MINISTRY OF NATURAL RESOURCES
CO-OPERATIVE REPUBLIC OF GUYANA

POLICY BRIEF #3

National bauxite resources assessment: where and how much?

TABLE OF CONTENTS

A. Scope ----------1

B. Background ----------2

- Policy context
- What is a mineral resources assessment?
- Terminology

C. Permissive tracts for local bauxite ----------3

D. Assessment of bauxite potential within tracts----------4

- Coastal belt permissive tract
- Intermediate-level plateau-type permissive tract
- High-level plateau-type permissive tract
- Southern Guyana permissive tract

E. Coastal Belt bauxites: Lack of new prospects?----------12

F. Remote sensing techniques: way forward for our plateau-type bauxites----14

G. Policy recommendations----------16

H. Annex----------17

A. SCOPE

This policy brief is the third in a series of seven such documents on the future of Guyana's bauxite sector. Its objectives are to:

(i) give an updated assessment of the country's bauxite potential by mainly focusing on the resources outside of the current bauxite mining areas around Linden and Aroaima.

(ii) suggest where and how the government should direct its geological info-gathering activities. Put differently, it describes the additional geological work the government should undertake to make bauxite prospects ready for "handing over" to private investors.

At its core, therefore, the brief involves a mineral resources assessment for bauxite: where and how much are our remaining bauxite resources?

B. BACKGROUND

Policy context: Policy position #4 within the draft National Mineral Sector Policy Framework and Actions (NMSPFA), prepared for the Ministry of National Resources in December 2018, speaks to the need for "Raising the attractiveness and competitiveness of Guyana's mineral sector for large investments." Under this policy, Strategic goal #18 recommends that government should "… enhance the availability, quality and dissemination of suitable data on Guyana's geology and mineral potential (inclusive of coastal and shallow marine areas) in line with the information needs of mining investors."

These positions in the NMSPFA define the scope of this policy brief, aimed at assessing Guyana's bauxite endowment.

Since the 1960s, an assessment of the country's bauxite potential has not been undertaken despite an increase in information in the last two decades. In particular, two mineral exploration programs were conducted that shed new light on the country's bauxite potential. Around 2003, the first of these programs evaluated the potentially massive bauxite occurrences in the Pakaraimas, applying remote sensing techniques for this purpose for the first time in Guyana (see Section F below). The second effort targeted the Essequibo and Pomeroon groups of bauxite occurrences (which span nearly 50% of the country's coastal bauxite belt) and was the first regional bauxite exploration of its kind in Guyana (see Section E below).

What is a mineral resources assessment (MRA)? A mineral resources assessment involves the determination of the potential mineral wealth of a defined region. Based primarily on geological data and reasoning , a MRA seeks to fully identify the discovered and undiscovered types of deposits in the region and to guesstimate the undiscovered resources for each deposit type. A MRA done in 1980, for example, concluded that northern Guyana likely contains 10 to 20 copper-zinc ore bodies, totaling several hundred thousand tonnes, even though no such deposits were discovered there at the time.[1]

By nature, MRA's are probabilistic and speculative. Nevertheless, the information they provide has been used by governments to make decisions concerning (i) national economic planning, (ii) land use policy, and (iii) mineral exploration.

Assessment can be done by a range of methods: from qualitative to quantitative; from objective to subjective; from one individual to a group opinion; and from basic to elaborate.

In this brief, the MRA for bauxite is performed in two steps. Step 1 involves the demarcation of permissive tracts for bauxite occurrences in Guyana. Step 2 assesses

[1] See Gibbs, A.K. (1980) – Geology of the Barama-Mazaruni Supergroup of Guyana. PhD thesis. Harvard University; pp 293 - 295.

the identified and speculative bauxite resources within each tract. Both steps rely exclusively on a literature review of company reports, academic studies, and GGMC reports. The underlined terms are defined immediately below and in the annex.

Terminology: Because of the huge financial, economic and political stakes involved in mineral exploration and extraction (and the risks of misunderstandings, misinformation, and misappropriations), it has now become the worldwide standard that public communication on these activities must strictly utilize a recognized list of pre-defined terms. The accepted definitions of these terms used in this and all other policy briefs are given in Annex 1.

