Bauxite residuum derived from Khondalite and Charnockite

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Abstract

The bauxite deposits occurring amidst the Eastern Ghats overlie either the Khonda­
lite or Charnockite group of rocks. Their frequency, however, is more on the khonda­
ritic 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 impli­
cations 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 morpho­
logy, 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 khonda­
lites 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 neo­
tectonics 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 forma­
tion 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

<table>
<thead>
<tr>
<th>Character</th>
<th>Bauxite derived from Khondalite</th>
<th>Bauxite derived from Charnockite</th>
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</thead>
<tbody>
<tr>
<td>i. Colour</td>
<td>Pink, cream, yellow-brown and reddish-brown</td>
<td>Relatively dull looking and dark red</td>
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<tr>
<td>ii. Hardness</td>
<td>Medium hard and soft</td>
<td>Very hard and hard</td>
</tr>
<tr>
<td>iii. Texture</td>
<td>Porous and spongy; top sections vermicular and vesicular at places</td>
<td>Relict foliations and joints pronounced</td>
</tr>
<tr>
<td>iv. Structure</td>
<td>Relict foliations and joints pronounced</td>
<td>Relict foliations and joints are feeble and occasional</td>
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<tr>
<td>v. Scars</td>
<td>Up to a maximum height of 22 m developed</td>
<td>Maximum of only 10 m</td>
</tr>
<tr>
<td>vi. Hard cap</td>
<td>Iron-crust is either too thin or absent</td>
<td>Iron-crust is invariably present</td>
</tr>
<tr>
<td>vii. Associated partings</td>
<td>Thin partings of partially altered khondalite present in a few profiles</td>
<td>Such partings are rather rare</td>
</tr>
<tr>
<td>viii. Transition</td>
<td>Partially altered khondalite in a majority of the profiles and lithomarge in others</td>
<td>Universally lithomarge; occasionally highly kaolinised or rotten rock</td>
</tr>
<tr>
<td>ix. Vegetation</td>
<td>Scarce</td>
<td>Relatively more</td>
</tr>
<tr>
<td>x. Mineralogy</td>
<td>Predominantly crystalline and occasionally dense gibbsite; hematite in major amounts and goethite in subordinate; free silica impregnations occasionally encountered in lower sections of the profile</td>
<td>Both dense and crystalline gibbsite common; goethite in major amounts and hematite subordinate; free silica impregnations relatively more in middle and lower sections</td>
</tr>
<tr>
<td>xi. Chemistry</td>
<td>Al₂O₃ 40-61% Fe₂O₃ 8-24% TiO₂ 1-2%</td>
<td>Al₂O₃ 40-50% Fe₂O₃ 15-28% TiO₂ 2-7%</td>
</tr>
<tr>
<td>xii. Thickness</td>
<td>Upto 32 m.</td>
<td>Upto 16 m.</td>
</tr>
</tbody>
</table>

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.

Acknowledgement: Sincere thanks to all my mentors for their guidance and encouragement. These are some aspects I discussed with my colleagues in the field, while introducing them to bauxite exploration. They are thus the source of inspiration in me and I am grateful to them.