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GUYANA : Unresolved Geological Questions

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INTRODUCTION

In the nearly 20 years that I have worked in Guyana, some aspects have become better understood. However there are many areas where field information is available, but the facts do not fit into any accepted framework. It is hoped that this presentation will act as a spur to further study and discussion!

PRE-RORAIMA FORMATIONS; HOW MANY PHASES ARE THERE?

The Muruwa Formation is best known from eastern Guyana. It consists of quartzite, with some conglomerate and is very similar to the Roraima Group. West of Parish's Peak (1a, Figure 1) the Muruwa is unconformable on greenstone basement, and has two phases of slight folding. On the east side the overlying Iwokrama Formation volcanics and then almost flat lying Roraima Group rocks appear to be semi-conformable (Heesterman et. al., 2015). Further west in Venezuela (1b) it appears that the Muruwa / Los Caribes Formation is overlain with a local unconformity by the meta-pelites and graywackes of the Haimaraka Formation (Barron 1975), but the Iwokrama Formation is not recognised. Beds are sometimes more steeply dipping. The equivalent of the Muruwa in Suriname is the Ston Formation (1c), which also shows open folding (Gibbs & Barron (1993).

In conclusion the Muruwa represent early sedimentation on greenstone basement, before being covered by the Haimaraka Formation, or laterally equivalent Iwokrama Formation. Sediments all show 2 phases of open folding. Sedimentation resumed, and he Roraima Group was deposited.

The problem then comes in the Haimaraka and Issineru river areas (1d), where the Haimaraka Formation is considered by Renner & Gibbs ((1987) to overly the Mazaruni Group greenstones, and the Mazaruni Group is unusually un-deformed. The question then comes; what about the assorted conglomerates that appear to be high in the sequence in both the Mazaruni and Barama Groups and are also steeply dipping?

POST MURUWA GRANITES

In Guyana larger granites were historically all considered to be ~2.1 Ga "Younger Granites". However in Suriname the Dalbana Formation (Iwokrama equivalent) has well described associated biotite and leuco-granites (Kroonenberg et. al. 2016). Dating of Iwokrama volcanics and granites near the Brazilian Border by Nadeau et. al. (2013), as well as the Makarapan Riebeckite Granite (Fraga et. al. 2017) has proved that these are of similar age (~1.98 Ga). The large areas of granite locally containing Muruwa xenoliths (2a & 2b) are now also considered to be the same age, essentially shifting the known zone northwards.

Alexandre (2010) reports a granite host rock age of ~2.1 Ga and a uranium mineralisation age of 1.995 + 15 Ma at Aricheng (2c), on the north side of the Roraima Group area. The mineralisation age is similar to the age of the Iwokrama Formation, suggesting fluids could be related to this magmatic event. Barron (1968) reports small felsic intrusions into the Roraima in the Amatuk area (2d), also on the north side. Some tuffaceous bands are known within the Roraima Group. It appears that felsic rock emplacement continued after the Roraima Group was deposited, and such rocks occur further north than usually accepted.

An important question is how many other granites have been wrongly grouped. This is particularly significant in that molybdenite and tungsten occur in the same area as the granite hosted gold mineralisation at Eagle Mountain (2e), as well as minor Sn drainage geochemistry. Such chemistry is more likely to be associated with the Iwokrama Granites.