In addition to those in Annex 1, the following terms are used in the mineral resources assessment attempted here[2]:

> Permissive tract. An area considered inherently favorable for the existence of a specific deposit type (in this case, lateritic bauxite deposits) based on geological criteria. In other words, the geology permits the presence of the specified deposit in the area, even if none has been discovered there to date.
>
> Optimistic factor. Geological, exploration or other evidence that increases our confidence that large commercial deposits exist in the permissive tract.
>
> Pessimistic factor. Geological, exploration or other evidence that reduces our confidence that large commercial deposits exist in the permissive tract.
>
> Information requirements. This is defined here as the additional exploration work and datasets that are required to ready a permissive tract, or parts of it, for "handing-over" to potential mineral investors. The "handing-over" point is that amount of exploration data private investors expect the government to provide or which the government believes is enough to attract that investment.
>
> Quantitative assessments: Tonnages and grades. These are extracted from company and GGMC reports, and are not certified unless so stated.

C. PERMISSIVE TRACTS FOR BAUXITES IN GUYANA (STEP 1)

Step 1 involves the demarcation of permissive tracts for bauxite occurrences in Guyana. As defined above, a permissive tract is an area in which the geology permits the presence of the specified deposit type, even if none has been discovered there to date.

Guyana's bauxites are lateritic by geological origin. By topographic relief, they are separated into two sub-types: buried or lowland deposits and plateau or highland

[2] These definitions are somewhat different from those used by the USGS.

deposits. Four permissive tracts are delineated for these bauxites, one for buried deposits, and three for plateau type. One good outcome of this division is that the four tracts cover four different and distinct geographical and geological territories.

1) The Coastal Belt low-level laterite bauxite permissive tract
2) The intermediate-level plateau-type laterite bauxite permissive tract
3) The high-level plateau-type (Pakaraimas) laterite bauxite permissive tract
4) The southern Guyana laterite bauxite permissive tract.

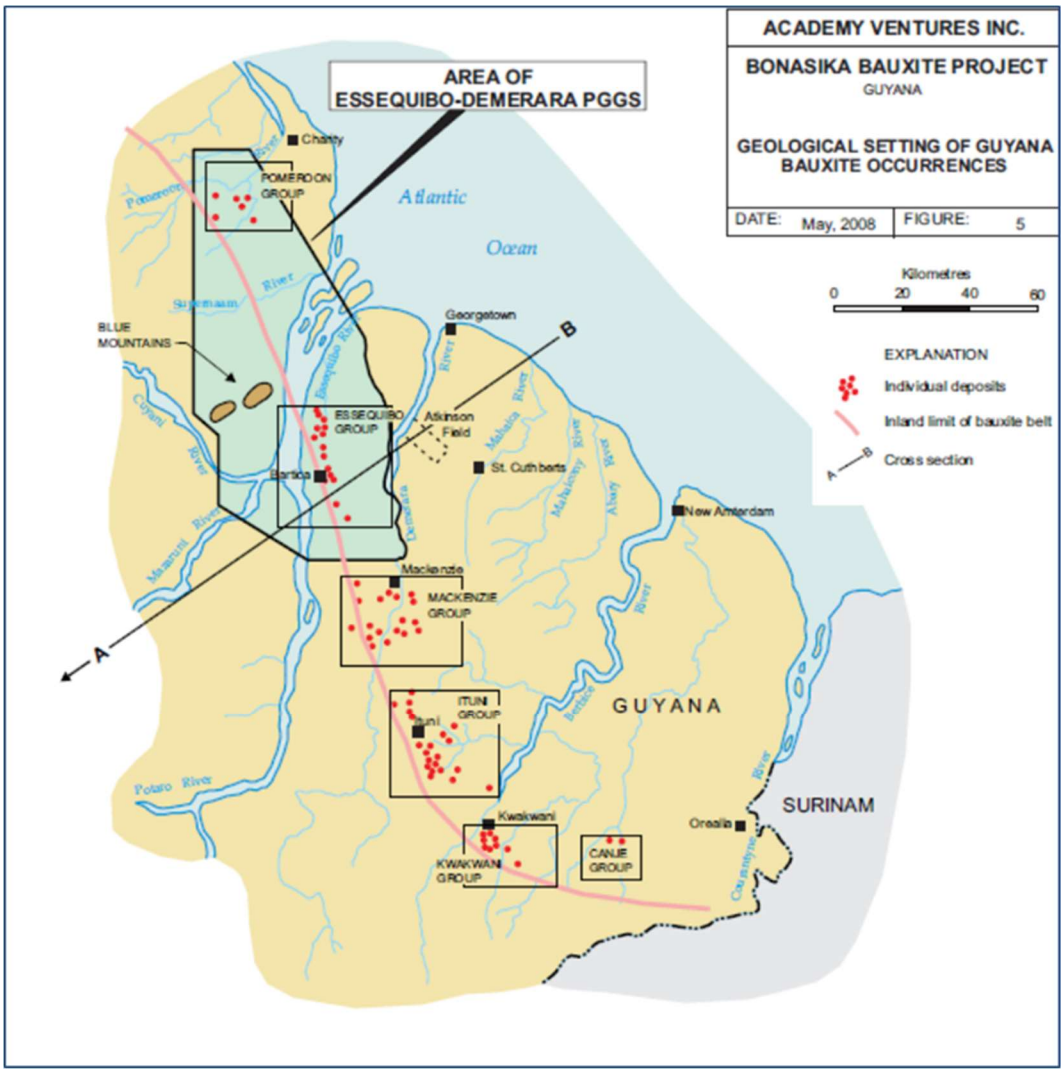
Two additional notes about permissive tracts. First, areas within them could be excluded based on unfavorable natural factors, such as the presence of excessive barren overburden or poor exploration results. Both these reasons for exclusion are possible for the bauxite permissive tracts in Guyana. For example, in one study, areas where bauxite deposits were buried below 40m by the Berbice White Sands Formation were considered uneconomical (not "permissive"). This brief does not, however, attempt this refinement, as information on overburden thicknesses is inadequate.

