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CHARACTERIZATION OF REGOLITH TYPES AND ITS IMPACT ON GOLD ANOMALY IN HIGHLY WEATHERED TERRAINS USING MULTIPLE DATASET

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ABSTRACT

Deposition of post mineralization materials and incessant evolution of regolith materials have resulted in many complex geological environments. These often produce subtle geochemical responses and make geochemical anomaly delineation very difficult. To mitigate the challenge of following 'false' anomaly emanating from the regolithic effect, the study mapped the regolith types and used it to explain the geochemical behavior of gold. Multiple dataset such as Aster, radiometric, GDEM were combined with ground truthing and evaluated to characterize the regolith into FRED. This was done alongside the collection of 3252 soil samples. The samples were analyzed for gold using BLEG with AAS finishing. The geochemical data were however interpreted accounting for the regolith. Multiple thresholds were chosen for each regolith using q-q plots. The results showed 24.3% to be depositional regolith and 75.7% was a residual environment consisting of 46% Ferruginous, 40% relict and 4% erosional. Both ferruginous and depositional regimes had capabilities of impacting negatively on gold anomaly. The result further showed that each regolith regime had capabilities of hosting mineralization and recommends that equal weight of importance should be accorded to all regimes. It further proposed that the regolith map should be fully integrated into geochemical data to avoid following 'false' anomalies.

Contribution/Originality: This study documents that regolith environments have huge influence on surface gold expressions and anomaly definition. Regolith-based geochemical interpretation is effective to account for each regolithic effect. Each regolith type has equal tendency of hosting realistic anomaly when equal weight of importance is accorded to them.

1. INTRODUCTION

Incessant climatic changes over the years have extensively affected most terrains in Ghana, predominantly the savannah areas and some tropical rainforests resulting in the present complex landforms (Arhin and Nude, 2009). The associated weathering processes and regolith landform evolutions post exploration challenges. Furthermore, these processes may co-exist with other geologic processes such as the deposition of post-mineralization materials to offset or obscure mineralization and impose exploration challenges (Arndt *et al.,* 2017).

For example, the unrestrained spatial dispersals of the weathered materials and soils at the study area have resulted in the accumulations of both transported and residual soils occurring in close proximities and speedily (Patrick *et al.*, 2012; Arhin, 2013). These uncontrolled accumulations cause changes in the soil geochemical pattern and subsequently enhance or dilute Au signatures in the geochemical host leading to many false positive anomalies (Anand and Paine, 2002; McQueen and Scott, 2008). Furthermore, the development and variations of the landforms and processes (such as weathering and erosions) that occur on the history of a terrain result in significant regolith landform patterns (Cassidy *et al.*, 1997; Patrick *et al.*, 2012). These landform patterns chiefly have control on the geochemical behaviour of metal transport and readily affect anomaly determination. As stated in Cheng (2012) it is usually impossible to define realistic anomalies in areas undercover unless the regolith environment and other processes affecting the geochemical environment are incorporated into the data interpretations. This means that adequate knowledge of the regolith environment is needed to define true anomaly. However, it appears that much about the regolith environment in the study area is not known and exploration was conducted without considering the influence of the regolith (Torkornoo, 2017). According to reports by Torkornoo (2017) soil geochemical results at the Dormaa Concession are generally patchy, low with spot-highs gold anomalies that are unrelated to bedrock mineralization. Again, anomalies detected at the Dormaa Concession also appear too small in size to merit further systematic geochemical survey. These challenges demonstrate the extent to which the geochemical signatures of gold in the area has been affected by the unrestrained spatial distribution of regolith materials. Arhin *et al.* (2015); Arhin and Nude (2009) and Anand and Paine (2002) have identified that the regolith materials overlying the coherent bedrock is able to influence the surface geochemistry thereby making gold in surface soil samples challenging to define true anomalies. Reports from (Craig, 2001; Pain *et al.*, 2001; McQueen, 2004; Anand and De Broekert, 2005; Arhin *et al.*, 2015) strongly recommend regolith mapping as an essential component during geochemical data interpretation in defining anomaly. According to Anand and De Broekert (2005) and Eggleton (2001) regolith mapping is an approach to describing the earth's surface in terms of both landforms and surface materials, whether of transported material, weathered rocks, duricrust, or fresh bedrock. McQueen and Scott (2008); Anand and De Broekert (2005) and Eggleton (2001) further explain that any regolith map developed for mineral exploration purposes should group regolith materials into regimes based on regolith evolution and weathering histories to depict the relationships between parent and surface materials. The knowledge of the regolith environment can now be used to explain the behaviour of surface gold data and subsequently be used to define realistic anomalies. This paper aims to characterize the regolith types of the Dormaa Concession in the Sunyani sedimentary basin. The influence of the regolith types on anomaly definitions will now be explained.

