Regolith geology of the Saramacca project

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Introduction

Exploration in a tropical environment as the rainforest in Suriname has many challenges. Deep weathering and a regolith ranging from two to two hundred meters is the norm. The Marowijne greenstone belt in Suriname hosts the gold deposits explored and exploited in the recent decades in Suriname. It is therefore of great importance to understand the landscape and the regolith developed onto this geological setting. The Saramacca gold project of IAMGOLD provides the unique opportunity to "peek" into the regolith over mineralized greenstone rocks in Suriname. The objectives of this study were:

- Mapping of the regolith/surface expression of the mineralization over the Saramacca project area
- To conduct sampling of the regolith units, do trace element geochemistry and SWIR for identifying exploration tools for future exploration within the greenstone belt of Suriname

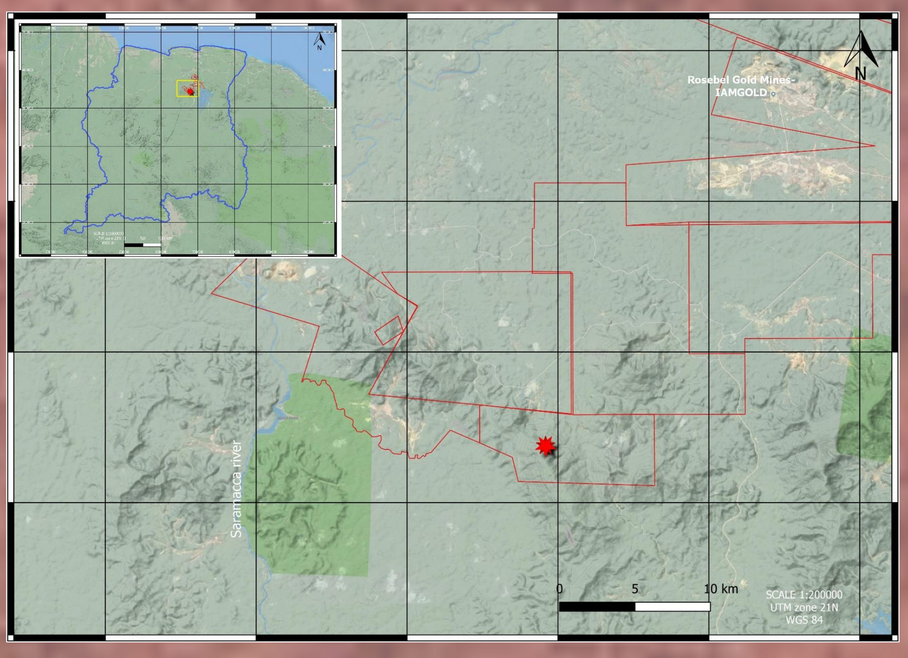


Figure 1. Location map of Saramacca project (red star) within IAMGOLD concessions and within Suriname.

