbonaceous shale which occur in close association with bauxite towards its base. Thus the bauxite deposits are indirectly assigned to Upper Cretaceous age ⁽⁹³⁾.

4.12 HIMACHAL PRADESH

Occurrences of boehmitic bauxite are reported at about one km NE of village Dehrau (30°49' : 77°39') in Simla district. Bauxite here forms the basal parts of Subathu Formation (Eocene), unconformably overlies the Morar-Chakrata Formation and is overlain by the Jaunsar Group (Krol Nappe) along the Tons-Krol thrust ⁽⁹⁴⁾. Bauxite occurs in localised pockets and lenticular beds, ranging in thickness from 1 to 3 m. Largest outcrop is 1 to 4 m thick and extends strikewise upto 40 m ⁽⁹⁴⁾. Bauxite is earthy, pale grey and brownish in colour and has characteristic pisolitic texture. Pisolites vary in size from 0.2-0.5 cm. Bauxite laterally grades into clay and laterite. This bauxite has not much economic significance ⁽⁹⁴⁾.

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