Study of Minor Bauxite Deposits, Madhya Pradesh: Geological Studies and Techno-Economic Evaluation

Rakesh Shrivastava[1] and Suyash Kumar[2]
1. Professor
2. Assistant Professor
Department of Geology, Government Model Science College, Gwalior, MP, India
Corresponding author:rakesh_geol@yahoo.co.in

Abstract

Indian bauxite deposits are mainly of lateritic origin. They have been grouped into five major bauxite districts based on similar geological and geomorphological features. Apart from major bauxite deposits of Eastern Ghat District (Orissa and Andhra Pradesh), minor pocket type deposits, particularly Satna, Rewa, Katni, Anuppur districts and adjoining areas belonging to Central Indian District have their own importance. Four representative deposits of these areas namely Naru (Satna), Tikar (Rewa), Padwar (Katni) and Chachandee (Anuppur) were studied with reference to their mineralogy, reserves and grade, mining and its impact on environment and techno-economic evaluation. Each of these deposits has reserves of less than 10 million tonnes mixed with three grades of ore namely metallurgical, refractory and cement. There are several other similar occurrences of bauxite in these areas. Mining methods in these deposits is erratic and selective. Associated clay and ochre mining is a characteristic feature of these deposits. Excavated areas are being backfilled in some places leaving others that may cause instability of slopes in future. As per chemico-mineralogical studies, the bauxite of Satna, Rewa area is boehmitic and titanium rich and of Katni, Anuppur areas is mixed gibbsitic-boehmitic. The ore mined from these areas is manually sorted on site into metallurgical and non-metallurgical categories and transported accordingly. There is scope for detailed study regarding complex utilization of ore belonging to these areas.

Keywords: Lateritic bauxite; Katni deposit; Deccan traps; Chachandee deposit.

1. Indian Scenario of Laterites and Bauxites

The Indian bauxite deposits are mainly of lateritic origin (in-situ and transported) with varying modes of occurrences and geological nature. The Chemical, physical and mineralogical characteristics of these bauxites vary widely. There are two basic approaches to bauxite classification schemes. First the pure scientific one which finds use in prospecting and exploration and second the techno-economic one reflecting industrial requirements. Indian bauxites were first classified based on their mode of occurrences as low level and high level deposits[1]. According to which, bauxite deposits in India are mostly associated with laterites which occur extensively as blankets or cappings, either on the high plateau and hill ranges of the peninsular India or in certain low level laterites on west coast and Central India. High level bauxites occur mainly in four regions or dissected table lands. They are: the Plateau regions bordering the states of Bihar and Madhya Pradesh, the Maikala range of hills in Madhya Pradesh, the Western Ghats and the Eastern Ghats.

Indian bauxites were regrouped [2] into five major bauxite districts based on similar geological and geomorphological features: the Eastern Ghat bauxite district (950-1450m above MSL), the Central India bauxite district (900-1200 m above MSL), the West Coast bauxite District (600-1200 m above MSL), the Gujarat bauxite district and the Jammu and Kashmir bauxite district

2. Bauxite Deposits of Central India

The Central Indian bauxites and laterites are plateau types, capping different rocks of Precambrian basement and basalts of younger age. They extend from Bihar, Jharkhand (Ranchi and Palamau districts) through Madhya Pradesh and Chhatisgarh (Surguja, Bilaspur, Mandla, Katni and Shahdol district) to Maharashtra (Kolhapur District). This paper focuses on minor pocket types of deposits belonging to Satna, Rewa and Katni districts extending up to adjoining Banda district of Uttar Pradesh. The discovery of Eastern Ghats bauxite during seventies in the states of Orissa and Andhra Pradesh brought a sea-change in the country's bauxite resource position. Resources of bauxite as on 01.04.2010 are placed at 3480 million tonnes[3]. Orissa has emerged as the lead producing state accounting for about 35% of total bauxite production. Next in the order are Gujarat (32%), Jharkhand (11%), Maharashtra (9%), Chhatisgarh (6%), and Madhya Pradesh (3%). The remaining 3% production of bauxite is contributed by Goa, Karnataka and Tamilnadu.

Although today all the attention has been diverted to the large resources of the east coast, nevertheless minor pocket type bauxite deposits of Madhya Pradesh belonging to Satna, Rewa Katni and Anuppur districts have their own importance because of their location near the existing alumina plants of Central India. Four deposits, selecting one from each district were studied with respect to their geological setup, salient features of bauxite mining and techno-economic valuation including uses and specification of the ore. Results are presented and discussed in this paper. The study of these four deposits will help to evaluate the existing bauxite deposits of similar nature and explore new occurrences in surrounding areas. An attempt in this paper has been made to delineate and propose sub groups within Central India bauxite district (Table 1)

Table 1.Sub grouping of bauxite deposits within Central India Bauxite district. (Refer Figure 1)