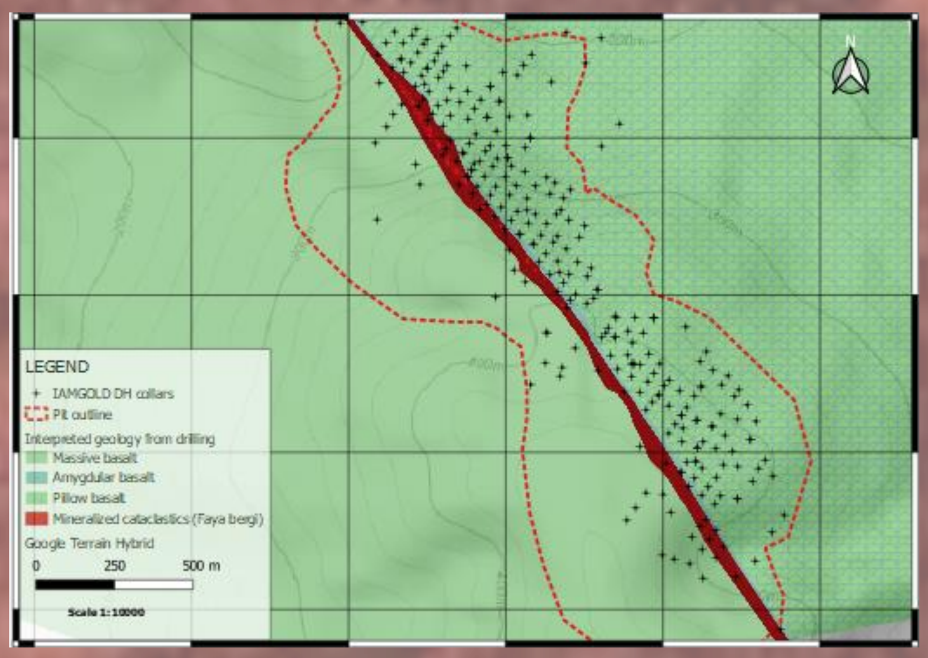


Figure 2. Interpreted geology, boreholes and pit outline (modified after SRK, 2017)

Geology and exploration of the Saramacca project

Saramacca gold project lies within the Saramacca concession of IAMGOLD in the district of Brokopondo, Suriname. Situated 25 km south west (straight line) of the Rosebel Gold Mines N.V. and 104 km south (straight line) of Paramaribo, the capital of Suriname (Figure 1). Geologically the project lies in the Paramacca formation which is dominated by pillow lavas, andesites and tuffs (Kroonenberg, et al., 2016).

Exploration work done in Saramacca were (SRK consulting, 2017):

- Pre 2016: airborne magnetics, radio metrics, stream sediment, augering, IP and 90 boreholes for 9293.5 meters (Goldenstar and Newmont)
- Since 2016: IAMGOLD drilled 217 boreholes (DD&RC) for 38,731 meters and were able to define indicated resources of 1.022 MOz grading 2.2 g/T Au and inferred resources of 0.518 Moz grading 1.18 g/T Au

The property geology (Figure 2) consists of subvertical units (striking NW) of massive basalt with a thin unit of amygdule basalt (1m to 2m) and a pillow basalt unit to the NE at least 75 m thick. It is between the amygdule and pillow basalt that the main mineralized, Faya bergi, fault (dip-slip) is located. The Faya bergi fault is a cataclastic zone with brittle to ductile features and strong silica alteration, sulfide mineralization and Fe/Mg carbonate alteration.

Methods and techniques

450 channel and grab samples were taken and sent for FA, ICP-AES and ICP-MS at Filab in Paramaribo. 150 selected pulps were analyzed for clay mineralogy and oxide content by SWIR spectroscopy (Figure 3).

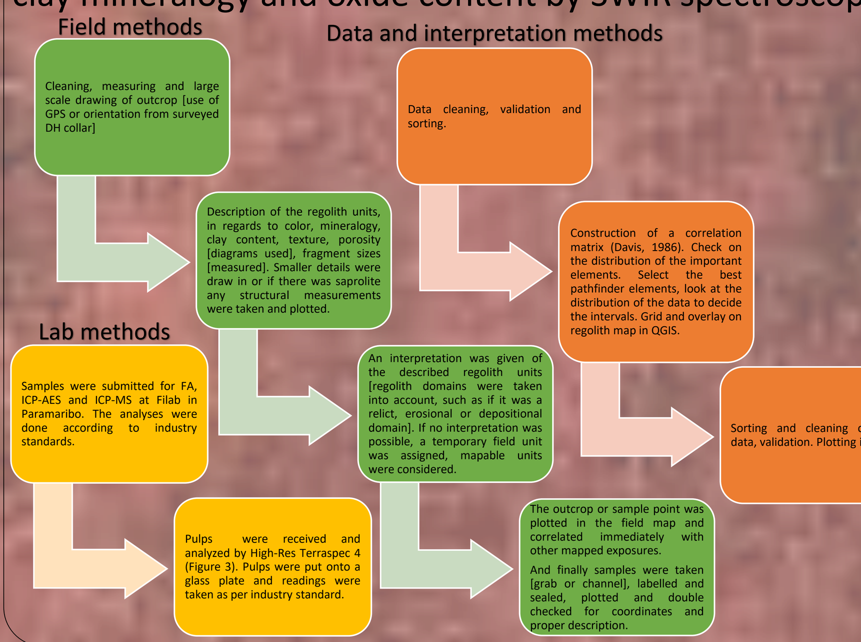


Table 1. Summary best correlating trace elements with Au

Pearson's r	ICP-AES	Pearson's r	ICP-MS
As ppm	0.571	As ppm	0.678
Be ppm	~~0.373~~	Sb ppm	0.634
Bi ppm	~~0.353~~	Cd ppm	0.412
Zn ppm	0.245	W ppm	0.302
Ta ppm	0.222	Be ppm	0.269

