

Written evidence submitted by Dr Kathryn Moore and Dr Penda Diallo (MIN0014)

Actions that seek to reduce global inequality will reshape complex supply chains for critical raw materials

Inquiry: Critical Minerals

Written evidence submitted by:

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We are specialists in critical metals and the social sustainability of bauxite mining. Over the years, we have examined the distribution of geological reserves and refining activities, the dependence on energy stability, the characteristics of field operations and testimonial data to understand where risks, and negative and positive impacts arise in the bauxite to aluminium supply chain. In this brief, we focus on compound criticality - where multiple critical metals are by-products that are extracted during minerals processing from another critical raw material, bauxite.

In our submission, we refer to the terms of reference and will cover:

- Which critical minerals are the most important to the UK's national priorities (including national security and the green transition)? Where are the vulnerabilities in these supply chains? What are the consequences of disruption to these supply chains?
- Where should the UK's focus be in developing bilateral relationships for improving our supply chain accessibility and traceability? How can the UK Government help mitigate any adverse impact of "debt-trap diplomacy" and increasing divides between the global South and global North?

Executive summary

Critical raw materials (CRMs) are usually mined, or separated as by-product metals during the refining of mined materials. Bauxite is a CRM and the ore for aluminium, which has the highest production levels compared to all other metals deemed significant to the Clean Energy Transition. Bauxite is an excellent example of compound criticality, where multiple CRM by-products are extracted during alumina refining, part-way along the bauxite to aluminium supply chain. Scandium, gallium, lithium, cobalt, titanium and REE are by-products for use in battery, magnet and photovoltaic applications. Within 30 years we will need half a billion tonnes of bauxite every year, compared to 390 million tonnes in 2021, which should increase access to by-product CRMs. However, criticality is related to regime stability and bottlenecks in supply chains.

The economic benefits of by-product CRM extraction occur at the sites of alumina refining and are not shared by the mining nations that export bauxite ore. Such nations, most

particularly Guinea, seek to develop downstream industrial activities and gain a better share in economic prosperity, despite debt-trap diplomacy with refining nations. The risks to end-product consumers, such as the UK, can be cumulative and they relate to both geo-political shocks in the mining regions, and to environmental or socio-political shocks in the regions where refining occurs. Actions of the FCDO to address inequalities in producer nations can reshape and create resilience in supply chains.

Section 1: [Which critical minerals are the most important to the UK's national priorities (including national security and the green transition)? Where are the vulnerabilities in these supply chains? What are the consequences of disruption to these supply chains?]

- 1.1 The World Bank identified aluminium as the 'high-impact, cross-cutting metal' that has the highest production levels compared to all other metals deemed significant to the Clean Energy Transition, with uses from solar PV installations to light-weighting of the transport fleet. Increasing global demand for aluminium means that perfectly efficient recycling is forecasted to make a maximum contribution of 61% to supply by 2050, ensuring a continued need to mine the aluminium ore, bauxite.
- 1.2 Bauxite is a critical raw material for the European Union. It is processed initially into alumina, which is then smelted to aluminium metal. A suite of high-value, by-product critical raw materials are extracted at the alumina refining stage: scandium, gallium, lithium, cobalt, titanium and REE used in battery, magnet and photovoltaic applications. Shocks relating to bauxite production may create secondary shocks for by-product CRM production. Our research team has specific expertise in the area of critical raw materials and would be pleased to support further work determining where compound criticality exists in supply chains.
- 1.3 Bauxites typically contain around 55wt % alumina, so that transportation of unrefined, wet ore has nearly double the mass of shipping of alumina. Global transportation of large volumes of low-cost bauxite has higher carbon footprint than transportation of lower volumes of alumina and by-product CRMs. Given the scale of bauxite production, alumina processing close to sites of bauxite mining will benefit the environment on a global scale.
- 1.4 It is economic for producers of alumina to ship large quantities of the unrefined ore because alumina (US\$320-400 per metric tonne) and its by-products (e.g. up to US\$1100 per kilogram for scandium oxide) have much higher value than bauxite (US\$40-55 per metric tonne). Bauxite-exporting nations are effectively excluded from the economic opportunities arising from raw materials production for the low carbon transition. Our findings illustrates how the definition of high-value raw materials as critical does not benefit the bauxite-exporting nations, but serves the interests of stakeholders down-stream in the supply chain.
- 1.5 Aluminium smelting is energy-intensive and strongly coupled to energy security and, thereby, fossil fuel dependency. Aluminium output at individual sites is impacted by high-risk local events but there are multiple smelting centres globally to ensure material flows. Thus, risks are greater at the upstream (bauxite to alumina) end of the supply chain where there is compound criticality, and a feedback loop of negative environmental and socio-economic impacts for the raw materials for the low carbon transition. Because the UK lies at the very end of the supply chain, it needs a full awareness of its cumulative vulnerabilities, and the socio-economic impacts of its consumption on the upstream portions of the supply chain.

