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Geochemistry of Bauxite deposits of Gothane-Vikhare, Hativale and Mahalunge villages in Rajapur Tehsil of Ratnagiri District, Maharashtra (India)

H. S. KALE[1], H. N. KAMBLE[1] and P. G. BHUKTE[2]

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Abstract

This paper mainly dealt with the geochemistry, mineralogy and genesis of the bauxite deposits of Ratnagiri district of Maharashtra. The bauxite deposit occurring at an elevation of 320 m from the mean sea level in the Konkan tract with a step-wise fall in the altitude from east to west. Regolith occurs mainly over the Deccan basalts and forms characteristic weathering profiles with distinct petro-mineralogical features. A simple geochemical balance of lateritization processes governing the development of several tens of meters of weathering profiles overlain by duricrust is estimated on the basis of detailed mineralogical and geochemical data.

The weathering mantle at the study area is composed of different weathering layers described from the base to the top of vertical profiles. These profiles are visible into the saprolith, pedolith, and in variably a topmost lateritic duricrust. Based on the textural and mineralogical studies, the saprolith is further differentiated into sap rock and saprolite where as pedolith is sub divided in to plasmic and mottled zones. The appearance of sap rock is not uniform throughout but it is observed in the Gothane-Vikhare profile where, as a well developed saprolite horizon is encountered at Hativale profile.

Primitive stage of alteration of primary minerals is observed well within the sap rock where as the profuse neo-mineralization is depicted by the saprolite zone. Pedolith part is characterized by the absence of relict minerals and it commences with an aluminous or ferruginous plasmic zone. Gibbsite is the main component of the bauxite zone with minor amount of goethite or limonite. The main component of the laterite zone is gibbsite with subordinate amount of goethite. The lithological gradation from bed rock upwards to the duricrust is very well preserved in the surrounding area.

Geochemical data of major oxides of the profile samples reveals that the rocks of the area are mainly composed of 81.23 to 99.44 % major oxides. The alumina content varies from 40.35 and 49.45% in bauxites and 25.72 to 33.84% in laterites where as it is very low in Deccan basalt which varies from 14.9 to 16.07%. Fe_2O_3 content varies in all the profiles which is highest at the lateritic zone (45.52-40.05-37.45%) and lower at the Deccan basalt (11.92-12.29-12.37%). The LOI is directly proportional to the alumina content and inversely proportional to the Fe_2O_3 content.

Key words: Bauxite, Duricrust, Lateritization, Sap rock, Saprolite, Deccan Basalts.

Introduction

Laterite is a residual ferruginous rock, commonly found in tropical regions and has close genetic association with bauxite. Laterite and bauxite show a tendency to occur together. Laterite gradually transforms into bauxite with decrease in iron oxide and increase in aluminium oxide. Bauxite and laterite deposits that form a capping over Deccan trap on the Rajapur plateau area and other surrounding regions in the Ratnagiri District are becoming increasingly important as a source of aluminium ore 'bauxite' and also for laterite bricks.

The study area covers a part of Rajapur taluka, major part of study area is covered by laterite with thin soil mantle at the top at some places it is covered by ha laterite duricrust. The area belongs to survey of India toposheet no. 47 H/6. It lies between Lat 16° 37' to 16° 34' and Long 73° 30' to 73° 33'. The study area belonging to the Western Ghats (WG) represents a small part of the Deccan Traps continental flood basalt province.

Most of the Indian bauxites are of lateritic origin[10,17,18,22,25] which occurs as extensive blankets or capping on high plateau. Large deposits of bauxite are generally associated with the east coast hills of India[1,6,23]. Swami Nath[27] classify the Indian bauxite deposits mainly on the basis of physiographic occurrences. The western coastal tract is less gifted in this respect even though bauxite mining is reported in this sector for last two several decades[4,21,29]. There were several reports of development of bauxite profiles at Konkan Plateau levels approx 60-120m above m.s.l. where several new workable deposits have recently been identified (Ghodke *et al.*, 1974).

Besides these, laterite/bauxite profiles are also seen at coastal levels spread over the coastal length of few hundred kilometers. Nearly all of these profiles have developed over trap basalt. Bauxite is a constituent of laterite profiles though not everywhere. Bauxite deposits are studied because of their economic value and because they play an important role in the study of paleoclimate and paleogeography of continents. They provide a rare record of the weathering and evolution of continental surfaces[12]. WG are the mountain ranges separated from the Arabian Sea by a narrow strip of the west coast of India.[15,16] Laterite, a common occurrence in western Maharashtra, occurs in two distinct regionally significant geomorphic areas. Which are the elevated Deccan plateau in the Western Ghats and a nearly continuous belt ~ 60 km wide and over 700 km long (between latitudes 12°N and 18°N) segregating the Arabian Sea and the Western Ghats[11,24]. Keeping this objective in view, studies of bauxite/ laterite bearing horizons (profiles) has been done[3].

Laterites and bauxites are produced by intense weathering in tropical soils, which enriches iron (of laterites) and alumina (of bauxites) as well as trace elements such as nickel, gold, phosphorus and niobium to ore grade[19]. Excellent manifestation of Baxitisation and lateritization is given by Fox[8], Bardossy and Aleva[2] and McFarlane[14]. Laterite occurrences and Bauxite deposits of Maharashtra were first studied in 1876 by R. Bruce Foote of the Geological Survey of India and were described by him in his classical work on 'Geological Features of the south Maharashtra country and adjacent districts[5]. Fox C.S.[8] gave details of some of the bauxite occurrences of the Rajapur tehsil. Ghodke[9] gave a generalized account of the geology of the area correlating almost all pre-trappean formations, excepting a few hematite-quartzite bands, with the Kaladgi Series[12].