The methodology involved the integration of multiple landscape datasets such as Aster global digital elevation terrain model (GDEM), ASTER, radiometric and ground verifications to group the regolith materials into four main regimes namely, Ferruginous (F), Relict (R), Erosional (E) and Depositional (D). This was done alongside the collection of 3252 soil samples along a grid of 800x400. The samples were taken to the SGS laboratory to be analzed for gold using bulk leached extractable gold with AAS finish. This study has been carried out on the Akroma gold project located at Dormaa Ahenkro in Brong region-Ghana in 2018.

1.1. Study Area, Geology and Geomorphology

The study area is located at Dormaa Ahenkro approximately 400 km northwest of Sunyani, the capital of Brong Region, Ghana Figure 1. The study area is within the Suyani sedimentary basin bounded to the southeast by the Paleoproterozoic Sefwi gold Belt and to the northwest by the Bui Belt Torkornoo (2017). The concession is approximately 86.44 sqkm². At its narrowest point, the Basin is 65 km wide, but broadens considerably to the south near Sunyani. The Sunyani Basin is predominantly underlain by thick sediments of north-east trending Birimian metasedimentary rocks intruded predominantly by biotite rich-granites (Kesse, 1985; Leube *et al.*, 1990; Dzigbodi-Adjimah, 1993). Belt type granitic plutons also occur centrally and to the southeast of the concession (Kesse, 1985;

Leube *et al.*, 1990; Dzigbodi-Adjimah, 1993). The sedimentary basin rocks common on the property are argillites, and wackes facies but also includes minor chert and few volcanoclasitic rocks (Griffis *et al.*, 2002). The geomorphological setup of the project area falls within the forest-dissected plateau with only few areas turned into secondary forest and shrubs (Dickson and Benneh, 1995). The terrain is fairly flat with broad hills and gentle slopes with elevations ranging from 270 to 360 metres above mean sea level. The climate of the area is of wet-semi equatorial type (Dickson and Benneh, 1995) with relatively abundant of rainfall ranging from about 1250 mm to about 2,100 mm, which is in tandem with the annual rainfall range in Ghana (MEST, 2012). The total evaporation is approximated to 1350 mm (Dickson and Benneh, 1995). According to Butt and Zeegers (1992); Freyssinet *et al.* (2005); Arhin *et al.* (2015) distinct climatic changes occurring over a long period of time facilitates lateralization processes that forms laterites.
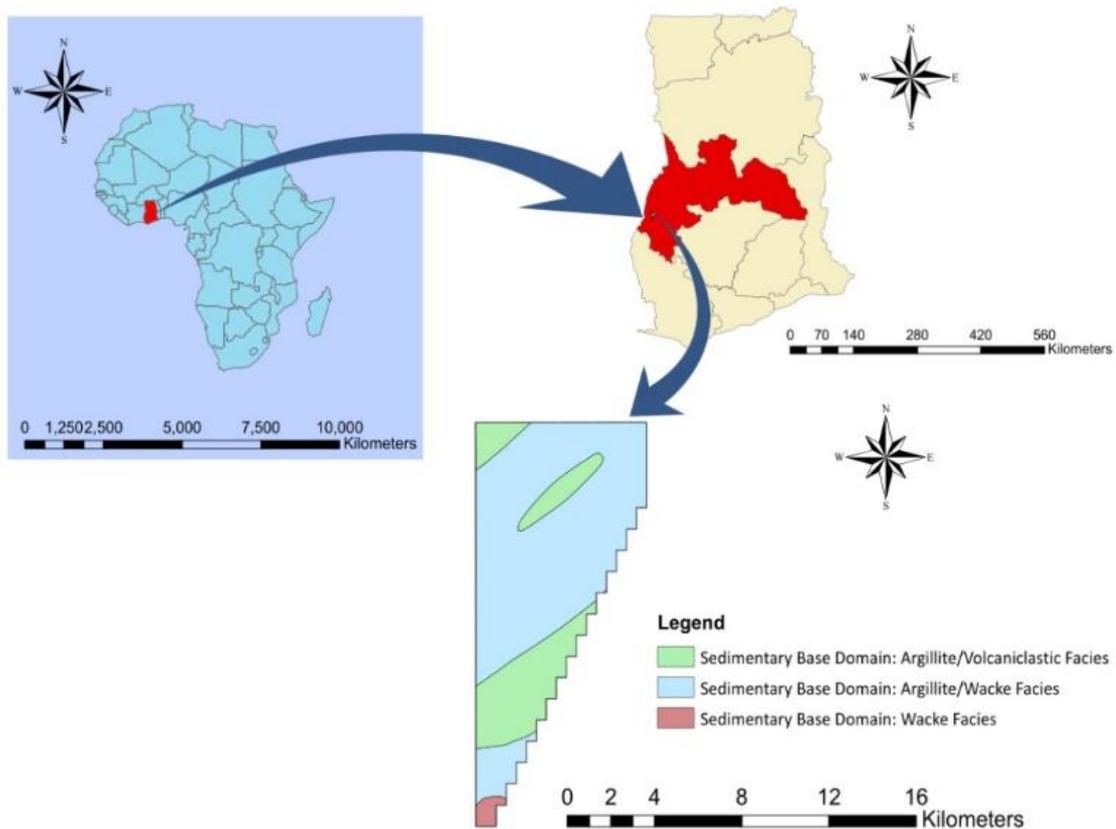
Figure-1. Geographic location of the study area with the local Geology located at Dormaa Ahenkro in Brong region, Ghana.