Secondly, permissive tracts can be subdivided based, for instance, on differences in perspectivity, exploration history, and geological knowledge. We try our hands at this.

D. ASSESSMENT OF BAUXITE POTENTIAL WITHIN TRACTS (STEP 2)

Step 2 assesses the identified and speculative bauxite resources within each permissive tract. It conclusions are based exclusively on a literature review of company reports, academic studies, and GGMC reports. The underlined terms are defined in the annex.

#1 THE COASTAL BELT PERMISSIVE TRACT



MAP 1: Map showing the six clusters of known bauxite occurrences on Guyana's coast. Tarakulli Group inserted. Original source: D. Bleackley. Geological Survey of British Guiana, 1959.

The coastal bauxite deposits occur in a belt 20-40 km wide and 250 miles long roughly parallel to the Atlantic Coast and up to 100 km from the coast (Map 1). The general geological setting throughout comprises of lenticular bauxite bodies of between 1 m and 10 m in thickness, situated beneath an overburden of between 1 m and over 100 m of the Berbice White Sand Series sands and clays. The underlying bauxite is not continuous, but most likely exists atop palaeo-plateaus, with little expression on the present topography.

Within this tract, seven deposit clusters or groups have been recognized (Bleakley, 1959). For present purpose, each group is treated as belonging to a tract subdivision or a zone, with their established names assigned to them. Usage of the term "zone" emphasizes the geographic area containing the deposits rather than the deposits themselves.

PERMISSIVE TRACTS	NAMES OF DEPOSIT CLUSTERS	ZONE NAMES
Guyana coastal plain	The Tarakulli group	The Tarakulli zone
	The Canje group	The Canje zone
	The Kwakwani group	The Kwakwani zone
	The Ituni group	The Ituni zone
	The Linden group	The Linden zone
	The Essequibo group	The Essequibo zone
	The Pomeroon group	The Pomeroon zone

In this mineral assessment, the Kwakwani, Ituni and Linden groups are exempted as they have a long history of bauxite production with verified resources and reserves. These are projected to support another 50 years and more of mining. Our focus is on the less well-known, unexploited permissive zones.

Tarakulli zone

Delineation of permissive zone: Zone encircles the cluster of bauxite occurrences located in the Tarakulli area in the Corentyne, Berbice, in eastern Guyana.

Deposit-type: Buried, lowland laterite bauxite deposit.

Examples of deposit type:

Exploration history: (i) 1962-64 by Reynolds Metals Company: *Drilling (700 holes).* (ii) in 2011 by First Bauxite Corp.: *Drilling (32 holes).*

Important data sources:

(i) Geological Evaluation of the Tarakulli Bauxite Deposit in the Corentyne River Area of Guyana" dated July 2001 prepared by Maurice C. Hamilton.

(ii) Presentations and reports of First Bauxite Corp.

Information requirements: None. "Handing over" point to private investors reached. Property already leased to private investors.

Optimistic factors: presence of high-quality, large tonnage bauxites confirmed.

Pessimistic factors: (i) little potential for additional resources likely, (ii) presence of thick overburdens (27 -75m).