Regional Geology :

The landscape is marked by flat terraces made up of late cretaceous lavas some with lateritic mantle. Abutting the costal lowlands, the foot belt of the Sahyadri is 40 to 120 m high undulating-to-rugged tracts, wearing a thick mantle of laterite[20,30]. Regionally the study area falling in parts of Rajapur Tahsil of Ratnagiri district and covering parts of T.S.47 H/6 comprises dominantly laterite[7].

There are however small and obscure exposures of rocks belonging to the Kaladgi Group and the Deccan Super Group. Well cuttings within the lateritic terrain at few places have thrown up Tertiary sediments and lignite. The difference in elevation of these laterites capping may be attributed to several periods of peneplanation accompanied by lateralization or a single lateralized peneplain, which has suffered pronounced faulting parallel to the west coast. Kaladgi sandstone and shale are exposed in the some parts of Ratnagiri area. The sandstone is fine grained in general, has a reddish buff to cream colour, very compact and has siliceous cement that makes the rock quite hard. Deccan traps in the area comprise two 'aa' flows belonging to the Purandargarh group. The flows are fine grained, aphanetic and are sparsely porphyritic in nature. At various places it developed as columnar joints, which are best exposed along the NH-17 north of Rajapur, in the Rajapur creek bed and also along the coastal highway section around Ratnagiri[23].

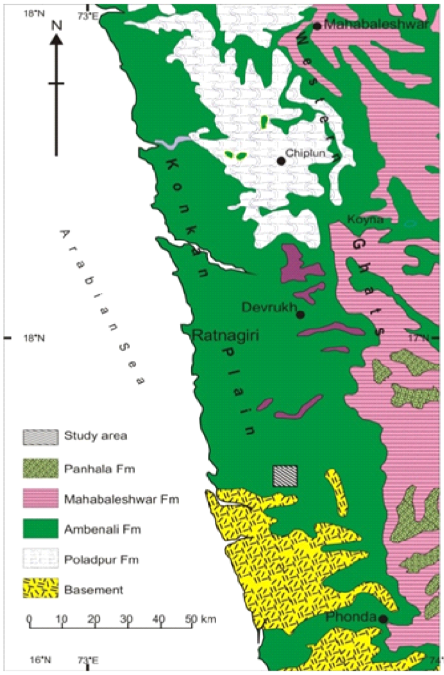

Fig. 1. Regional geological map showing study on area (Mitchell and Widdowon, 1991)

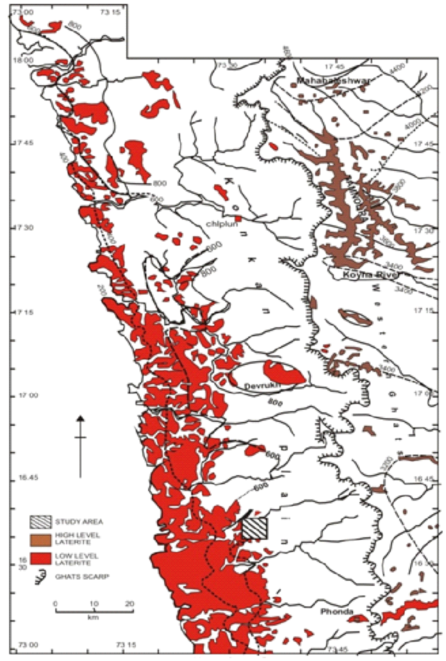

Fig. 2. Distribution of laterite with Stratum the base of two different Sequences (Widdowon and Cox, 1991)

Table 1. Stratigraphy of Western Maharashtra (Bhukte 2002)

Stratigraphy Sequence	Rock Unit	Geographic Distribution
Holocene- Pleistocene	**Alluvium, Laterite Bauxite**	Laterite- bauxite occurs in thane, Raigad, Ratnagiri, Kolhapur, Satara, Sangli and Sindhudurg districts.
Tertiary Formation	**Miocene- Pliocence Beds**	White and blue clays with carbonaceous layers are formed in the coastal areas of Ratnagiri and Sindhudurg districts.
Eocene- Upper Cretaceous	**Deccan Traps and Inter-trappeans**	Deccan traps cover almost the whole of state except substantial parts of Sindhdurg district in western Maharashtra. Inter-trappeans occur in Mumbai, Nagpur etc.
Proterozoic	**Kaladgi Group Dharwar Super Group Iron Ore Group**	Kaladgi rocks are found in Sindhudurg, Ratnagiri and Kolhapur (south) districts.In the Sindhudurg district meta-sedimentary rocks are correlatred with the upper Dharwar sequence.Iron ore deposits are found in Sindhudurhg district
Arechean or Azoic (Archeozoic)	**Basement Complex**	These are thoroughly crystalline rocks which show extreme complexity of characters (mineralogy, petrology, structure, etc.) and are encountered in the Ratnagiri districts of western Maharashtra.