Sector	Geological and Geographical area	Type	Reserves in Million Ton	Bauxite sub groupswithin Central India Bauxite district (proposed)
A	Rewa*, Satna*, Sidhi, Katni* districts of Madhya Pradesh and adjoining Banda, Mirzapur and Varanasi districts of Uttar Pradesh	Small group of deposits (No. of known occurrences - 171**)	<10	Eastern MP sub group (covers part of U P)
B	Mandla, Dindori, Balaghat, Shahdol, Anuppur* and Balaghat districts of Madhya Pradesh	Small group of deposits	<10	
C	Area of Madhya Pradesh covering Malwa plateau	Laterite occurrences, detail exploration is required.	<10	Western MP sub group
D	Guna, Shivpuri districts of Madhya Pradesh and adjoining Lalitpur district of Uttar Pradesh of Chhatisgarh	Laterite occurrences, detail exploration is required.	--	Northern MP sub group
E	Bilaspur, Surguja, and Raigarh districts of Chhatisgarh	Small deposit	--	Chhatisgarh sub group
F	Bastar area	Actual reserves not known	--	

* Four deposits selected for study belong to these districts ** Refer Table 3

examined particularly around the Katni and Anuppur Districts. The scope of new exploration also lies in delineated sub groups.

6.3 As per chemico-mineralogical characteristics of bauxite and the classification scheme of Indian bauxites, the bauxites of the study area are boehmitic and titanium rich. These characteristics require high pressure digestion technology (240 - 250^0 C) i.e. European Bayer process, which is being used at Balco's Korba and Hindalco's Renukoot plants in India. A very high alumina - low iron bauxite can beselectively mined, which can be used for refractory and abrasive purposes as practiced in ACC's Katni bauxite mine. Low grade ferruginous laterites produced during the mining of metallurgical grade bauxite can besupplied to steel or cement plants. Bauxite can be beneficiated to reduce iron and/or silica content to use them in refractory or abrasive industries. A study on complex utilization of ore and low grade bauxite ore can be proposed for these deposits to conserve and increase the bauxite resources of the area.

6.4 Bauxite mining cost in these deposits is comparatively far lower than its transportation cost to the alumina plants of Balco and Hindalco. Mining operations in these areas are not being carried out in a planned manner. Quarrying is done wherever pockets of high grade ore are present on the plateau. The total excavation consists of soil, overburden, associated laterites, and clean ore. The soft overburden is loosely packed ferruginous pisolitic laterites associated with soil, which can easily be removed. The hard overburden is made up of massive ferruginous laterite and requires blasting for their fragmentation. Environmental issues like proper back filling of soil, stability of slopes and replanting, particularly by mine owners, need to be monitored.

7. Acknowledgements

I am deeply grateful to learned and eminent former Professor and Head, Department of Geology, Government Model Science College, Rewa for his encouragement to begin research on laterites and bauxites of Madhya Pradesh. I express my gratitude to Dr. A. K. Nandi, Consulting Scientist, actively working in the field of bauxite and alumina. My sincere thanks also to the Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur for carrying out all laboratory and analysis work. I am also thankful to M/S Katni bauxite, private limited, Katni for providing all assistance to carry out field work at the Padwar and Chachandee deposits.

8. References

1. M. K. Roychowdhury and V. Venkatesh (1972): *Bauxite. Record. Geological. Survey of India,* V 102 (2) pp 79-91.
2. S. G. Nene et. Al. (1991): Position of Indian bauxite in the World and prospects of its export. *Mineral and mining,* September-October1991, pp 20-33.
3. Indian Minerals Yearbook 2014, (Part-III: Mineral Reviews), 53rd edition, Bauxite, Published by *Government of India, Ministry of Mines, Indian Bureau of Mines, Nagpur*.
4. P. G. Bhukte and M. J. Chaddha (2014): Geotechnical evaluation of eastern Ghat bauxite deposits of India. *Journal Geological Society of India*, Vol. 84, August 2014, pp 227-238
5. Directorate Geology and Mining, M.P. (1977): *Unpublished exploration report.*
6. A. K. Nandi (1992a): Techno economic evaluation of bauxite deposits of India. *Proceedings 7thInternational Congress of ICSOBA*, Balatonalmadi-Tapolca, Hungary.
7. A. K. Nandi (1992b): Application of XRD and XHF in characterisation of ores and minerals with special reference to laterite and bauxite. *Proceedings of seminar on Application of X-ray techniques in aluminium industry*, JNARDDC, Nagpur.
8. A. K. Nandi (1994): Metallurgical grading of Indian bauxites - A new scheme. *Mines and Metals*.

9. A. K. Nandi and C. V. Krishna Murthy (1986): Correlation among bauxite analysis, mineralogy and extractable alumina. *Vth Yugoslav International. Symposium on aluminium*, Mostar 25- IV 1986 Vol I. pp 46 - 65.
10. W. H. Andrews (1984): Uses and specifications of bauxite. *Proceedings Bauxite Symposium 1984. Los Angeles, USA*, AIME, New York pp 49-66.