Recommendations:

- 1.6 The FCDO through its policies must factor by-product CRM concerns into stewardship initiatives for major metals such as aluminium, in order to support a responsible

supply chain that aligns with UN Sustainable Development Goals, and to understand compound criticality and risks.

- 1.7 The FCDO through its diplomatic support must ensure that, for British Companies, engagement with stewardship initiatives, such as the Aluminium Stewardship Initiative Performance Standard, are mandatory rather than voluntary so that consumer nations would then be better able to understand the impacts of their resource use.
- 1.8 The UK must commit to the promotion of a responsible supply chain which works to reduce global inequality and cumulative carbon footprint by encouraging processing close to the sites of mining, thereby reducing the volume of transported material and enabling producer countries to retain value in the mining chain.

Section 2: [Where should the UK's focus be in developing bilateral relationships for improving our supply chain accessibility and traceability? How can the UK Government help mitigate any adverse impact of "debt-trap diplomacy" and increasing divides between the global South and global North?]

- 2.1 Guinea has the world's largest reserve of bauxite; it is amongst the top three largest global producers of bauxite and is key to the global aluminium and by-product CRM supply. The criticality of bauxite arises from a legacy of weak governance and regime instability, largely in Guinea.
- 2.2 Foreign investors and consumer countries see a cost-benefit from disorder in Guinea, and a national dependence on bauxite mining for the last 50 years. Ore-refining nations have investments that are deemed extractive or neo-colonial because they place Guinea in debt, while adding value to raw materials and intermediate products outside Guinea. There have been various protests in the bauxite mining regions of Guinea in relation to the invasive exploitation of bauxite with not enough profit for the population at large.
- 2.3 Dialogues about security of supply of critical minerals for downstream industrial activities, and policies about the transition to green energy in major Western and non-western countries, have greater visibility than the inequalities between upstream and downstream populations. There is little or no action for the inclusion of upstream countries like Guinea in arising debates and opportunities.
- 2.4 Countries from across the supply chain need to be included in the debate on the energy transition, in order to break the neo-colonial cycle where upstream countries only export low-value raw materials to countries with downstream manufacturing. Accessing the Guinean resource requires companies to position themselves as a partner of choice for the country and the people, where repeated calls for refinery development by foreign companies are not realised.
- 2.5 Shifts in societal-environmental interactions related to the bauxite-alumina (plus CRM by-products) supply chain are likely to become more frequent. The aluminium industry cannot sustainably continue without engaging properly now with Guinean communities, including rural youth and women as the population groups most vulnerable to the impacts of extraction. The authors have specific expertise in bauxite mining in Guinea and stakeholder relations and would be pleased to support further work.

Recommendations:

- 2.6 The FCDO must commit to addressing inequality, and neo-colonial structures by supporting and advocating for inclusive, transparent and win-win business engagements in upstream industries in countries like Guinea.
- 2.7 The UK must ensure that upstream countries are represented in discussions about green-energy transitions and that all British institutions operating in those countries

contribute to local sustainable development that supports rural youth and women, as the most vulnerable communities in mining areas.

- 2.8 The UK must support in-country capacity building in Guinea through provision of scholarship that will develop specialist, up to date expertise, and capacity building for both students and government officials from Guinea.

We would be pleased to provide further information to inform this inquiry. Please do not hesitate to contact Kathryn Moore [k.moore@exeter.ac.uk] and Penda Diallo [penda@aluminium-stewardship.org, and p.n.diallo@exeter.ac.uk].

Further reading:

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