Table 2. Summary of the dominant mineralogy obtained from SWIR analysis

Regolith unit	Dominant SWIR mineral	Dominant SWIR oxide
Ferricrete		Hematite
Colluvium	Gibbsite	Hematite
Duricrust	Gibbsite	Hematite
Mottled clay	Mix (Gbs, Kln, Pg)	Goehtite
Saprolite	Kaolinite/Paragonite	Hematite

Conclusions

- Occurrences of colluvium are the result of material moving downslope, evidence is clearly seen in Figure 4-F1. This unit is hosts fragments of duricrust and ferricrete, massive clay, soft and indurated saprolite fragments and mottled clays.
- The ferricrete in Saramacca shows macroscopic evidence of transported material and may have formed during dryer climates. It would seem there is inversion of topography. We would argue that the lack of Gibbsite dominating in this unit indicates a dryer climate. As Gibbsite is formed in the duricrust below. In wet tropical climate Kaolinite weathers to Gibbsite (Beauvais and Colin, 1992), Gibbsite may be key in differentiating between ferricrete and duricrust (Table 2 and Figure 8).
- Paragonite which has been related to mineralization(Ojeda, 2018) is observed from mottled clay to saprolite in close proximity to the Faya bergi zone (Figure 8). Purple basalt saprolite is mostly (>70%) Kaolinite and Hematite.
- Au correlates strongly with As and Sb (Figure 5, Figure 6 and Figure 7), these are the pathfinders to look for in the Saramacca trend and the greenstone belt. ICP-AES does not have the detection limits needed to measure Sb, Be and Bi (50% n <DL)in the regolith (Table 2).
- Ti vs Zr ratios for duricrust all the way to saprolite indicate a basaltic/minor andesitic protolith. As seen by plots in Figure 9.
- Sr vs V which work in Mali (Benn et al., 2012) can also be used for lithogeochemical discrimination when mapping the regolith in Suriname (Figure 10). Only the ICP-MS data was used here as ICP-AES does not have the detection limits needed for Sr.