Quantitative assessment: Identified resources: 62.8 Mt of in-situ wet bauxite; a grade of 58.6% Al_2O_3, 4.7% SiO_2, 2.5% TiO_2 and 3.3% Fe_2O_3.

Canje zone

Delineation of permissive zone: Zone encircles the cluster of bauxite occurrences located in the Canje area in the Corentyne, Berbice, in eastern Guyana.

Deposit-type: Buried, lowland laterite bauxite deposit.

Examples of deposit type:

Exploration history: (i) 1962-64 by Reynolds Metals Company: Drilling (516 holes).

Important data sources: Presentations and reports of First Bauxite Corp.

Information requirements: None. "Handing over" point to private investors reached. Property already leased to private investors.

Optimistic factors: (i) Potential for high-quality bauxites.

Pessimistic factors: (i) presence of thick overburdens, (ii) little potential for additional resources likely.

Quantitative assessment: none reported.

Essequibo zone

Delineation of permissive zone: Zone encircles the cluster of bauxite occurrences located in the Essequibo portion of the Coastal Belt.

Deposit-type: Buried, lowland laterite bauxite deposit.

Examples of deposit type: Bonasika

Exploration history: (i) in 1950s-1960s by Harvey Aluminum Company (*drilling*); (ii) in 1930s to 1960s by DEMBA (*prospecting and drilling*); (iii) 2008-2011 by Rio Tinto/First Bauxite Corp. (*geological mapping; ground geophysics, using ground penetrating radar; augering; scout drilling for target assessment; and drilling for target evaluation*).

Important data sources: Rio Tinto company reports.

Information requirements: None. Handing over to private developers has already occurred.

Optimistic factors: (i) within the zone, mine development and production at Bonasika at present, (ii) high-quality bauxite intersections in a few other areas in the zone.

Pessimistic factors: (i) poor exploration results reported over much of the zone outside of Bonasika, (ii) difficult exploration conditions due mainly to thick overburden, poor accessibility, and absence of mineralization vectors. (iii) lack of continuity of bauxite zones.

Quantitative assessment: none reported.

Pomeroon zone

Delineation of permissive zone: Zone encircles the cluster of bauxite occurrences located in the Pomeroon portion of the Coastal Belt.

Deposit-type: Buried, lowland laterite bauxite deposit.

Local examples of deposit type:

Exploration history: (i) *2008-2011 by Rio Tinto/First Bauxite Corp. (geological mapping; ground geophysics, using ground penetrating radar; augering; scout drilling for target assessment; and drilling for target evaluation).*

Important data sources: Rio Tinto company reports.

Information requirements: None. Handing over to private developers has already occurred.

Optimistic factors: High-quality bauxite intersections in a few areas.

Pessimistic factors: (i) poor exploration results reported over much of the zone, (ii) difficult exploration conditions due mainly to thick overburden, poor accessibility, and absence of mineralization vectors. (iii) lack of continuity of bauxite zones.

Quantitative assessment: none reported.

#2 THE INTERMEDIATE-LEVEL PLATEAU-TYPE PERMISSIVE TRACT

Delineation of permissive tract: flat-topped hills between the coastal belt and the Pakaraima mountains. Summits reflect one of three different peneplain levels. Major summits include the Blue, Oko, and Eagle mountains. Tract includes all geologies of the Barama-Mazaruni Supergroup.

Poor exploration results make the Blue mountain region a comparatively less prospective zone within the tract.

Deposit-type: the intermediate-level plateau-type laterite bauxite deposit.

Local examples of deposit type: Blue mountain, Oko mountain, Eagle mountain.

Exploration history: (i) in 1955/56 by Harvey Aluminium in Blue Mountain (*drilling*). (ii) 2008-2011 by Rio Tinto/First Bauxite Corp. (*geological mapping; ground geophysics, using ground penetrating radar; augering; scout drilling for target assessment; and drilling for target evaluation).*

Important data sources:

i) Hardwick, p. / Harvey Alumnium (1956): Exclusive Permission 535, Report on Exploration for period September 1955 to March 1956.

ii) Cameron, N.R. (1979): Report on the geology of the Blue Mountains.

iii) Rio Tinto/First Bauxite company reports.