2. MATERIALS AND METHODS

2.1. Data and Pre-Processing

The remotely sensed dataset including GDEM, ASTER Level IT were all obtained from the USGS site. The radiometric data was also obtained from the Ghana Geological Survey Authority. These images were pre-processed prior to their usage. For example, the images were geometrically corrected and georeferenced to the WGS-84 datum and UTM zone 30N coordinate system. The 90m resolution GDEM image was first processed in ArcGIS 10.3 during which the fill algorithm was used to remove all small imperfections in the data. It was then imported into global mapper for regolith information to be extracted.

Aster L1T image was also pre-processed on ERDAS IMAGINE and later imported onto Arc GIS. The Aster image was free of clouds however, its sensor properties provided spectral coverage in fourteen bands with three subsystems (VNIR, SWIR, and TIR) (Agustin, 2017). Since all the bands had different spatial resolutions it was necessary to re-classify the VNIR and SWIR images into 30m resolution to aid the creation of RGB (Tapley, 2002; Agustin, 2017). This was done through the layer stacking process in Erdas. Again, two separate scenes were

captured for the study area so a seamless image was created using the MosaicPro tool in Erdas Imagine. Finally, the radiometric data was also pre-processed by levelling and micro-levelling for the removal of residual errors and noise using the Geosoft software (Tapley, 2002). The Grid and Image tool in Geosoft were used to create single count images for K, Th and U. Image enhancement techniques such as colour composite were applied to these three radioelement maps and were subsequently integrated to form a three band ternary plot (Wilford et al., 1997).

2.2. Regolith Landform Units Mapping (RLU)

This was considered as the first step of the classification process and used remotely sensed data such as Aster, GDEM and radiometric. The classification of the terrain using the remote sensing data relied on well-established spatial, genetic and environmental correlation techniques between landforms, mineralogy and regolith as suggested by McQueen and Craig (1995); Laffan and Lees (2004); Arhin (2013); Agustin (2017). Pain et al. (1991) defined Regolith landform units (RLU) as areas within which similar landform and regolith characteristics can be isolated at the scale of mapping. The GDEM was classified into three different elevation classes such as low lying relief, moderate and elevated areas based on appropriate thresholds. A minimum threshold of 320m was set for the high areas while areas below 300m were considered low relief. These three classes of elevation were digitized appropriately and separately to represent residual, semi-residual and depositional respectively (Arhin, 2013). These classification were based on the assumption that hillcrest or, hill tops and pediments tops represent residual environment while low lying areas represent depositional environments (Arhin, 2013). The GDEM could not be used to define the ferruginous units and could also not separate the residual into relict and erosional regimes so other datasets were considered. Band ratio techniques were also applied to the ASTER image. The band ratio of (b4/b3) was able to highlight Iron rich and ferric oxides areas (Agustin, 2017). These were however extracted as a single unit to represent the ferruginous regime. The extracted ferruginous units were then used to update the existing RLU map. The ASTER image could not show the chemistry of the various units and could also not distinguish most of the boundaries well. The gamma ray spectrometry was then used to improve the detections of the regolith mapping units. The ternary plot comprised colours generated from the relative intensities of the three components and represents subtle variations in the ratios of the three bands. Potassium, Thorium and Uranium were assigned to the red, green and blue respectively. The goal was to recognize and understand radiometric response from earth materials and use it to map regolith units as used previously by Arhin (2013) and Wilford et al. (1997). So in determining the different regolith domain types, the high, moderate and low concentrations of the three radioelements K, eTh and eU were extracted separately using different polygon symbols to represent distinct regolith units. The extracted ferruginous regolith unit and knowledge of the geochemistry obtained from the ternary plot were then used to update the existing RLU map to form the final RLU map. The RLU classification was scale dependent and could be fraught with some landform units' misrepresentations. The rest of the concession without information depicted in white were covered during the ground verifications. Again, the landscape classification could not be used in distinguishing the residual into erosional and relict regimes.