Geochemistry and SWIR results

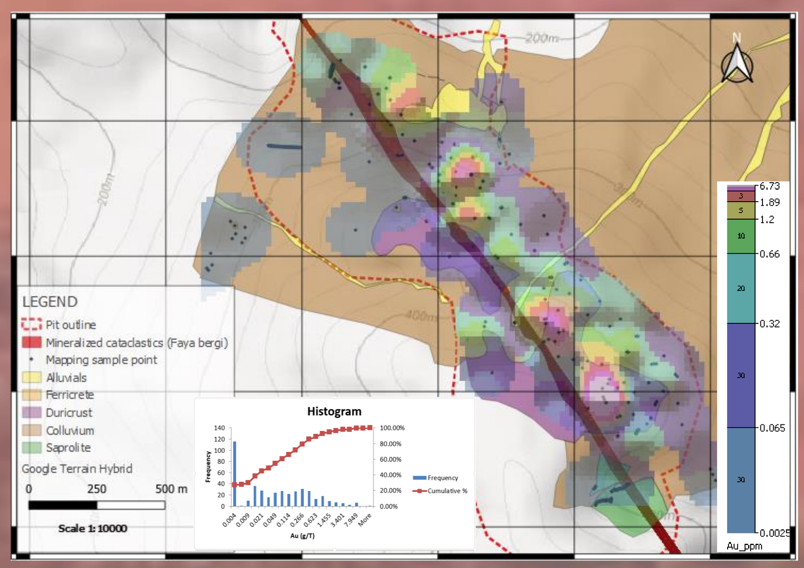


Figure 5. Au grid and histogram plotted on the regolith map of Saramacca

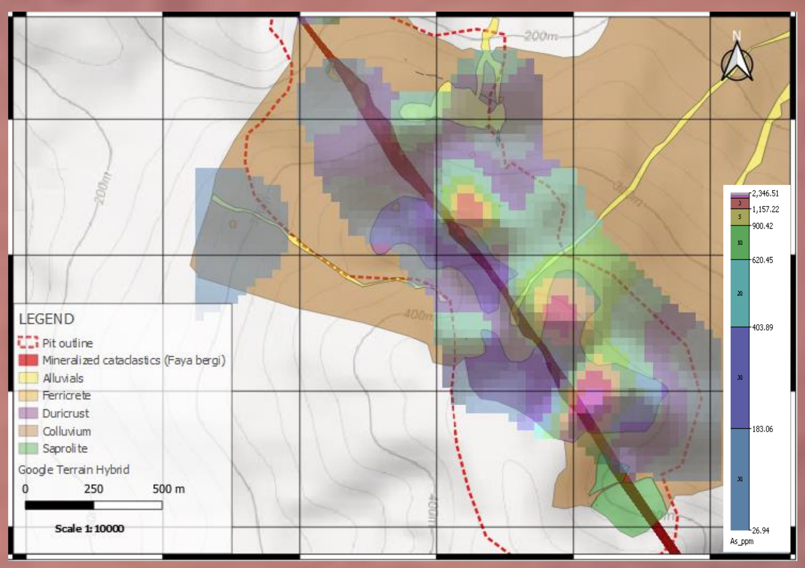


Figure 6. As grid plotted on the regolith map of Saramacca

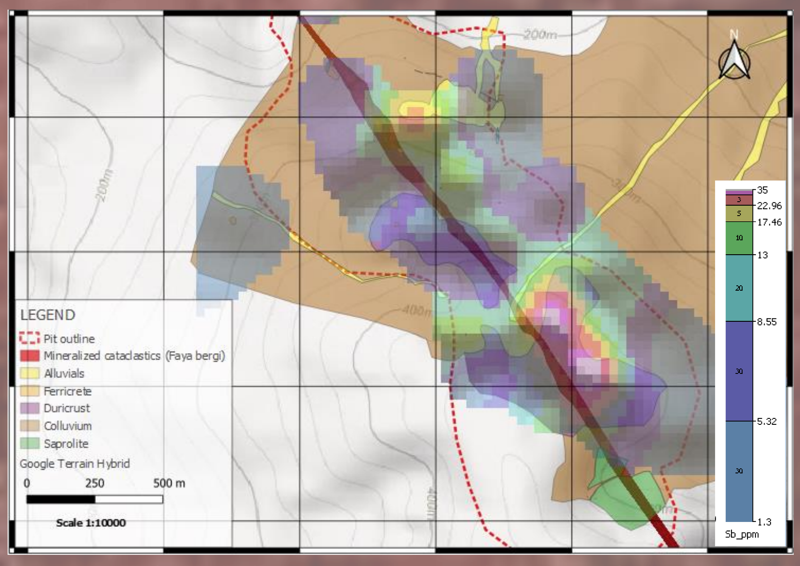


Figure 7. Sb grid plotted on the regolith map of Saramacca

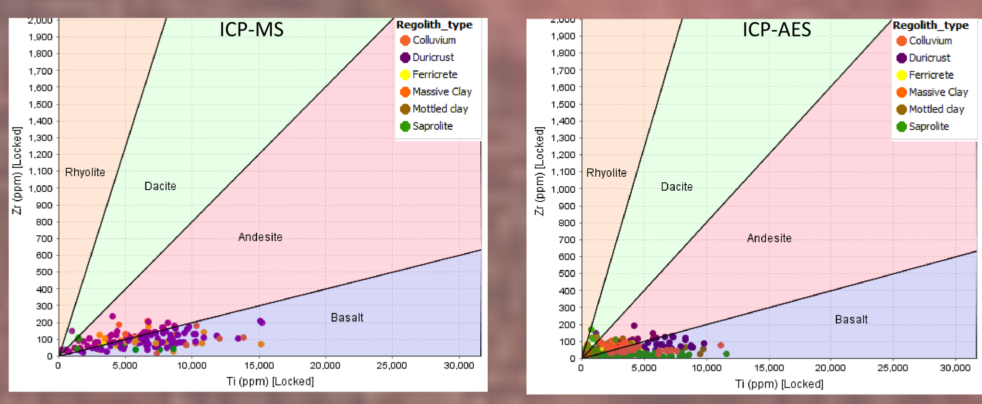


Figure 9. Zr vs Ti (Hallberg, 1984)