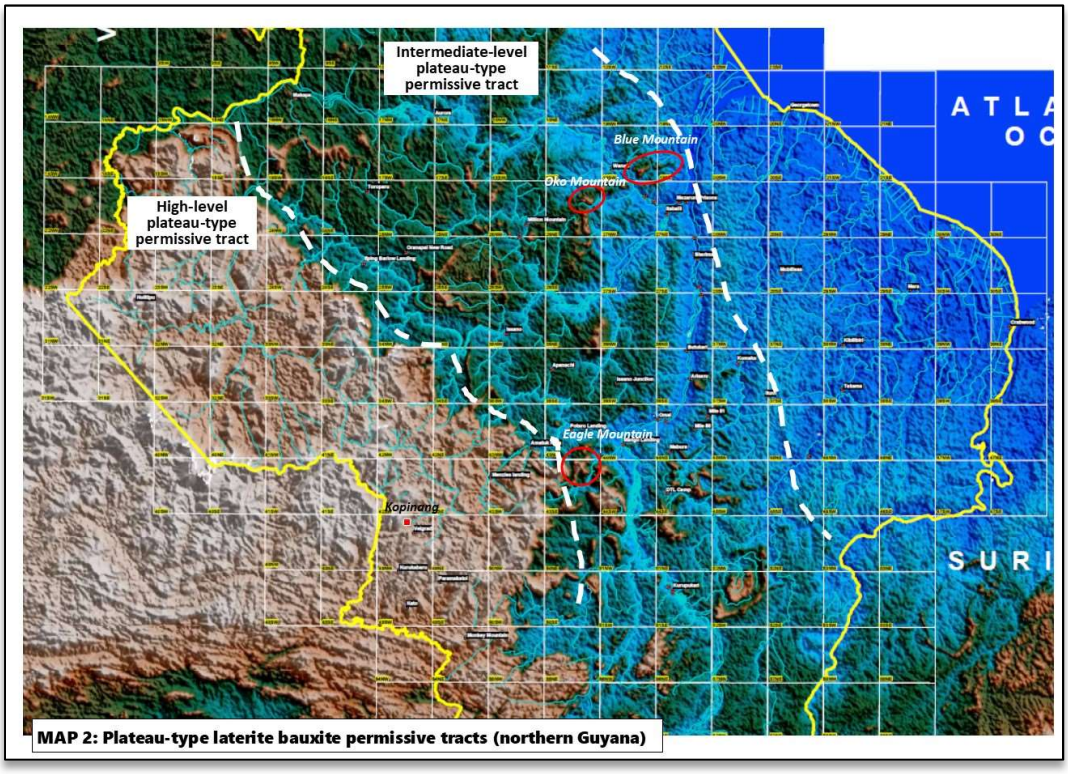
Information requirements: None in the Blue mountain, as the area has recently been extensively explored by mining investors.

In the wider permissive tract, the prospectivity of the remaining plateaux need to be ranked based on area (bauxite rarely forms of plateaux less than 2-3 km^2), slope (the flatter the surface, the better), degree of dissection (the less dissected, the better), and planation level (even if all other factors are equal, different planation levels produce different laterite profiles).

Optimistic factors: (i) good geological setting, with several peneplain surfaces, (ii) proven presence of bauxite occurrences, such as at Blue and Eagle mountains.

Pessimistic factors: (i) Bauxite development underneath the laterite cap on Blue mountains (the highest-rated prospect within the tract) proved to be less continuous than expected from earlier observations of outcrops and float occurrences, apparently due to removal of previously more extensive bauxitisation by erosion; (ii) Observations on drill core also indicate that secondary kaolinisation of gibbsite played a role in reducing the bauxite content, (iii) high-value results in Blue mountains confined to area of limited size.

Quantitative assessment: none reported.



MAP 2: Plateau-type laterite bauxite permissive tracts (northern Guyana)

#3 THE HIGH-LEVEL PLATEAU-TYPE PERMISSIVE TRACT

Delineation of permissive tract: The tract is associated with the mafic and ultramafic rocks of the Avanavero Suite that intrude the Roraima Supergroup in the form of sills and dykes. Bauxite was first detected in 1956 from analysis of a river float in the basin of the Kopinang river, a tributary of the Potaro river. The specimens contained high grades of bauxite, which triggered an intensive exploration campaign in 1959/60.

The sedimentary sequences in the Roraima are excluded from the permissive tract, as geology and exploration work indicate that the areas above these rocks do not contain bauxite.

Based on good results from exploration work from 1959/60 to early 2000s, the following three zones within the tract possess comparatively higher favorability:

(i) The Kopinang basin

(ii) The Sukabi basin (to the west of Kopinang)

(iii) The Kamarang-Kukui area, in the basin of the upper Mazaruni river.