2.3. Field Work

Field exercise was embarked on at a scale of 1:50m. Cut grid lines, road cuts, footpaths and trails were used as traverse lines along which the already identified units on the RLU map were ground verified. In addition, exposed regolith landform units that were not captured on the RLU map were also mapped. Pits were dug at some locations to decipher the depth of covered materials and each landscape location was recorded by GPS. At every landscape location, observations were made on the mapping units and its immediate surroundings. Identification clues such as soil texture, type of cementing matrix, texture of other weathered materials, sphericity of quartz pebbles, rock fragments, indurations, outcrops, truncated exposures, grain composition and nature of topography were used to identify the regolith type (Cohen et al., 2010; Arhin, 2013). Along these traverse lines surface materials that bear

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relationship to the underlying substrate and contain large amounts of angular to sub angular lithic units were mapped and considered residual regolith. Areas where preserved existing lateritic profiles were found to be concealed predominantly by rounded to sub-rounded lithic and quartz fragments and sediments from diverse sources were ascertained by pits and mapped as depositional. Terrains within which varying degrees of truncation of the lateritic profile has occurred and patches of saprolite and clay zones exposed at surface were mapped as erosional. This includes outcrops and exposures. Finally, areas characterised by the occurrence of lateritic residuum at or close to surface. In situ soils and soils with insignificant lateral movements were included in this regime. This regolith domain represents an ancient weathered surface but the grouping was based on factual observation during the field ground truth mapping (Cohen *et al.*, 2010; Arhin *et al.*, 2015). These environments were mapped and added to the regolith and landform data. The Feoxide- rich landscapes, lateritic, duricrusts, lateritic gravels were all mapped to be part of the ferruginous regime.

Mapping codes were assigned to each regolith mapping units to aid easy identification on the map. These codes were depicted as alphanumeric codes and presented as map symbols. Details of mapping codes were captured in Table 1. The first two upper case letters indicate the code for the landform units. The second two letters were lower cases and indicate the regolith materials whilst a numerical subscript acts as a modifier to distinguish the presence or absent of surface crust (Arhin, 2013). The example below represents how the classification code was generated and explained:

HCdc1: duricrust on a hill crest cemented with iron oxide representing (Ferruginous):

- *HC: describes the main landform type (Hillcrest).*
- *dc: This describe the main regolith type (duricrust).*
- *1: this is a modifier number used to divide between more subtle differences between units. In this case it represent iron oxide.*

Table-1. Regolith Mapping unit codes.

Landform	Code	Regolith materials	Code	Surface crust	
Erosional rise	ER	Silty sediment	L		
Alluvial plain	AP	Sandy sediment	A	None	0
Smooth plain	EP	Gravel	G	Iron	1
Rough plain	DP	Silt + gravel	Lg		
Hill crest	HC	Silt + sand	La		
Hill slope	HS	Silt + boulders	Lb	**Regime**	**Code**
Base of hill	BH	Sand + Clay	Ac	Ferruginous	F
Laterite	Lc	Lateritic lag	Ll	Relict	R
Hill top	HT	Duricrust	Dc	Erosional	E
		Saprolite	Sr	Depositiona	D
		indurated laterite	Il		
		Pisolithic soil	Ps		

Source: Arhin (2013).

The observable features mapped on the field were compiled and grouped based on regolith mapping similarities and classified to represent a specific regolith regime (Arhin, 2013; Arhin *et al.*, 2015). The different regolith types were digitized and coded with a unique colour on a GIS environment. This led to the production of a factual map of the area. The factual map was superimposed on the existing RLU map. The superposition, however, authenticated the landscape classification map and all possible fraught associated with landform misinterpretation were resolved. The final regolith grouped the regolith mapping units into Ferruginous, Relict, Erosional and Depositional.