Local Geology :

The area under present study lies in the districts of Ratnagiri.The Rajapur Laterite capping forms part of the vast undulating laterite peneplain extending along 100 km. The sandstones of Precambrian Kaladgi Group of rocks are covered by basaltic flows of Deccan Trap rocks in the study area. The basalt flows have been lateralized to give rise to bauxite deposits in this area. The area is covered by basalts with thick laterite capping. The rock is traversed by joints trending N10°E-S10°W. The local stratigraphic sequence as established so far is tabulated below.

Table 2.2. Stratigraphic Succession of the Study Area
(Bhatia.S. and Katti.S, GSI 2008)

Periods	**Lithographic units**
Miocene/Pliocene to Quaternary	Laterite with bauxite pockets
Upper Cretaceous to Lower Eocene	Purandargarh Formation of Sahaydri Group
Precambrian	Kaladgi Group of rocks

Laterite: Thick laterite cappings hosting the weathering profiles occur on tablelands made up of horizontal to subhorizontal simple lava flows of ‘aa’ type which belong to Purandargarh Formation of Sahaydri Group of Upper Cretaceous to Lower Eocene period overlies the sandstones, siltstones and shales of Kaladgi Group of Pre-Cambrian age. The laterite extensively occurs as capping on the basalt flows of Rajapur plateau. The laterite is vesicular, cavity ridden, brecciated and characteristically brick red in colour with thin iron pans invariably occurring above the litholmarge zone. The lateritic portion above lithomargic portion is generally vermicular and often filled with limonitic and aluminous clays. The average thickness of laterite is 8 to 12m; the apparent thickness of laterite at many places appears to be 15 to 20 m with table lands of laterite.

Bauxite: The bauxite outcrops are restricted to the western margin of the Gothne-Vikhare plateau for nearly 540 m, eastern margin of the Hativale area, towards the south-western margin of the Mahalunge area. A few well rounded boulders of quartzite are also observed along with the bauxite material on all the plateau of the Rajapur laterite capping which might have been transported along with soil to this location. Megascopically, the bauxite varies from a hard tough grey rock with streaks of clay to almost a loosely packed pinkish clayey material. Several types of bauxite with characteristics textures are observed viz; concretionary, pisolitic and vermicular[26].

Lithomargic clay: Lithomargic clay invariably occurs below the bauxite horizon and is exposed along the eastern and western slopes of the Gohane-Vikhore, Hativale and Mahalunge areas, where caving has also been noticed below the laterite (Fig. 8-B). The lithomargic clay is generally covered by talus and scree material or by thick vegetation. Lithomargic clay varies in thickness from a few meters to 12m.

Deccan Basalt: The basalt flows in this area are exposed along the southerly flowing nallah beds. These are exposed at an elevation of around 40m in the area and at around 60 to 70m in the some areas. The basalt is massive, dense greenish to grayish black in color, fine grained slightly porphyritic in nature. The basalt flows are traversed by NNW-SSE and ENE-WSW sets of joints and are capped by laterites.

Weathering profiles :

A weathering profile represents the complete sequence of weathered rock from the soil surface down to the intact parent rock. The profile comprises horizons of very variable thickness, located one above the other. The weathering profiles in this work are described using the terminology of Eggleton[7]. A thin duricrust with unconsolidated to well-studded ferruginous nodules is present in a profile. The *saprolith* comprises saprock and saprolite that has retained the fabric originally expressed by the arrangement of the primary mineral constituent's ofthe parent material. *Saprock* is a compact, slightly weathered rock of low porosity[28] with fewer amounts of the weather able minerals.

Gothane-vikhare profile :

These profiles are represented by the Gothane-Vikhore plateau Section around 16° 36'4''N- 73° 31'26''E at elevation of about 548 feet above MSL. It has developed over porpyritic dark gray to green colored basalt. The alteration of basalt has given rise to a considerably thick saprock horizon in which the original texture of the rock is retained. The overlying saprolite zone exhibits alteration of primary minerals to kaolinite and secondary iron hydroxides. However, the original fabric of the rock providing certain compactness to this horizon is preserved (Fig. 4). Saprolite is overlain by the plasmic horizon. It is dominantly constituted by clays and no primary texture of the rock is retained in it. Appearance of buff-gray colored pisolites (0.5 to 1 cm diameter) cemented in brownish-yellow ferruginous matrix marks the onset of the mottled horizon forming the bauxite zone. Approximately 1.5 m pisolotic pink colored bauxite zone appears above the yellow clay zone of saprolite. Pinkish aluminous lateritic zone is acquainting as the change in the profile, capping the aluminous laterite is present 3 m zone of rusty brown to dark red laterite. This part also shows development of aluminous pisolites, which very at the top capped by thin soil crust showing abject vegetation[31].

Hativale profile :

This Konkan plateau profile is represented by a 13 m thick profile horizon. It is an immature profile depicting development of low grade (40% Al_2O_3) ferruginous bauxite. This weathering profile is located around 16°36'25''N - 73° 31'30''E at 606 ft above MSL in the area of Hativale village. This profile has not undergone intense weathering to produce a good bauxite horizon at the top. However, it shows good profile differentiation in a small section of about 13 m (Fig. 5). Grey colored vesicular basalt forms the bedrock in this profile showing slightly altered nature. This bedrock basalt is invariably altered and exfoliated giving rise to a thin saprock horizon. Overlying saprolite horizon shows predominantly clayey zone. The upper part of the bauxite zone is made up of cherty bauxite which is more ferruginous towards the top. A ferruginous laterite horizon occurs over the bauxite zone showing a porous nature due to the presence of irregularly shaped cavities. To the top of ferruginous laterite horizon, the upper part of aluminous laterite shows profuse vermiform texture, indicating movement of aluminous material in gel form. It is followed up by a pocket of pisolitic bauxite zone.