Deposit-type: high-level, plateau-type laterite bauxite deposit.

Local examples of deposit type: Kopinang bauxite occurrences.

Exploration history: (i) 1959/1960*s* by the Geological Survey of British Guiana *(mapping, pitting, sampling)* (ii) 1999 – 2001 by Goldstone Resources Inc.*(test pitting, satellite image interpretation)*

Important data sources:

i) Bateson, J.H., 1961. Preliminary report on the ferruginous bauxites of the Pakaraima Mountains. Geological Survey Department, Georgetown, Guyana.

ii) Bateson, J.H., 1962. Further investigation of the laterites of the Kopinang Basin, Pakaraima Mountains. Geological Survey Department, Georgetown, Guyana. Unpublished Report JHB.

iii) Bleackley, D., 1960. Occurrence of bauxite in the Pakaraima Mountains. Geological Survey of British Guyana. Unpublished report DB 1/60.

iv) Fey, M.V., 2001. Reconnaissance assessment of lateritic bauxite in the Kopinang Basin. Unpublished report for Migrate Mining Ltd.

v) Fey, M.V., 2003. Assessment of remote sensing interpretation of lateritic bauxite distribution in the Kopinang Basin, Guyana". Unpublished report.[3]

Information requirements: (i) ground checking of remote sensing interpretation of potential mineralized areas beyond the Kopinang river basin, (ii) augering, pitting and sampling to check on continuity, thicknesses, and chemical compositions, (iii) demarcation and preliminary resource assessment of priority targets.

Optimistic factors: (i) bauxite occurrences in places have been confirmed by drilling and augering, (ii) parent rock (Avanavero Suite) and bauxite occurrences extend over extensive areas, (iii) grades comparable with Australian bauxite deposits for metal-grade bauxite production.

Pessimistic factors: (i) not all potential areas identified by remote sensing contain bauxite, (ii) initial chemical results suggest low potential for refractory-grades and for bauxites to be used as sweeteners for alumina refining.

Quantitative assessment: identified and undiscovered resources likely to reach several hundred million tonnes.

[3] The two Fey reports are not publicly available.

#4	THE SOUTHERN GUYANA PERMISSIVE TRACT

Delineation of permissive tract: The geology, topography and erosional history make most of southern Guyana permissive for plateau-type laterite bauxite development. Berange (1977) highlighted the following areas based on accessibility and preliminary geological observations: (i) laterite-capped mesas formed on the Kanuku Complex, (ii) laterites overlying the Apoteri Volcanies forming the Toucan Hills at the eastern end of the rift valley, and (iii) Red earth overlying the Wamakaru Granulites and the Kanuku mountains.

No exploration work has been conducted for bauxite in southern Guyana. Therefore, no zone is excluded or given a higher favorability rating.

Deposit-type: mostly plateau-type laterite bauxite deposits.

Local examples of deposit type: None currently.

Exploration history: none

Important data sources: Berrange J.P. (1977)- The geology of southern Guyana, South America.

Information requirements: reconnaissance exploration using remote sensing technique with field checking and selected target appraisal.

Optimistic factors: (i) large geographic extent of parent rocks and presence of several peneplains.

Pessimistic factors: none currently.

Quantitative assessment: none reported.

E. COASTAL BELT BAUXITES: LACK OF NEW PROSPECTS?

The coastal bauxite belt is reported to contain as many as 100 bauxite occurrences, clustered into seven groups. After Bleackley (1959), from south to north, these clusters are named the Tarakulli group, the Canje group, the Kwakwani group, the Linden group, the Ituni group, the Essequibo group, and the Pomeroon group. To date, only deposits in the Kwakwani, Linden, Ituni, Essequibo groups (at Bonasika) have been mined, with the main orebodies in the Ituni area being mostly depleted.

Since the 1960s, no reconnaissance-scale exploration has been conducted in the belt until 2008 when Rio Tinto in an agreement with First Bauxite Corp. commenced exploration in the Essequibo and Pomeroon sections of the belt based on a Permit

for geological and geophysical surveys (Essequibo-Demerara PGGS) initially covering 7875 km^2.[4] The PGGS covered roughly 50% of the coastal bauxite belt (Map 1).