2.4. Gold Geochemical Data

In order to expressly identify prospective gold anomalies, a total of 3252 soil samples were collected. The 3252 soil samples were obtained at a grid of 400x 50m. The samples collected were sieved to <125 µm size fraction

before submittal to SGS Laboratory in Tarkwa, Ghana for gold analysis using Bulk leached extractable gold (BLEG) method with AAS finish. Prior to geochemical anomaly definition usually computed from the gold assay values; in this study the gold results were sorted with respect to the regolith environment. Threshold values were calculated separately for each regolith regime using mean plus two standard deviation and Q-Q plots. By this method the influence of the various regolith materials on gold migration in the secondary environment is discussed.

3. RESULTS

The spatial distribution of the identified regolith materials extracted from the remotely sensed images during the landform mapping have been outlined below. The residual and depositional regolith regimes extracted from the GDEM are shown in Figure 2 and Figure 3 respectively. The extracted classes from the GDEM were unable to distinguish the residual materials with little or no drift from the data. Similarly, the proximal and distal sediments were indistinguishable from the image interpretations. This was noted by Tapley (2002) and Arhin *et al.* (2015) when they indicated that no single remote sensing image processing and interpretation can wholly define all the regolith regimes. The first RLU map made up of both the extracted residual and depositional units were presented in Figure 4.
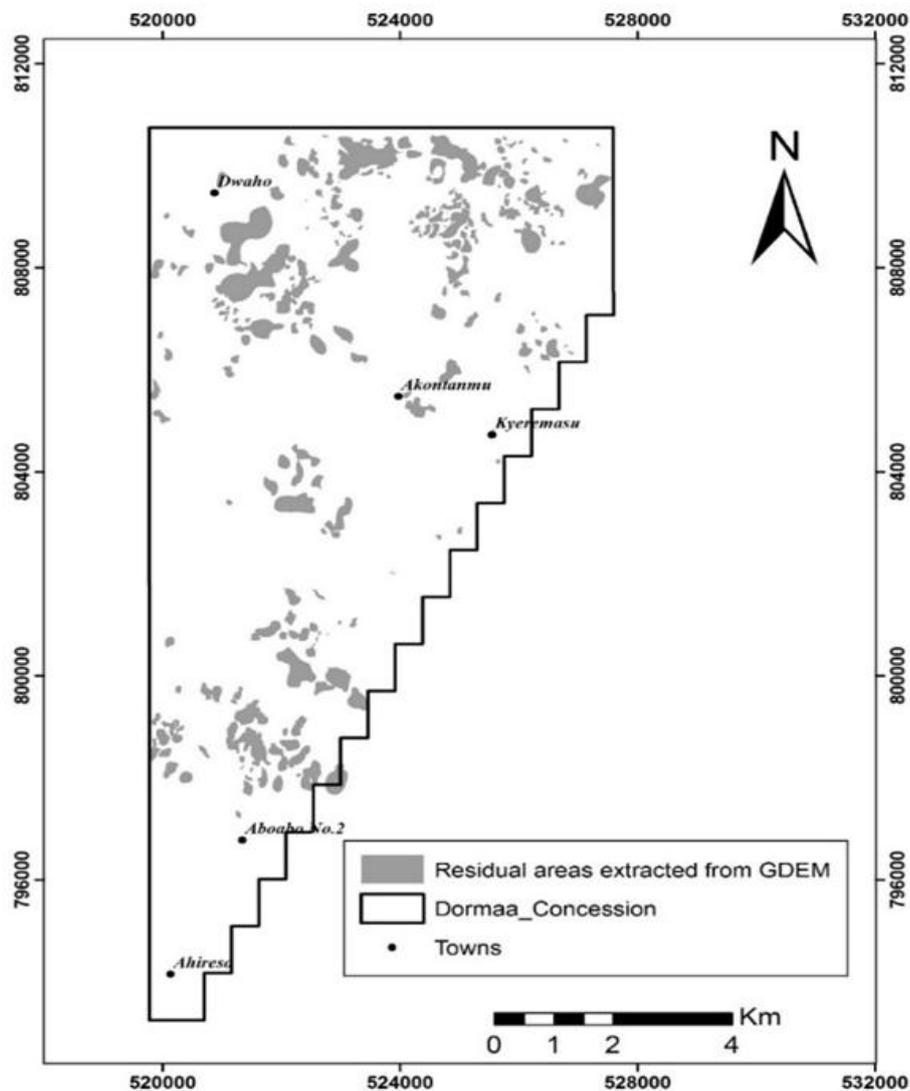
Figure-2. Residual areas extracted from the GDEM.
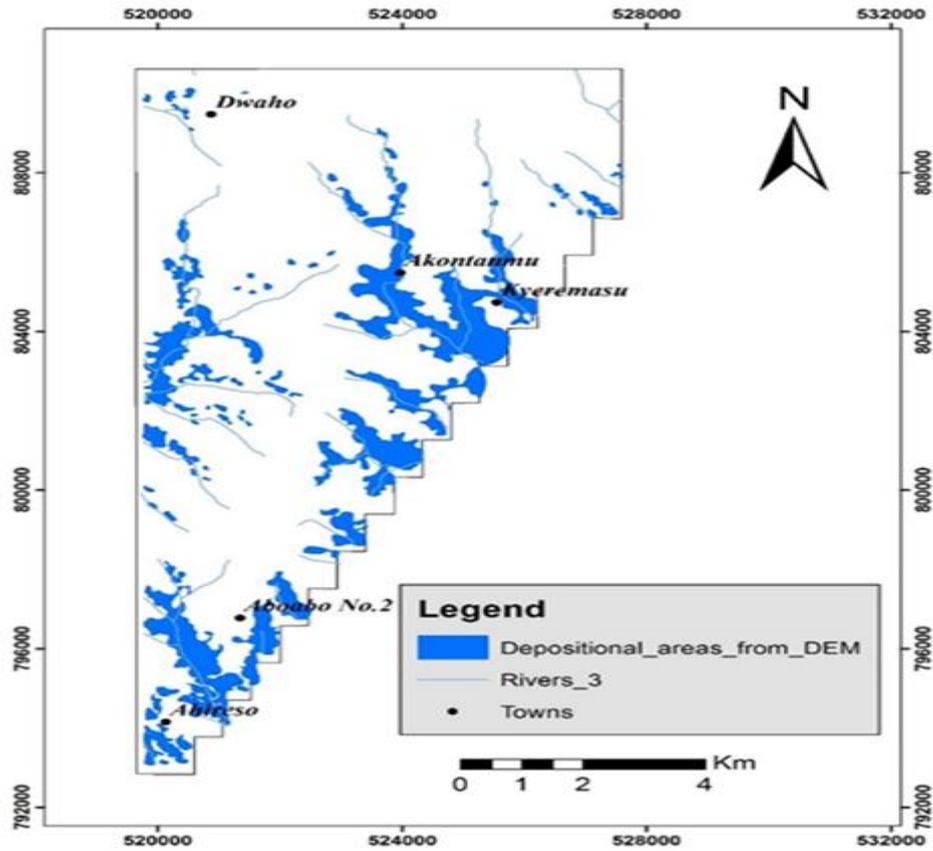
Figure-3. Depositional areas extracted from the GDEM.
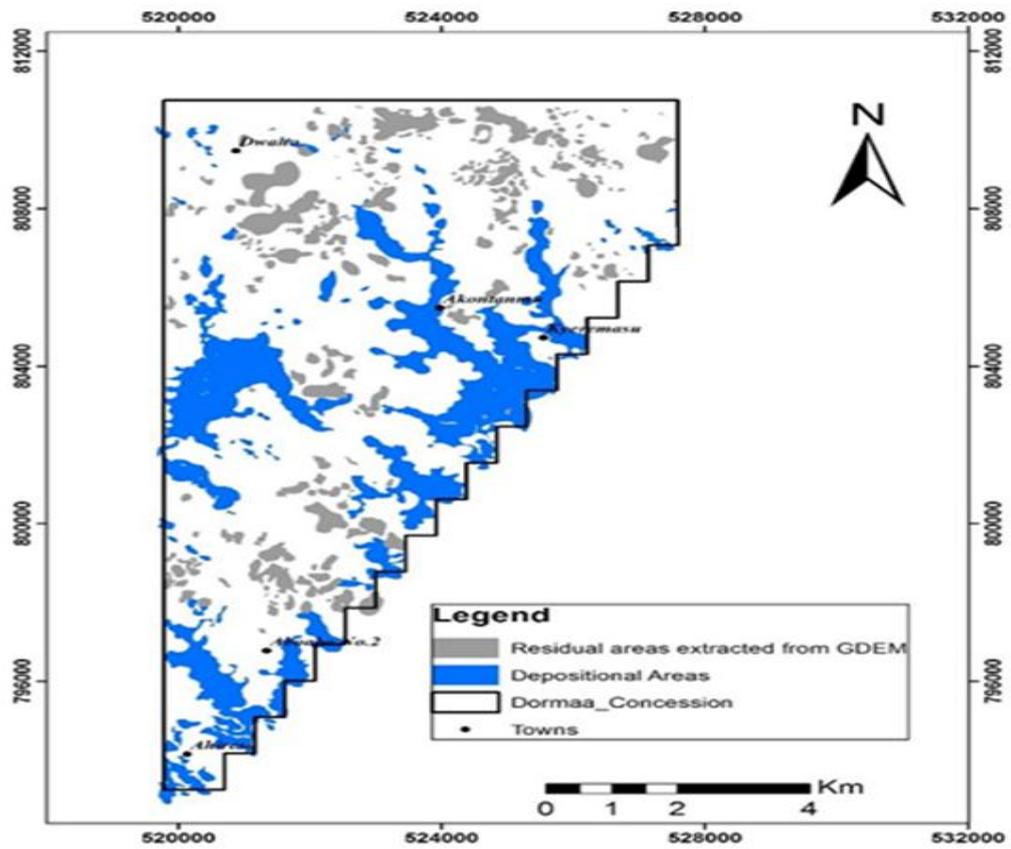
Figure-4. RLU map of residual and depositional regolith.