Mahalunge profile :

This Konkan plateau weathering profile is located around latitude 16°35'25''N longitude 73° 31'30''E at 606 ft above MSL in the vicinity of Mahalunge village. This is an immature Konkan plateau level profile with bauxite forming in small pockets within the laterite zone of Miocene/Pliocene to Quaternary age. This profile has developed over gery to pale greenish fine grained bed rock basalt of Purandargarh Formation of Sahaydri Group (Table 2.2). This profile shows that basalt is altered to bauxite via a clay layer. The altered basalt at the bottom of this profile shows pseudomorphic replacement of plagioclase by clay. There is no apparent manifestation of the saprolith part in this profile and it only shows a 12.5 m thick pedolith horizon represented mainly by variants of the mottled zone (Fig. 6). The mottled zone in this profile begins with an aluminous laterite horizon showing porous nature due to the presence of irregularly shaped vugs of variable dimensions overlies the pinkish grey lithomargic clay there is present aprox. 1.5 m zone of pinkish grey bauxite which is little compact and hard as compared to bauxites of other two study area profiles. A hard, pale-red lateritic residuum with almost equal abundance of aluminous and ferruginous components overlies the bauxite zone. From the parent rock alumina is gradually enriched, through a lower zone of leaching to an upper zone of concretion, where bauxite is formed.

The topmost part comprises of a duricrust containing few unconsolidated to well-studded ferruginous nodules. This part of profile shows fragmented nature and presence of gibbsite as tiny, shining grains. This topmost duricrust also exhibits presence of fragmental nature due to greater degree of solution activity in this horizon.