The work lasted three years and included:

1) Review of historic exploration data.
2) Geological traverses and mapping of bauxite occurrences.
3) Analysis of SRTM (Shuttle Radar Topographic Mission) and other DEM (digital elevation) data.
4) GPS mapping to plan access and logistics and areas for line cutting.
5) Use of ground penetrating radar (GPR) to find a reliable vector to mineralization and to identify the depth of the overlying sand.
6) Scout drilling to check for the presence of bauxite.

Rio Tinto, the operator for the project, reported several difficulties in undertaking the reconnaissance work, including:

- overburden cover of variable depths (from 0 to >100m);
- deposits are mostly buried and exhibit no or minimal expression on the present topography;
- the lack of definitive geophysical methods and other vectors of mineralization to directly identify buried bauxite;
- apparent lack of continuity of bauxite beds, with bauxite being found in clusters of small deposits;
- thick jungle cover with access difficulties.
- missing or hard-to-find records of previous exploration efforts.

In February 17, 2011, a Letter of Understanding between First Bauxite Corp. and Rio Tinto Mining and Exploration Ltd terminated the joint venture. Rio Tinto, in its 2011 annual report, declared that this was due to "poor results." In 2014, First Bauxite cancelled its application for twenty prospecting Licences in the Essequibo-Demerara PGGS.

Based on the above, this policy brief concludes that the prospectivity for bauxite mineralization in the entire northern portion of the Guyana coastal bauxite belt, north of the Bonasika bauxite mines, has significantly decreased. To all intents and

[4] After two rounds of relinquishment of mainly low-potential and low accessibility territory, the PGGS was eventually reduced to 4,368 km^2.

purposes, the area could be removed from the coastal belt permissive tract for three reasons: (i) the unfavorable exploration results from the Rio Tinto project, especially in terms of deposit size and continuity, (ii) the absence of any geological criteria that could point to the location of buried deposits, and (iii) the tested and expected ineffectiveness of geophysical techniques to detect the presence of buried ore bodies. Given these geological, implementation, and technological obstacles, this portion of the bauxite belt is unlikely to attract further investor attention.

In the southern portion of the belt, outside of the bauxite mining zones, exploration in 2011 confirmed the presence of sizeable quantities of bauxite in the Tarakulli and Canje zones. Whether the zones have the resource base for long-term production of metal-grade bauxites (200 - 300Mt reserves) or for production of non-metallurgical bauxites (good chemistry and mineralogy) awaits further field evaluation.

F. REMOTE SENSING: WAY FORWARD FOR OUR PLATEAU-TYPE BAUXITES

From the literature, use of remote sensing techniques offers a relatively fast, accurate identification of potential bauxite deposits, reliable enough for target selection for bauxite reconnaissance and ranking of prospects. The preferred techniques have used images from the Shuttle Radar Topography Mission (SRTM) [5] and Landsat Thematic Mapper (Landsat TM) [6]. While such techniques are not new to mineral exploration, the use in the search for bauxites has been relatively recent.

The effectiveness of SRTM images relies on the existence of any geomorphological or topographical expression the sought-after mineralization may have that is in contrast with that of the surrounding landscape. The technique is consequently more effective for plateau-type bauxite occurrences. On the other hand, the Landsat TM technique relies on whether mineralized areas produce a spectral expression in contrast to that produced by the surrounding unmineralized areas due to differences in, for example, vegetation type and cover, soil and rock type, and hydrogeology.

The SRTM technique has been applied to bauxite exploration in Guyana on at least three occasions, two of which successfully. Starting from 2003, Goldstone Resources

[5] The Shuttle Radar Topography Mission (SRTM) is an international research effort that obtained digital elevation models on a near-global scale from 56°S to 60°N,[2] to generate the most complete high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that flew on board the Space Shuttle Endeavour during the 11-day STS-99 mission in February 2000. To acquire topographic data, the SRTM payload was outfitted with two radar antennas.

[6] A Thematic Mapper (TM) is one of the Earth observing sensors introduced in the Landsat program. TM is an advanced, multispectral scanning Earth resources sensor designed to achieve higher image resolution, sharper spectral separation, improved geometric fidelity and greater radiometric accuracy and resolution than the MSS sensor.

Inc successfully used the technique to conduct reconnaissance of bauxite occurrences in Kopinang area in the Pakaraimas. The interpretation was accompanied by a limited augering program in selected areas. The project confirmed most of the findings of Bleakley's studies in the 1960s, in particular his conclusion that the area may contain several hundreds of millions of tonnes of bauxite. The two reports commissioned by Goldstone are[7]:

1) "Satellite image processing and remote sensing interpretation of lateritic bauxite in the Kopinang." (July 2003) by N. J. Wullschleger.
2) "Assessment of remote sensing interpretation of lateritic bauxite distribution in Kopinang Basin, Guyana." (November 2003) by M. V. Fey.