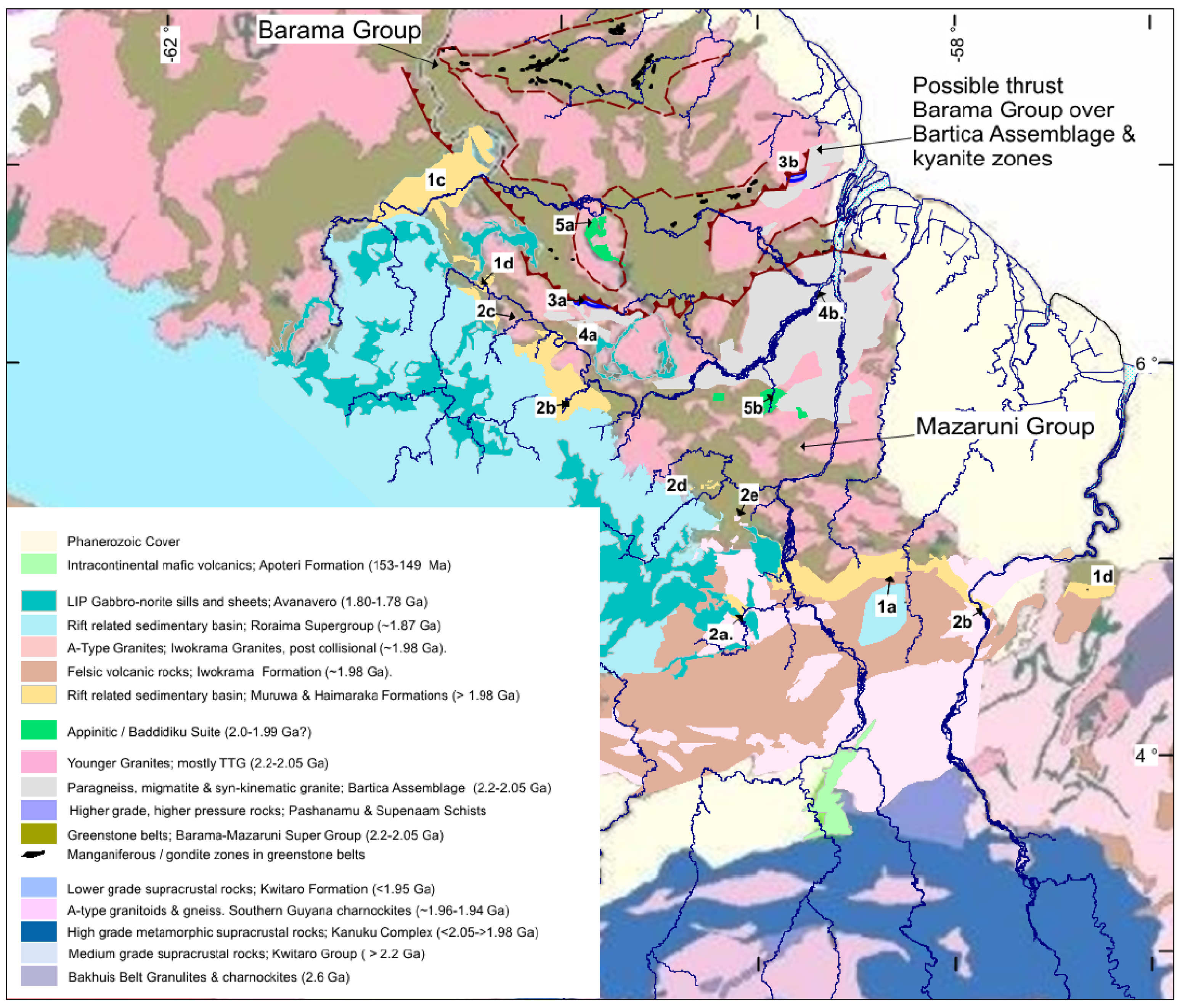
UNCORRELATED HIGHER GRADE ROCKS

Large areas of greenstone belt are lower greenschist facies. However on the south side of the Puruni River (3a), outcrops of muscovite-biotite-cordierite and chloritoid schist occur (Heesterman *et. al.*, 2005). A kyanite-sillimanite-muscovite schist outcrop occurs close to boulders of an unusual coarse iron rich cummingtonite / grunerite rock (Figure 2a). Massive grunerite is more commonly found in amphibolitic banded iron formation rocks. Greenschist facies meta-siltstone and andesite occur within 1.5km on the north side of the Puruni River. Clearly this represents a fault contact. Bartica assemblage rocks occur to the south, suggesting these higher grade rocks are associated. A second location (3b) with folded kyanite-staurolite rocks believed to have formed after meta-pelites also occur in the Supenaam area (Barron 1965), again in proximity to rocks mapped as Bartica Assemblage. Further work is needed!

THE BARTICA ASSEMBLAGE

Paragneiss, migmatite, amphibolite & quartzite with syn-kinematic muscovite (biotite) granite were considered to have been formed by granitisation of greenstones (Cannon, 1965). Cannon describes two phases of folding, and suggests that locally rocks are granulite facies. Some authors map larger coherent areas of amphibolite and quartzite as higher grade greenstones, and only gneissose and migmatitic rocks as Bartica Assemblage. Hildebrand *et. al.* (2014) shows that the greenstones in the El Callao district of Venezuela are thrust over quartzites (Muruwa Formation?) that cover the Supamo Complex (Bartica Assemblage equivalent), and then folded. This means that the Bartica Assemblage relationship to the greenstone belts in Guyana also needs re-examination. Possible thrust contacts are shown in Figure 1.

Some of the gneissose looking granites, as well as undeformed associated granites contain euhedral allanite (some zoned) overgrown by euhedral magmatic epidote (Heesterman *et. al.* 2004 & 2005), which can not have formed as a result of metamorphism. An example is shown in Figure 2b. Allanite is a high pressure form of epidote with a high radioactive / Light Rare Earth element content, which is unstable at lower pressures. Similar mineralogy and textures have been used to infer a depth of formation of ~30km (Chang & Andronicos 2009). This suggests the possibility that at least some of these rocks are high pressure syn-tectonic granites with streaked out amphibolitic xenoliths. A date on the Kartabu / Itabaru Granite which is described in detail by Cannon gives the same age as the Younger Granites (Nadeau, 2014). The association of Bartica Assemblage rocks with ambiguous areas of kyanite rich rocks (see above) suggests this issue is worth another look.