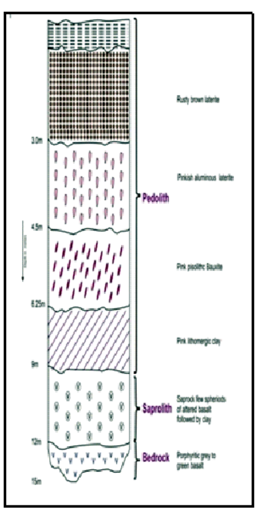

Fig. 4 : Gothane-Vikhare Profile

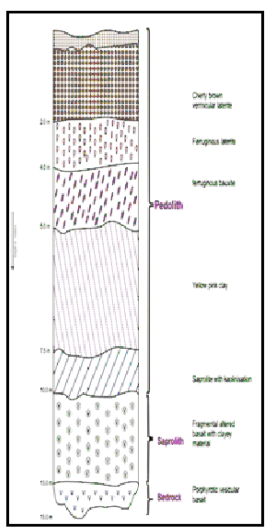

Fig. 5 : Hatiwale Profile

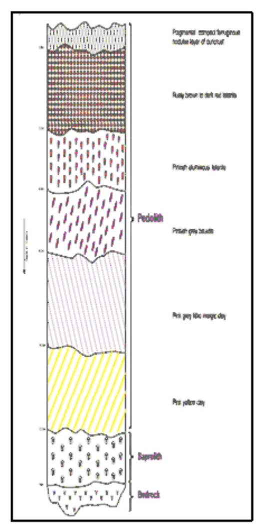

Fig. 6 : Mahalunge Profile

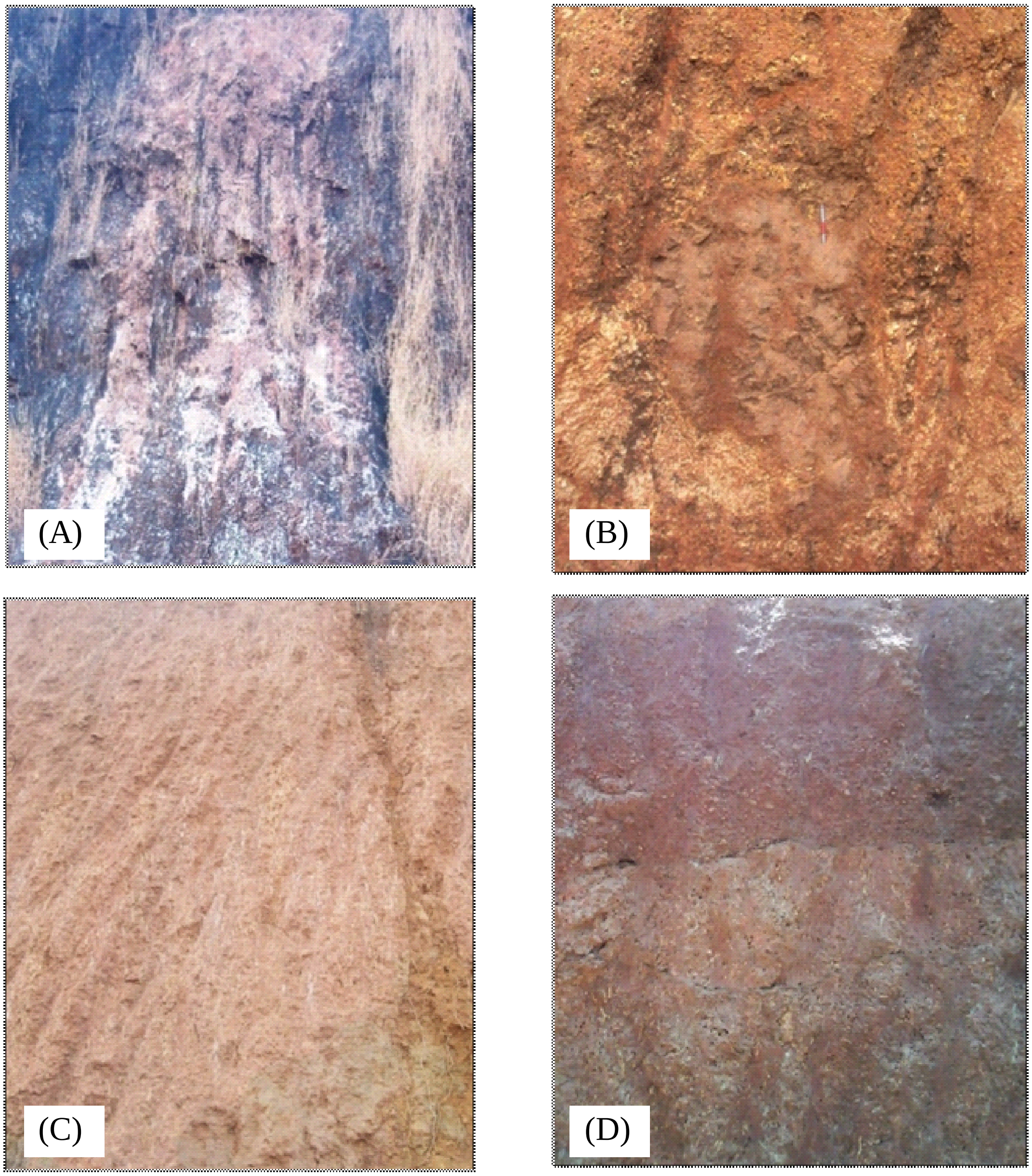

Fig. 7: Field photographs

A - Hativale saprock,photograph showing altered basalt with kaoilnization.

B - Gothane-Vikhare Saprock,photograph showing few saproids of altered basalt surrounded by clay.

C - Mahalunge, photograph showing pikish grey lithmergic clay.

D - Gothane-Vikhare laterite, photograph showing contact between rusty brown laterite and pinkish aluminous laterite.