The second application of the technique for the assessment of bauxite potential in Guyana is described in a 2005 academic study conducted by Geo-Kom Ltd and titled: "Identification of Laterite Bauxite Deposits with Application of Remote Sensing Techniques." (2007) By György Komlóssy. Geo-Kom Ltd.

The study used several case studies worldwide to demonstrate the effectiveness of the technique for plateau-type bauxites. The identification of potentially bauxite-bearing plateaus in the Pakaraimas is noted as one such successful case study. GGMC must tailor its bauxite exploration programs accordingly.

The third case in the use of SRTM in Guyana was mostly interested in targeting the buried bauxite occurrences in the Coastal Belt and was far less successful. The work was conducted from 2007 on behalf of Rio Tinto during its exploration of the Essequibo-Pomeroon bauxite groups. The company however reported that

> "… the presence of the sand overburden in the coastal belt makes it more difficult to directly relate the modern surface to bauxite mineralisation at depth, and to ignore the influence of modern drainages. As no evidence was found that planation surfaces interpreted from the SRTM data have any meaning in areas of the coastal bauxite belt with > 10 m of overburden, it was decided not to employ this tool for targeting purposes."

For plateau-type bauxite occurrences, with their topographic contrast, SRTM images can be readily interpreted for assessment of bauxite potential and for target selection. The technique has, however, shown to be ineffective in meeting similar goals for the buried coastal bauxite deposits in Guyana.

Landsat Thematic Mapper (TM) has very limited application for bauxite exploration in Guyana. This is largely due to the uniform tropical forest cover over mineralized and unmineralized areas.

.

[7] None of these reports is in the public domain.

G. POLICY RECOMMENDATIONS

Policy recommendations in this brief follow those in the draft National Mineral Sector Policy Framework and Actions (NMSPFA), prepared for the Ministry of National Resources in December 2018. Strategic goal #18 recommends that government should "… enhance the availability, quality and dissemination of suitable data on Guyana's geology and mineral potential (inclusive of coastal and shallow marine areas) in line with the information needs of mining investors." Accordingly, for bauxite, government, through the GGMC, should:

1) Collect and collate data and information on all previous bauxite exploration and mining activities by both private and state mining entities.
2) Conduct regional assessments of plateau-type bauxite potential especially in the Pakaraimas and southern Guyana using remote sensing techniques and ground-truthing exercises (such as that done by Goldstone Resources in 2001).
3) Archive all information digitally for reliable and convenient storage, retrieval, public viewing and dissemination.
4) set up a searchable and interactive online database and website
5) completely revamp the GGMC library in terms of information storage, preservation, cataloguing, and retrieval;
6) archive physical collections of drill core, chip samples, and thin sections; and
7) include bauxite as part of its systematic promotion campaign internationally.

H. ANNEX

A. Mineral occurrences and mineral deposits

Geological reports also frequently refer to:

i) A **mineral occurrence** is a concentration of a mineral or element that is considered valuable (of intrinsic economic interest); or that is of scientific or technical interest. The concentration of the element is above its average crustal abundance. The material in a mineral occurrence would be termed mineral resources.

ii) A **mineral deposit** is a mineral occurrence that contains one or more element (or mineral) sufficiently above the average crustal abundance to have potential economic value (or have reasonable prospects for eventual economic extraction). The material in a mineral occurrence would also be termed mineral resources.

iii) An **ore deposit** is a mineral deposit that has been tested and is known to be of sufficient size and grade to be mined and marketed at a profit under the prevailing conditions of prices, costs and technology. The "profit" decision may be based on factors other than financial/economical. May include strategic/military (mining of strategic minerals) or social/political considerations (Bauxite mining in Linden). An ore deposit contains probable and proven reserves.

B. For mineral assessment purposes, we use the following terms:

Resource. A mineral concentration of sufficient size and grade and in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Identified resources. Resources whose location, grade, quality, and quantity are known or are estimatable from specific geologic evidence.

Undiscovered resources. Resources in undiscovered mineral deposits whose existence is postulated on the basis of indirect geologic evidence.

Hypothetical resources. Undiscovered resources in known types of mineral deposits postulated to exist in favorable geologic settings where other deposits of the same types have been mined.

Speculative resources. Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made or in types of deposits as yet unrecognized for their economic potential.