Locality Key

1a Muruwa Formation eastern Guyana.
1b Haimaraka Formation Guyana
1c Los Caribes Formarion Venezuela
1d Ston Formation Suriname.

2a & 2b, Iwokrama Granite with Muruwa xenoliths.
2c Aricheng; U mineralisation age ~1.99 Ga.
2d Felsic intrusions into the Roraima Group.
2e.Eagle Mountain area.

3a & 3b; Higher grade metamorphic grade rocks including kyanite schists in the Pashanamu and Supenaam areas

4a & 4b; Bartica Assemblage and syn-tectonic granites.

5a. Gabbro with deuteric alteration.
5b. Kaburi Anorthosite and other layered intrusions.

Note: Mn areas have been exaggerated.

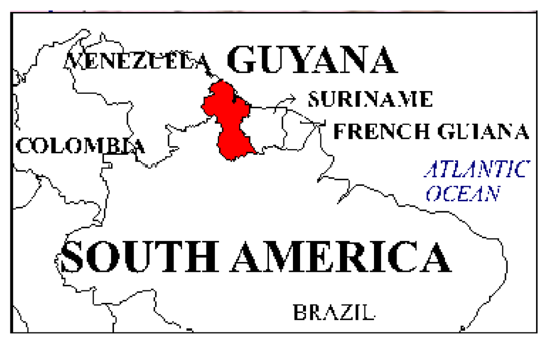


Figure 1. Geological map of northern Guyana modified after Fraga et. al. 2017

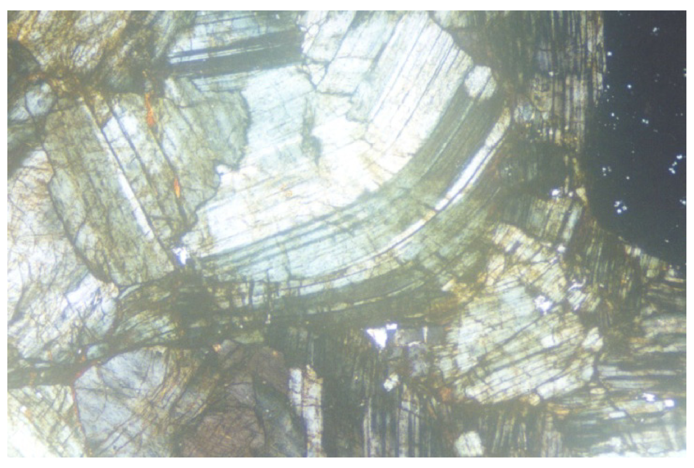


Figure 2a. Bent and fractured Fe-rich cummingtonite. Width of field 1.32mm. xpl. 176589E / 697217N, UTM PSAD56

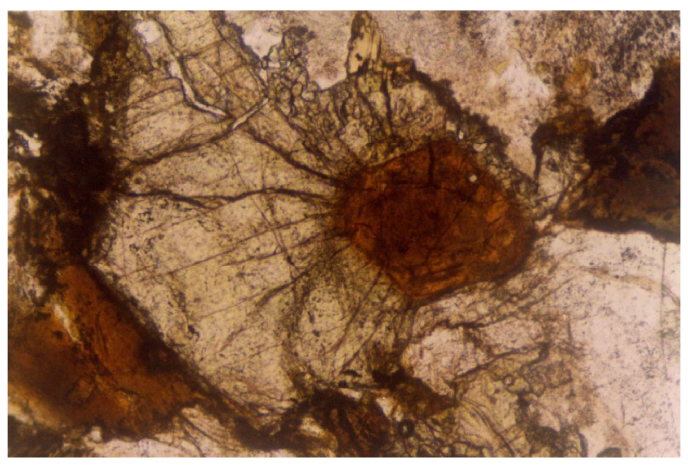


Figure 2b. Syn-tectonic adamellite. Zoned euhedral allanite in epidote. Width of field 1.3mm, ppl. 195203E / 715140N

APPINITIC SUITE / BADDIDIKU SUITE (OLDER BASICS)

Not all large coarse grained gabbroic intrusions are part of the Avanavero Suite. Two other types of larger un-metamorphosed gabbroic intrusions can be recognised. These are appinitic gabbro / dolerite, frequently with deuteric alteration (5a,), and layered mafic intrusions, also often with hornblende as the dominant mafic mineral such as the Kaburi Anorthosite (5b).