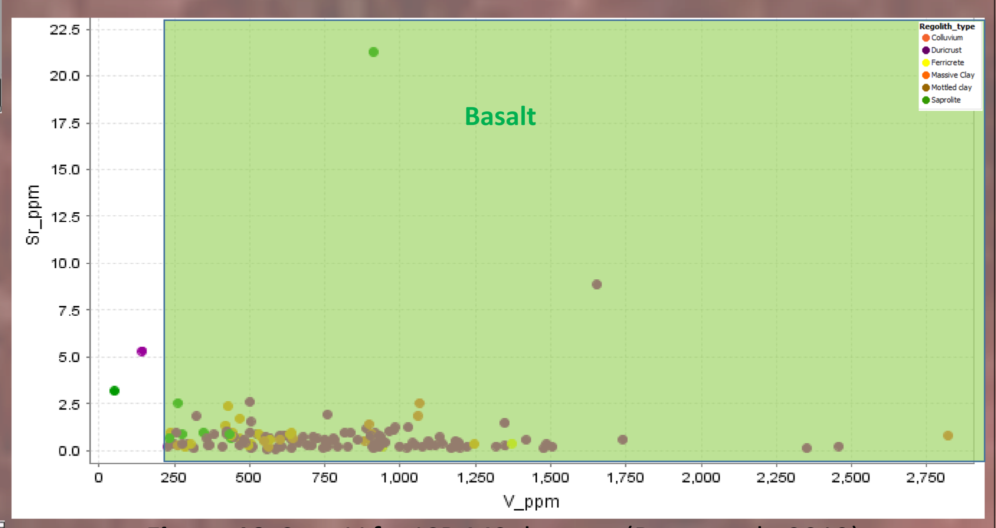
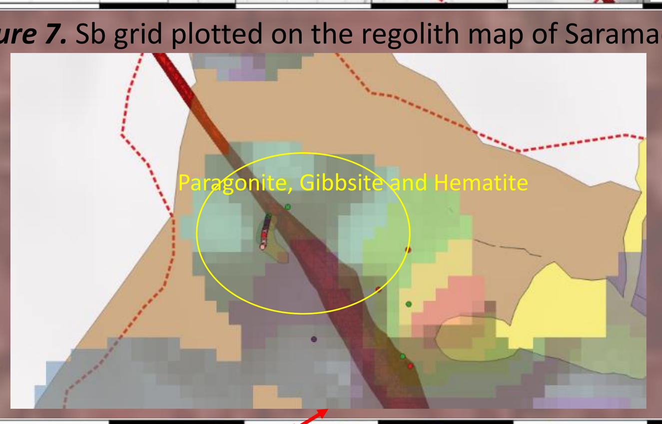


Figure 10. Sr vs V for ICP-MS data set (Benn et.al., 2012)