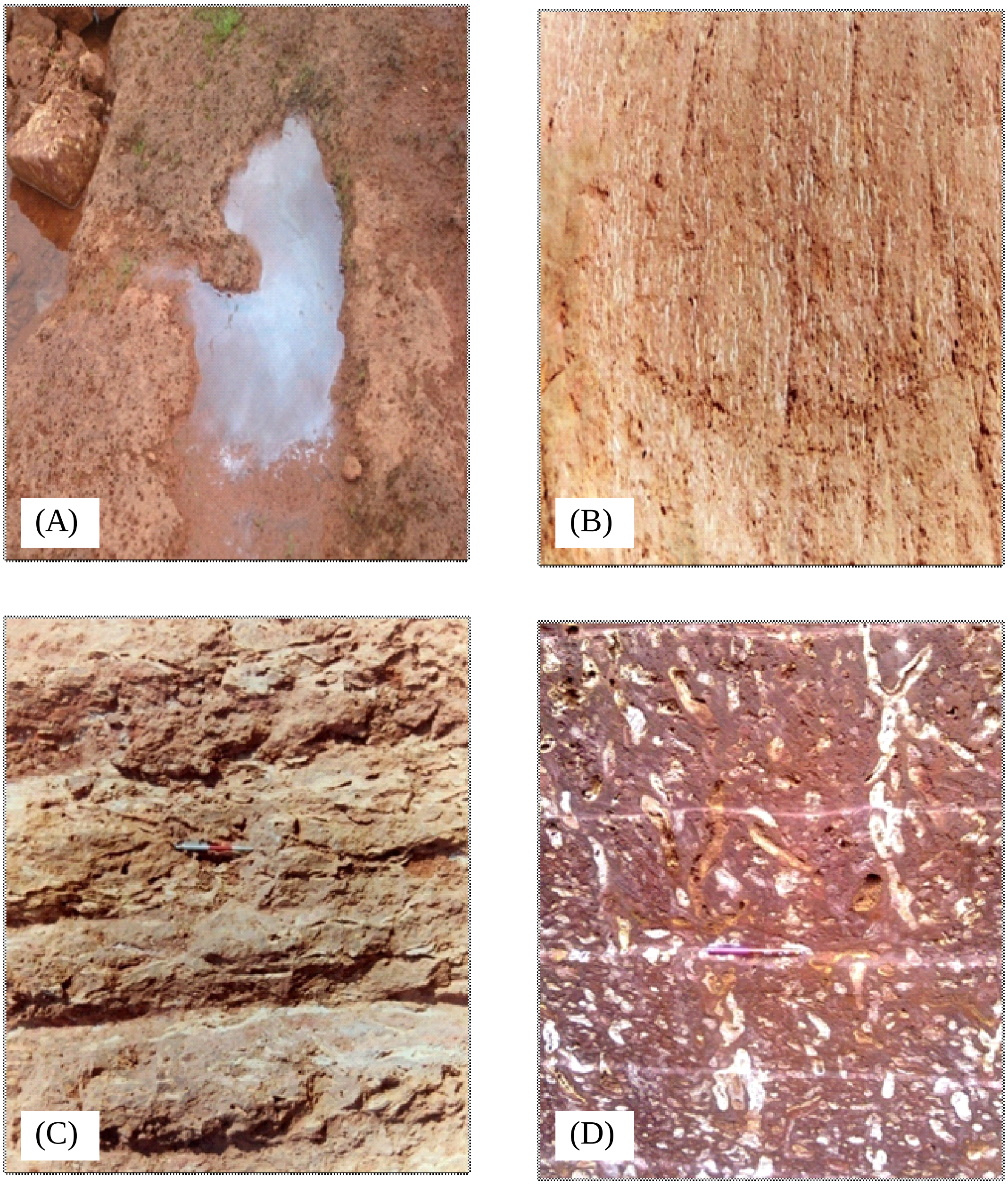

Fig 8: Field photographs

A : Photograph showing empty opening in the top laterite due to removal of clay.
B : Gothane-Vikhare, photograph showing yellowish brown lithomergic clay.
C : Mahalunge bauxite, photograph showing bauxite of mahalunge showing variation in same zone.
D : Hativale, photograph showing cherty brown vermiclar laterite.

Geochemistry of Weathering Profiles :

The major and trace element geochemistry has become an indispensible tool to investigate various aspects of laterite/bauxite formation such as parent rock composition, diagenesis and epigenetic process related to bauxitisation, environmental conditions (Eh- Ph, drainage, and climate), and mineralogical changes in parent rock[13]. Though more than sixty chemical constituents in bauxite have been reported, but Al_2O_3, Fe_2O_3, SiO_2, TiO_2 and loss on ignition (LOI) generally constituents 99% of bauxite composition. An Al-rich composition of the parent rock is a likely crucial factor for an accelerated bauxitizition process. In the residual accumulation of bauxite ores, aluminium. is considered to be an immobile element during weathering, subaerial erosion and digenesis of bauxite[29], that is concentrated in situ as inert (immobile) lateritization residue .Geochemistry changes vertically in these weathering profiles.

Table 3. Geochemical analysis results for Major oxides laterite-3, bauxite-3, duricrust-1 and Deccan basalt-3 samples of three weathering profiles.
(3 saprolith samples results taken from GSI published report.)

Sr. No.	Sample code	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	LOI	Total Major oxides
1	GV/L/1	11.75	25.72	45.52	1.79	14.48	99.26
2	GV/B/1	4.56	49.45	16.55	2.74	26.14	99.44
3	GSI/K/S/1	26.35	34.67	17.86	3.86	15.61	98.35
4	GV/DB/1	50.04	16.07	11.92	3.59	1.24	82.86
5	H/L/1	3.91	33.51	40.05	1.52	20.27	99.26
6	H/B/1	16.63	40.35	17.55	3.96	20.56	99.01
7	GSI/P/S/1	22.7	22.6	27.2	4.04	13.91	90.45
8	H/DB/1	49.69	14.9	12.37	3.92	0.35	81.23
9	M/D/1	8.35	26.29	46.69	2.15	15.57	99.05
10	M/L/1	6.29	33.84	37.45	2.39	19.31	99.28
11	M/B/1	7.56	48.11	14.25	3.88	25.42	99.22
12	GSI/M/S/1	13.5	20.8	40.3	2.82	12.2	89.62
13	M/DB/1	51.72	14.53	12.29	3.13	0.88	82.55

Note: GSI/K/S/1, GSI/P/S/1, GSI/M/S/1 samples code area geochemical analysis results of saprolith from kumbhawade, Padve and Mutat respectively (after Joshi, A., *et. al*. 2002)

The chemical analyses of the three major horizons of the weathering profiles are given in Table 3. The following descriptions and inferences are based on this data. In each diagram, complete sequence available has been selected to show the progressive path of alteration.

Bedrock (Deccan Basalt): From the table 5.1 GV/DB/1, H/DB/1, M/DB/1 are the sample code of the Deccan basalt samples from Gothane-Vikhare, Hativale, Mahalunge respectively.It is observed that the SiO2 content of the basalt depicts a narrow range (49.69-50.04-51.72%). total iron content (Fe_2O_3) (-11.92-12.29-12.37 %) is slightly lower than the Al_2O_3 (12.29 -14.90-16.07 %) content. Basalt of plateau level profiles defines a restricted TiO_2 content (3.13 -3.59-3.92%), while the LOI content is very low (0.35-1.24-0.88 %).

Bauxite Zone: From the table 5.1 GV/B/1, H/B/1, M/B/1 are the sample code of the bauxite samples from Gothane-Vikhare, Hativale, Mahalunge respectively.

In this Konkan plateau profiles, medium grade pisolitic bauxite occurs in Gotane Vikhore (Al_2O_3: 49.45%) and Mahalunge (Al_2O_3: 48.11%). Significant enrichment of TiO_2 (3.96-2.74-3.88 %) is observed from these bauxitic zones. Bauxite in these places is more ferruginous (17.55-16.55-14.25 %) with higher silica range (4.56-4.56-7.56 %). These varieties with higher iron content are being referred here as ferruginous or ferruginous cherty bauxite.

