GENERAL CHARACTERISTICS OF BAUXITES

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Section Outline

• What is bauxite?
• Sources
• Seaborne traded volume and carrying fleet
• Bauxite chemistry and mineralogy
• Mining and Processing
• Bauxite Investigated by the GBWG and their general characteristics
• Examples of Bauxites
What is Bauxite?

• Bauxite is a rock formed from the weathering of either silicate rocks (granite/basalt) or carbonate rocks (limestone/dolomite).
• Bauxite is the primary aluminium ore for most of the world’s production of aluminium.
• Most bauxite is via silica rocks to form lateritic bauxite where long term leaching of silica and other soluble materials due to a wet tropical or subtropical climate results in the precipitation of aluminium hydroxides, namely gibbsite.
• Bauxite is typically a soft, white to grey to reddish brown material with an earthy luster.
• Large bauxite deposits are usually found as flat layers near the surface.
Sources
Seaborne Trade Volume And Carriage

<table>
<thead>
<tr>
<th>Vessel Size</th>
<th>% By Tonnage</th>
<th>% By Voyage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handymax (~50k DWT)</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Panamax (~80k DWT)</td>
<td>80</td>
<td>79</td>
</tr>
<tr>
<td>Capesize (&gt;170k DWT)</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Global seaborne bauxite (Mt) ~ 100Mtpa Total

- Brazil
- Guinea
- Australia
- Malaysia
- Sierra Leone
- Guyana
- Ghana
- Other
# Bauxite Chemistry and Mineralogy

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Mineralogy</th>
<th>Typical %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium Hydroxides</td>
<td>Gibbsite, Boehmite, Diaspore</td>
<td>50%</td>
</tr>
<tr>
<td>Alumina Silicate</td>
<td>Kaolinite</td>
<td>15%</td>
</tr>
<tr>
<td>Iron Oxide</td>
<td>Hematite</td>
<td>15%</td>
</tr>
<tr>
<td>Silica</td>
<td>Quartz</td>
<td>35%</td>
</tr>
<tr>
<td>Other (eg Ti)</td>
<td>Ilmenite</td>
<td>Trace</td>
</tr>
</tbody>
</table>
Mining / Processing

• Typically extracted by strip mining
• Overburden soil layer removed.
• The bauxite layer is broken up using methods such as blasting, drilling and ripping with bulldozers.
• Loosened bauxite is loaded into trucks, railroad cars or conveyors and transported to pre-processing plants and/or to port stockpiles before shipping.
• Three main bauxite products depending upon pre-processing;
  • Direct Shipped Ore (DSO): minimum screening and crushing to remove oversize and organic contamination.
  • Beneficiated ore: ore is crushed, screened and washed to remove fines.
  • Dried for handleability.
GBWG Bauxite’s Investigated

• Bauxite from;
  • A – Australia (Exporter of Bauxite)
  • B – Brazil (Exporter of Bauxite)
  • C – China (Importation of Bauxite including from Indonesia, India and Malaysia)
  • R – Rusal (Importer of Bauxite including from Guinea, Guyana and Jamaica)
  • G – Guinea (Exporter of Bauxite)
  • M – Malaysia (Exporter of Bauxite)
Particle Size Distribution (PSD)
% Passing- 1mm vs 2.5mm

\[ y = 0.76x \]
\[ R^2 = 0.97 \]
Australian Bauxite
Brazilian Bauxite
Malaysian Bauxite
Guinean Bauxite
Guyanese Bauxite
Cargo instabilities due to moisture

- **Liquefaction**
  - Requires a fully saturated or near fully saturated and fine grained granular cargo with sufficient cyclic forces

- **Formation of a dangerous wet base**
  - Requires the cargo to drain and form a saturated layer.
  - Similar to liquefaction in that a fully saturated finer grained granular cargo and sufficient cyclic forces are required

- **Loading as a slurry**
  - Shipping as liquid and not as solid cargo

- **Other instabilities due to moisture**
Summary

• Bauxites come from various locations globally
• Bauxites investigated by the GBWG include those from Australia, Brazil, India, Indonesia, Guinea, Guyana, Jamaica and Malaysia and represent over 90% of the seaborne traded bauxites
• Bauxites are, within limits, composed of similar minerals, namely gibbsite, boehmite, kaolinite, quartz and hematite
• Bauxites have large differences in particle size distribution depending upon the deposit and processing
• Geotechnically, the bauxites studied can be described as ranging from silt with much gravel to silty gravel with sand and cobbles. Particle shape ranges from spherical and round to angular.
• All bauxites tested have a consistent particle size relationship between the % passing 1mm and % passing 2.5mm
• Other instabilities due to moisture, apart from liquefaction, needed examination