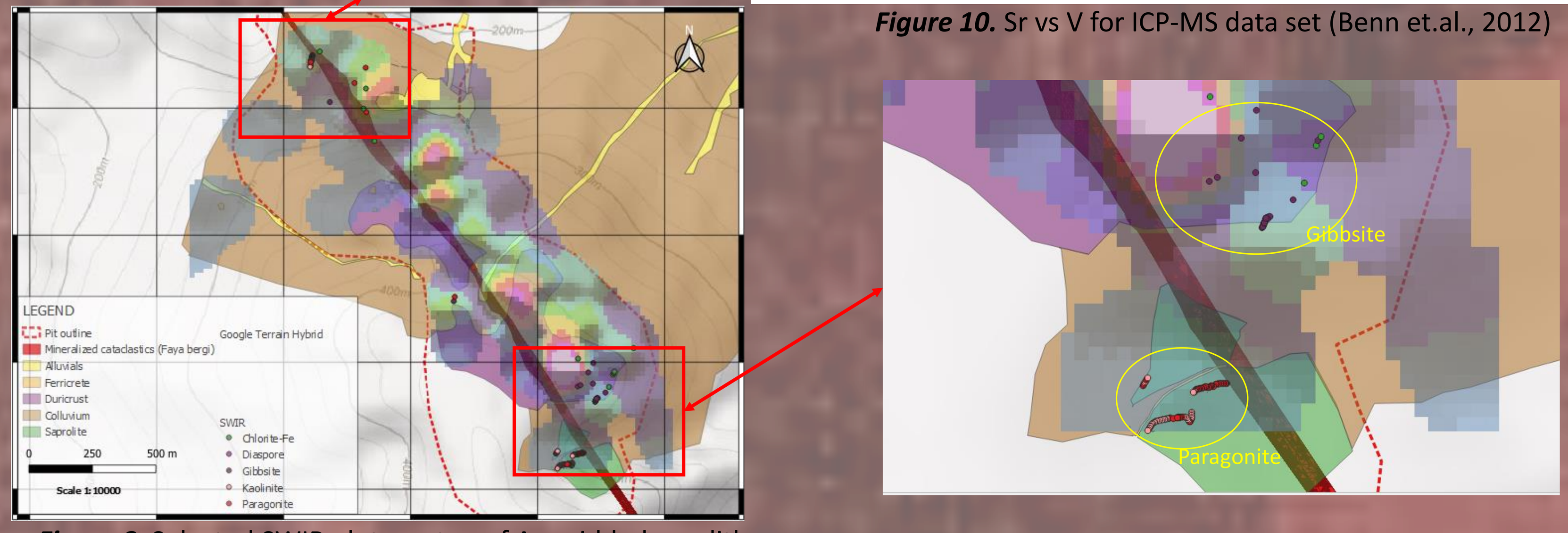


Figure 8. Selected SWIR plots on top of Au gridded regolith map

Figure 3. Terraspec 4 High-Res mineral analyzer

Regolith mapping results

The regolith map is presented in Figure 4. 7 regolith units were encountered in the area. The recent alluvials in Figure 4 were mapped but not sampled/considered.

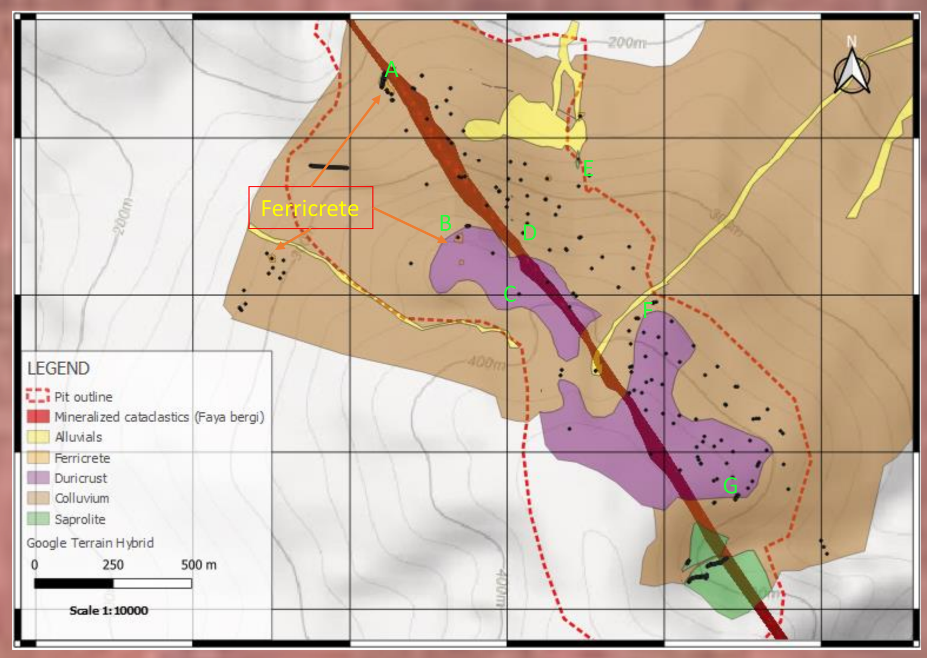
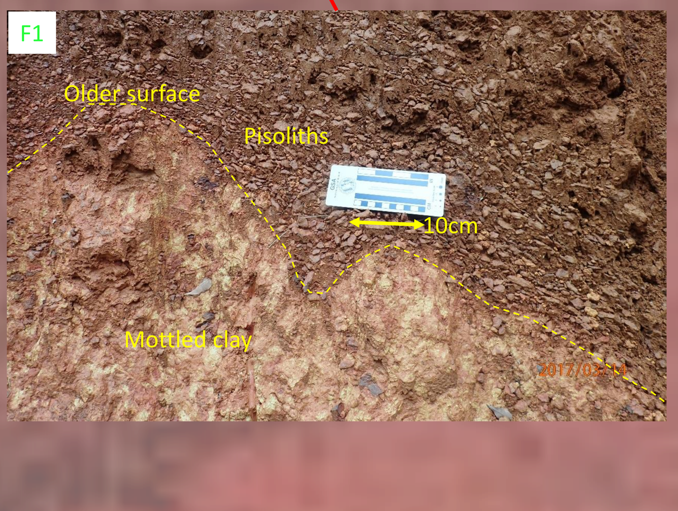
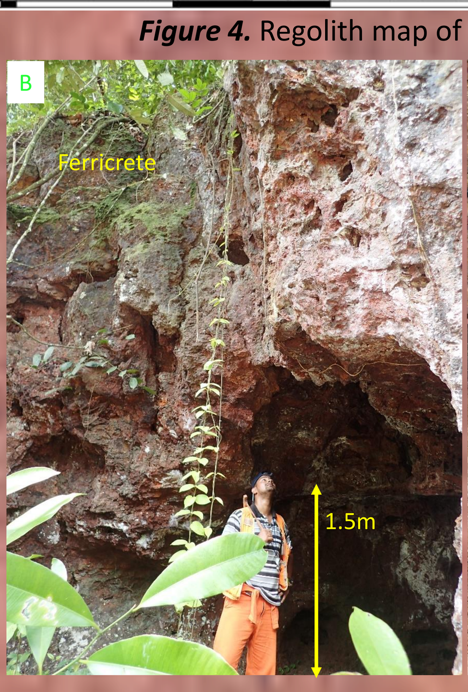
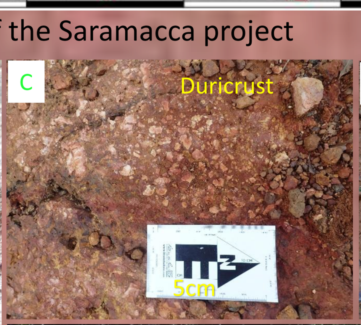
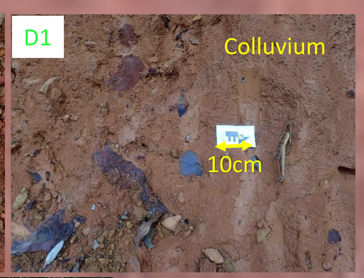


