Bauxite residuum derived from Khondalite and Charnockite

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Abstract

The bauxite deposits occurring amidst the Eastern Ghats overlie either the Khondalite or Charnockite group of rocks. Their frequency, however, is more on the khondalitic rocks. Gibbsite constitutes the main aluminous mineral in both the cases. Goethite is ubiquitous in the residuum derived from charnockitic rocks while hematite occurs in larger proportions in the others. Salient contrasts in the residuum derived from either of the two major rock types of the Eastern Ghats are described and their possible implications surmised.

Introduction

Occurrence of bauxite amidst the Eastern Ghats and in proximity to the east coast of India is now well known. The Eastern Ghats which constitute a major physiographic province in the Indian Peninsular shield are essentially made up of rocks belonging to the khondalite and charnockite groups besides some intrusive complexes in select areas. Bauxite occurs both on khondalite and charnockite; their frequency, however, is more on the former. The marked contrasts in morphology, mineralogy and chemistry are cogently synthesised and their possible implications surmised in this note.

Mode of occurrence

Bauxite occurs as blanket type of cappings in both the cases. Laterite *sensu stricto* occurs as thin intercalations within the bauxitic profiles. The areal spread and thickness, however, are limited in respect of the residuum derived from the charnockitic rocks. Morphologically speaking, the terrain in which the duricrust derived from khondalite occurs, exhibits either polydirectional or unidirectional moderate to steep slopes. The terrain is relatively flat or gently undulating when the source rock is charnockite. This feature is in conformity with the khondalite-Charnockite landscape devoid of such duricrusts capping them. Further, the khondalites occupy relatively higher elevations and the charnockites are confined to the lower levels wherever they are juxtaposed. The same morphology is maintained when they are capped by a blanket of bauxitic residuum extending across the contact at places. This observation may have relevance while attempting an interpretation of the neotectonics on a regional scale.

Synthesis

The bauxitic profiles derived from khondalite not only have vast areal spreads and sizeable thickness, but they are also better in quality than those derived from the charnockitic rocks (Ramam, 1976). Felspar, sillimanite and garnet which are the integral constituent minerals in a khondalite cumulatively contribute to the formation of gibbsite, while it is only the felspar that gives rise to gibbsite in a charnockite. It means that relatively high alumina content is intrinsic in the khondalite itself. Further, the foliation planes, macro and micro joints, fractures, and fracture cleavages of the constituent minerals (felspar and sillimanite) together accelerate the 'effective permeability' resulting in mature bauxitic profiles as a sequel to chemical weathering. On the other hand, the meagre foliations, limited tectonic openings and general

Comparative study of bauxite derived from Khondalite and Charnockite

Character	Bauxite derived from Khondalite	Bauxite derived from Charnockite
i. Colour	Pink, cream, yellow-brown and reddish-brown	Relatively dull looking and dark red
ii. Hardness	Medium hard and soft	Very hard and hard
iii. Texture	Porus and spongy; top sections vermicular and vesicular at places	Vermicular and vesicular; massive
iv. Structure	Relict foliations and joints pronounced	Relict foliations and joints are feeble and occasional
v. Scarps	Up to a maximum height of 22 m developed	Maximum of only 10 m
vi. Hard cap	Iron-crust is either too thin or absent	Iron-crust is invariably present
vii. Associated partings	Thin partings of partially altered khondalite present in a few profiles	Such partings are rather rare
viii. Transition	Partially altered khondalite in a majority of the profiles and lithomarge in others	Universally lithomarge; occasionally highly kaolinised or rotten rock
ix. Vegetation	Scarce	Relatively more
x. Mineralogy	Predominantly crystalline and occasionally dense gibbsite; hematite in major amounts and goethite subordinate; free silica impregnations occasionally encountered in lower sections of the profile	Both dense and crystalline gibbsite common; goethite in major amounts and hematite subordinate; free silica impregnations relatively more in middle and lower sections
xi. Chemistry (general range)	Al_2O_3 40–61% Fe_2O_3 8–24% TiO_2 1–2%	40–50% 15–28% 2–7%
xii. Thickness	Upto 32 m.	Upto 16 m.

resistance, in view of their massive character of the charnockitic rocks, render their 'effective permeability' less intense thereby limiting the extent and thickness of the residual profiles derived from them. It is thus logical to surmize that the gross lithology of the parent rock aided by its 'effective permeability' play a decisive role in steering the intensity and degree of leaching in chemical weathering. This holds good provided all other pre-requisites like climate, topography, rate of precipitation, Eh and pH of the circulating waters have acted in their desired equilibrium.

In conclusion, it may be said that while the basic laws and operative processes of chemical weathering are similar on a regional scale, the quality and quantity of the resultant end product is eventually dependent on the local geologic (lithology and structure) and geomorphic environment.

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Reference

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