Laterite: From the table 5.1 GV/L/1, H/DL/1, M/L/1 are the sample code of the laterite samples from Gothane-Vikhare, Hativale, Mahalunge respectively. This horizon is noted in all Konkan plateau profiles of this study. It shows slightly higher Fe_2O_3 (37.45-40.05- 45.52%) than the Al_2O_3 (25.72-26.29-33.84%) values in all the three profiles. This zone shows impoverishment of SiO_2 (3.91-11.75%) as compared to bauxite zone and depletion of TiO_2 (1.52-2.39%). Average "Loss on Ignition" (LOI) of the bauxite is highest 28-31% in the high alumina gibbsitic bauxite (trihydrate alumina bauxite). The lowest average loss on ignition (15-19%) is found in deposits dominantly composed of monohydrate aluminum oxide-boehmite and diaspore. Loss on ignition (LOI) shows a special pattern in the above (Table 3) geochemical analysis results. As the results of bauxite zone and laterite of all three weathering profiles compared LOI shows a special pattern. The LOI is directly proportional to alumina (Al_2O_3) content and inversely proportional to Fe_2O_3 (Fig. 9). As the percentage of LOI increases the content percentage of alumina also increases this indicates the gibbsitic nature of the bauxite deposit.

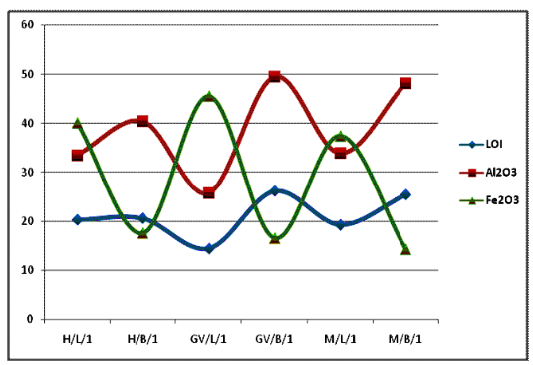

Fig. 9. Geochemical relationship between LOI: Al_2O_3: Fe_2O_3

Geochemical Transformations :

Gothane-Vikhare Profile :

High Al_2O_3 content supports the observed mineralogical dominance of gibbsite with a marginal depletion towards top (Fig. 10). Geochemical transformation from bedrock basalt to saprolith is observed by significant depletion of SiO_2 (49.69 to 26.35 %), appreciable enrichment of ofAl_2O_3 (14.90 to 34.67%) in addition to slight concentration of Fe_2O_3 (12.37 to 17.86%) and TiO_2 (3.92 to 3.86 %). The transformation from saprolith to bauxite zone is marked by further deplection of SiO_2 (26.35 to 4.56 %) which is increase to a major amount in the laterite (11.75%).Al_2O_3 content shows augmentation from saprolite (34.67%) to ferruginous bauxite (49.45%) where as a reverse trend is observed for Fe_2O_3 with depletion from saprolith (34.67%) to ferruginous bauxite (16.55%) upto 18.12%. This pisolitic bauxite is slightly more Fe-enriched and silica depleted as compared to other two profiles of Rajapur. The upward onset of bauxite horizon manifests an extreme enrichment of Al_2O_3 (49.45%) to produce a medium grade Ore. the topmost laterite is characterized by the enrichment of Fe_2O_3 (45.52%) along with depletion of Al_2O_3 (25.72%) and TiO_2 (1.79%).

Hativale Profile :

Silica (SiO_2) depletion is gradual from bedrock basalt to the overlying saproilth but it shows a drastic decrease in the (Pedolith) bauxite and laterite (Fig. 11). It can be related to the breakdown of primary silicates to kaolinite in the saprock and saprolite and its further decomposition to from gibbsite in the pedolith horizon. The breakdown of kaolinite is also supported by the enrichment of Al_2O_3 the bauxite zone. Fe_2O_3 content shows a marginal increase from the saprolite (12.37%) to the bauxite (17.55%) but a significant enhancement in laterite (40.05%) marginal change (3.96-3.92%) in TiO_2 content is reveled but a significant depletion is reveled in laterite (1.52)

Mahalunge Profile :

In study of weathering profile at Mahalunge, lateritic zoning is best demonstrated by the increasing iron (33.84%) and decreasing silica (6.29%) contents from the bottom to the top of the profile. Also this profile also shows a gradual depletion of SiO_2 from saprolith zone (13.5 %) to the top most duricust (8.35%) (Fig.12). Al_2O_3 shows a marked enrichment from bedrock to (14.53%) to the bauxite (48.11%). Fe_2O_3 depleted from saprock (40.3%) towards the upper zone bauxite (14.25%), and then it shows a gradual increase towards the laterite horizon (37.45%) and further top duricrust (46.69%). Alumina content increases sharply in the bauxite zone (48.11%) but the high SiO_2 (7.56%) and Fe_2O_3 (14.25%) make its quality inferior. The upper laterite horizon *i.e.* duricrust shows depletion in the Al_2O_3 (26.29%) and significant increase in the Fe_2O_3 (46.69%). Leaving apart the usual concentration in saprolith the TiO_2 concentration increases in the bauxite.