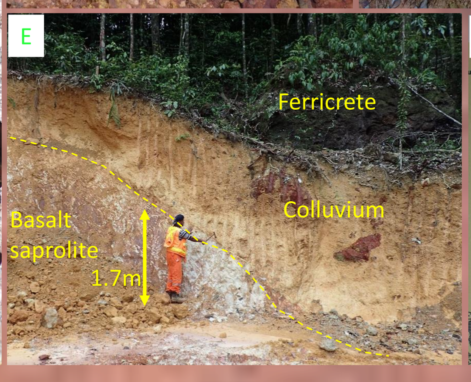
Figure 4. Regolith map of the Saramacca project

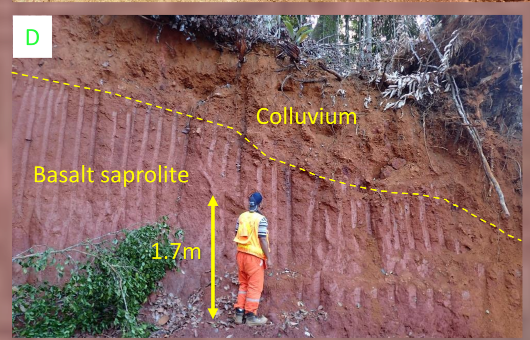












Unit	Description
Alluvials	Recent clays, sand and gravel in gullies, active creeks.
Colluvium	Consists of poorly sorted Fe –oxide rich clay material with duricrust fragments, indurated saprolite fragments, ferricrete fragments and pisoliths. Sizes of the fragments vary from 1cm to 3m in size and are angular to sub-rounded in nature.
Ferricrete	Highly weathered unit, with conglomerate like texture of many Hematite rich (>90%) fragments [1m to 1m]. Erratic.
Duricrust	Porous to massive unit, with >70% Hematite, massive to botryoidal in texture, often has Limonite and Gibbsite.
Massive clay	Red to yellow massive clay with some minor Fe-Ox fragments or occasional pisoliths. Original texture completely gone.
Mottled clay	Stained yellow to white clay with remnants of saprolite in Fe occurrences. Kaolinite and Limonite rich.
Basalt saprolite	Fine grained purple to red colored clay rich saprolite, very little to no very fine Quartz. 60% -70% Fe/Mn-oxide rich clays and fractures. Interpreted as basalt saprolite

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