Some of these areas have been investigated for their platinoid potential. Such rocks are never found intruded into the Muruwa, Iwokrama or Roraima Group, and so are probably older. One dubious age date (1.9Ga) is known from a layered intrusion at Achiwuib in southern Guyana (Berrange 1977). I suspect these rocks are similar to the Lucie Gabbro in Suriname (1,985 Ma) described by Kroonenberg et. al. (2016). Quite a bit of multi-element rock chemistry and petrology is available from GGMC projects, and along with age dating may help understand these rocks.

REFERENCES

Alexandre, P., 2010, Mineralogy and geochemistry of the sodium metasomatism-related uranium occurrence of Aricheng South, Guyana: Miner Deposita (2010) 45, 351–367.

Barron, C.N., 1965, The geology and kyanite deposits of the Upper Supenaam River: Geological Survey of British Guiana, Records Vol 2. 11-17.

Barron, C.N., 1975, Notes on the Geology of Guyana along the frontier with Venezuela: Anais Décima Conferência Geológica Interguianas, Belém, 1975, p 219-240.

Barron, C.N., 1968, Notes on the stratigraphy of the Lower Roraima Formation in the Potaro-Ewang area of British Guiana, and on the discovery of acid intrusives within it: Geological Survey of British Guiana, Records Vol 4. 58-60.

Berrangé, J.P., 1977, The Geology of Southern Guyana, South America: Institute of Geological Sciences, National Research Council, London, Overseas Memoir 4.

Cannon, R.T., 1965, Anatexis in the Bartica Assemblage, British Guiana: Comptes Rendus de la Societe geologique de Finlande No XXXVII (1965), 177-192.

Chang, J.M, Andronicos, C.L., 2009, Constraints on the depth of generation and emplacement of a magmatic epidote-bearing quartz diorite pluton in the Coast Plutonic Complex, British Columbia: Terra Nova, Vol 21, No. 6, 480–488.

Fraga, L.M., Cordani, U., Reis, N., Nadeau, S. and Maurer, V.C., 2017a, U-Pb Shrimp And La-Icpms New Data For Different A-Type Granites Of The Orocaima Igneous Belt, Central Guyana Shield, Northern Amazonian Craton: Anais do XV Simpósio de Geologia da Amazônia, Belém, 2017.

Fraga, L.M., Dreher, A., Kroonenberg, S., de Roever, E.W.F., Faraco, T. Wong, T. Reis, N. and Lago, A., 2017b, Geological and Geodiversity Mapping Project on the Brazil – Suriname border: Explanatory note for the geological and mineral resources and geodiversity maps: Brazilian Geological Survey / Companhia de Pesquisa de Recursos Minerais.

Kroonenberg, S.B., de Roever, E.W.F., Fraga, L.M., Reis, N.J., Faraco, T., Lafon, J.N. Cordani, U. & Wong, T.E, 2016 Paleoproterozoic evolution of the Guiana Shield in Suriname: A Revised Model: Geologie en Mijnbouw, 95 (4) 491–522.

Gibbs, A.K., and Barron, C.N., 1993, The Geology of the Guiana Shield: Oxford Monographs on Geology and Geophysics No.22.

Heesterman, L.J.L, Arjune, B.K., Cole, E, and Kemp, A.W., 2004, Kartuni Project: Geology Geochemistry and Structure. Guyana Geology and Mines Commission, Geoservices Division, Report No. GS 1/2004.

Heesterman, L.J.L, Kemp, A.W., Arjune, B.K & Cole, E.W., 2005, Pashanamu Project. Geology, Structure and Geochemistry: Guyana Geology and Mines Commission, Geoservices Division, Report No. GS 1/2005.

Heesterman, L.J.L, Kemp, A.W., Arjune, B.K & Cole, E.W., 2015, Kurupukari Project, A Summary of Geochemistry and Geology: Guyana Geology and Mines Commission, Geoservices Division, Report No. GS 2/2015.

Hildebrand, R.S., Buchwaldt, R. & Bowring, S.A., 2014, On the allochthonous nature of auriferous greenstones, Guayana shield, Venezuela: Gondwana Research 26 1129–1140.

Nadeau, S., Chen, W., Reece, J., Lachman, D., Ault, R., Faracao, T., Fraga, L., Reis, N. and Betiollo, L., 2013, Guyana: The Lost Hadean Crust Of South America?: Brazilian Journal of Geology, 43(4): 601-606.

Nadeau, S., 2014, Guyana Geological Time Scale: Poster for the Guyana Geology and Mines Commission Mining Week 2014.

Renner, R. & Gibbs, A.K., 1987, Geochemistry and Petrology of Metavolcanic Rocks of the Early Proterozoic Mazaruni Greenstone Belt, Northern Guyana: Pharaoh, T. C., Beckinsale, R. D. & Rickard, D. (eds), Geochemistry and Mineralization of Proterozoic Volcanic Suites, Geological Society, London, Special Publications 1987, v.33; p289-309.