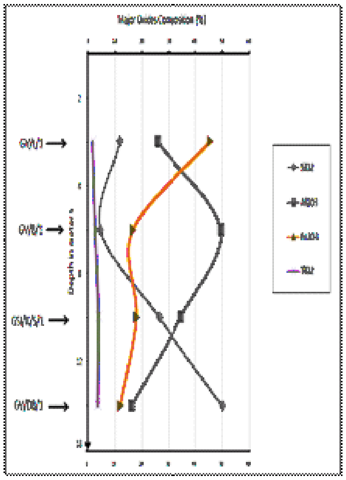

Fig. 10. Major Oxide Variation in Gothane – Vikhare Profile

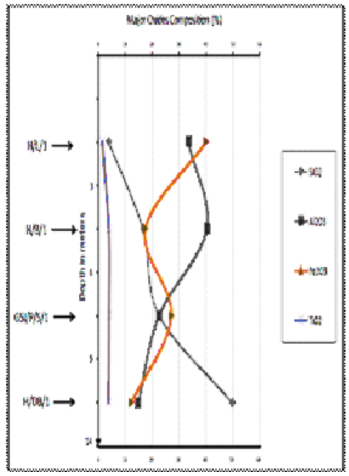

Fig. 11. Major Oxide Variation in Hativale Profile

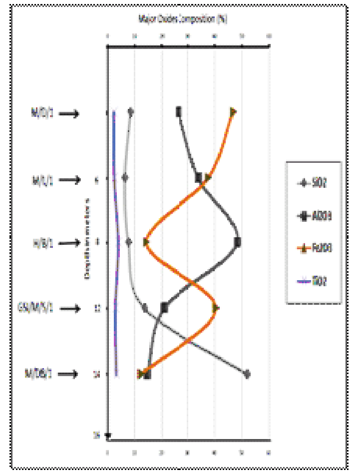

Fig. 12. Major Oxide Variation in Mahakunge Profile

Discussion and Conclusion

This study, attempted a detailed characterization of representative weathering profiles level in "Gothane-vikhore, Hativale and Mahalunge of Rajapur tahsil, at plateau levels. Petrographic and geochemical characteristics of representative weathering profiles have already been addressed with in detail. Analytical data of 13 samples representing 4 from Gothane-vikhore profile, 4 from Hativale profile and 5 from Mahalunge profiles is plotted. Out of 13 samples analytical results of 3 saprolith sample results of GSI's published report from Kumbhawade, Padve, Mutat profiles were used for better study of weathering profiles.

Two trends are observed in the weathering profiles one leading to concentration and deposition of Fe-rich beds and the other to segregation of aluminous compositions. Thus, it is quite clear that there are fundamental similarities in development of weathering profiles in the three levels studied. However, important mineralogical and chemical differentiations are also seen. The study shows clearly that there is a variation in mainly silica and iron oxide contents with depth in the bauxite deposit studies. This is linked to the weathering process. The strong decrease in silica content upward is due to the increasing replacement of kaolinite by, gibbsite and the severe dissolution of quartz. Variable thickness of saprolith and peodolith horizon even at one level suggests interplay of various other local parameters like effective drainage density, vegetation and slope.

Regolith profiles spread over different levels show well-differentiated horizons. Well-developed saprolite zone with kaolinite as the main mineral has developed in the plateau level profile. These mottles depict aluminous composition and are predominantly composed of gibbsite. Their authigenic derivation similar to the processes leading towards development of pisolite in bauxite is suggested.

Laterite over major part of the surveyed area is vermicular to porous type with very little clay filling in the cavities. Bauxite, in general is massive to finely brecciaed type in the bedded/layered unit. It varies in colour from off white to grayish white-pink also ferruginous bauxite occurs in Hativale. Bauxite occurs in lensoid form with average thickness of about 2m. The bauxite developed over the trap country in general has +40% Al_2O_3; low TiO_2 up to 3.9%. Basalt shows porphyritic texture with fine to very fine laths of plagioclase in a matrix of plagioclase microclines pyroxenes, opaque oxides, rarely olivine, and glass. In the saprolite horizon there is a near complete breakdown of the primary minerals. The alteration of basalt has alteration of primary minerals to kaolinite and secondary iron hydroxides. Gibbsite forms the predominant mineral in the entire profile. Goethite is absent in this pisolitic bauxite Gibbsite occurs as randomly distributed microcrystalline platelets, aggregates in the cryptocrystalline matrix and as thin hairline veins.

In this Konkan plateau profiles, medium grade pisolitic bauxite occurs in Gothane -Vikhare and Mahalunge. Significant enrichment of TiO_2 is observed from these bauxitic zones. Bauxite in these places is more ferruginous with higher silica range. These varieties with higher iron content are being referred here as ferruginous or ferruginous cherty bauxite. The lateritc horizon is noted in all Konkan plateau profiles of this study. It shows slightly higher Fe_2O_3 than the Al_2O_3 values in all the three profiles. This zone shows impoverishment of SiO_2 as compared to bauxite zone and depletion of TiO_2.

The LOI is directly proportional to alumina (Al_2O_3) content and inversely proportional to Fe_2O_3. Mature weathering profiles manifesting bauxite bearing horizons are present in study area. The general nature of these weathering profiles will reflect the interactions between climate, topography, parent material, soil biota and time.

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