North Australian bauxite deposits: A comparison of Gove and Weipa

Greg Rogers[1]

Rio Tinto Aluminium (RTA) mines bauxite from its mining lease at Gove, located 650 km east of Darwin in northeast Arnhem Land in the Northern Territory, Australia. The majority of the bauxite product is shipped to external customers, with moderate internal consumption at RTA's alumina refineries in Gladstone. The principal ore-type and main commercial source of aluminium is bauxite, which consists of mixtures of aluminium hydroxide minerals and impurities.

Deposits composed mainly of gibbsite are known as trihydrate-type because this mineral contains three water molecules, whereas deposits dominated by boehmite or diaspore are referred to as monohydrate types. Trihydrate bauxite is cheaper to process than the monohydrate varieties since it is more soluble during the Bayer alumina extraction process, using less energy.

Lateritisation/bauxitisation is essentially the adjustment of the structure, composition, and mineral assemblage of parent rock to the conditions of the Earth's surface under a wet climate. The main agents are physical and chemical weathering processes, the latter being more active than the former in a flat-lying tropical setting.

During lateritic weathering, successive layers typically develop on parent rock over a period of 10^5–10^7 years. The complete *in situ* profile is composed of up to five layers, some of which can be split into two or more zones. In descending order, from top (surface) to bottom (**Figure 1**), they are:

- **Soil** can be *in situ* or transported.
- **Duricrust** constitutes a hard, heterogeneous or homogeneous textured zone dominated by Fe and/or Al hydroxides; this forms the bauxite.
- **The mottled zone** is essentially a transition zone between the duricrust, where Al and Fe accumulate and the pallid zone, where Fe is leached.
- **The pallid zone** is also known as the clay zone.
- **Saprolite** is *in situ* weathered parent rock.
- **Parent rock** is the material from which the weathering profile is derived.

The following description of the Gove bauxite will be compared with Weipa in the presentation. The Gove bauxite appears to be a weathering product of Cretaceous marine sediments that overlie Proterozoic basement rocks of the Arnhem Inlier. They comprise Palaeoproterozoic (ca 1870 Ma) pelitic, calcsilicate, psammitic and mafic gneiss, and migmatite and garnetiferous leucogranite of the Bradshaw Complex (Rawlings *et al* 1997). Diamond drilling (Dodson 1967) and geological mapping indicate that there is a 100–200 m thick succession of gently dipping, Lower Cretaceous sandstone and claystone (Yirrkala Formation) unconformably overlying the Bradshaw Complex.

The bauxite zone has historically been up to 10 m thick but is more typically 3–4 m in thickness. It comprises a number of distinct layers in either a dominantly cemented ('hard') profile or a dominantly poorly cemented to uncemented (loose or soft) profile. Hard profile bauxite generally consists of, in descending order, a thin overburden layer (OB) of mixed loose pisolites and topsoil, a thin loose

[1] Rio Tinto Aluminium, 123 Albert Street, Brisbane QLD 4000, Australia
Email: Greg.Rogers@riotinto.com

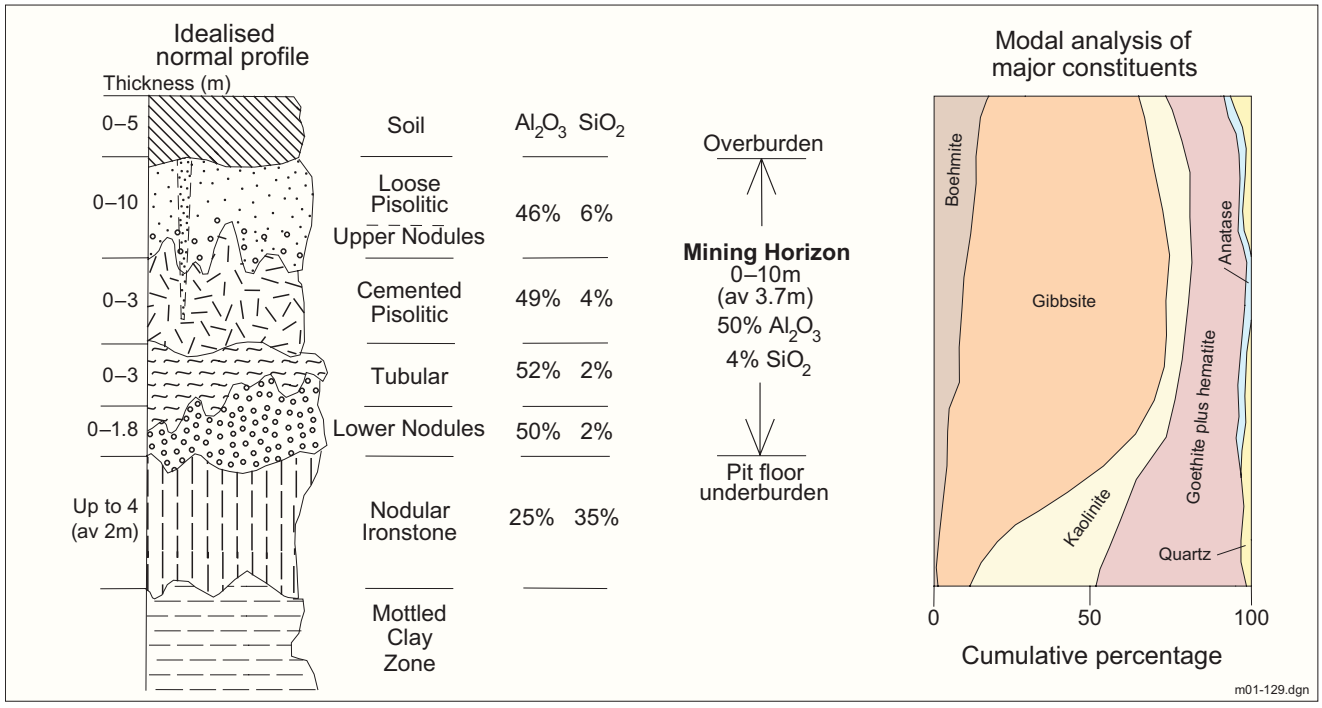

Figure 1. Gove Mine – Schematic profile of the Bauxite Plateau (Ferenczi 2001).

Figure 2. Hard bauxite profile. (**a**) Clean loose pisolites. (**b**) Typical brittle cemented soft. (**c**) Close-up of cemented hard bauxite. (**d**) Typical tubular ore with vesicular cavities. (**e**) Moderately cemented nodules with abundant pore spaces. (**f**) Laterite close-up showing large ferruginous nodules and angular fragments.

pisolite layer (LP; **Figure 2a**), a weakly cemented pisolitic bauxite layer (Cemented Soft – CS; **Figure 2b**), a strongly cemented pisolitic bauxite layer (Cemented Hard – CH; **Figure 2c**), an extremely vughy 'tubular' bauxite layer (Tub; **Figure 2d**), a nodular bauxite layer (Lower Nodules – Nod; **Figure 2e**), and a base of vughy laterite (Lat; **Figure 2f**).

References

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