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The improvement of the regolith classification continued with the analysis and interpretation of ASTER imagery. Result obtained from the interpretation of the Aster image was presented in Figure 5 and showed the digitized ferruginous units. The classification techniques could not show the different classes of ferruginous units and so all iron rich areas, saprolite lags, ferric oxides and caps were all mapped to represent the ferruginous unit. In addition, the radiometric data was used to improve the mapping procedure by helping to adjust the boundaries of some units and revealed the mineralogy of the units. The final updated RLU map obtained by combining all the extracted information from ASTER, GDEM and radiometric is displayed in Figure 6. The empty spaces displayed in Figure 6 were made of different classes of regolith materials but could not be mapped at the present scale. These were however covered during the field work.
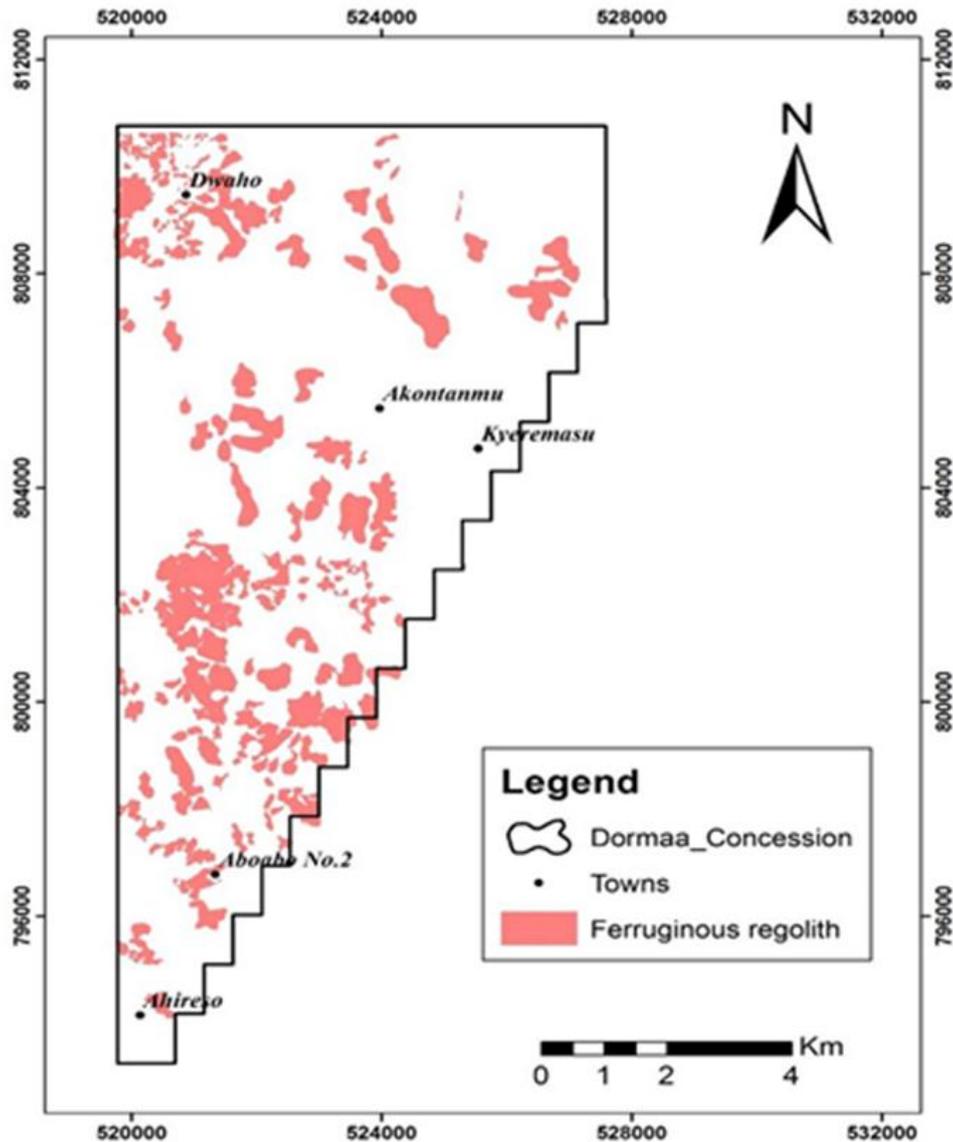
Figure-5. Ferruginous regolith units extracted from Aster.
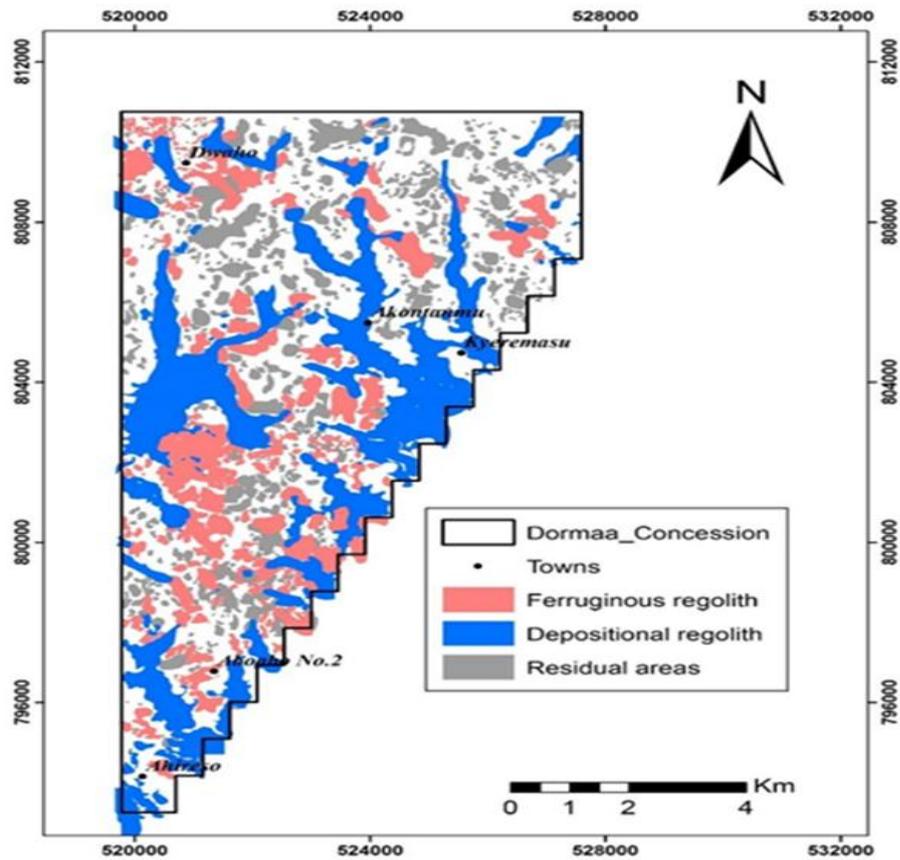
Figure-6. RLU map of residual, depositional and ferruginous regolith.

The validation process generally confirmed the existence of the various regolith landform units captured on the RLU map except for some few areas which were fraught with misrepresentations. During the mapping exercise, class supported lateritic duricrusts, sediments from depositional environments, exposures, truncated outcrops, lateritic pans and quartz veins were confirmed to be prevalent on the area Figure 7 and Figure 8.

Figure-7. Outcrops of clast supported in-situ lateritic duricrust classified under ferruginous regime.
Source: Field work.

Figure-8. (A) and (B) represents some Erosional areas identified on the field; (C) represent sediments of the depositional regime; (D) Lateritic pans encounted on the field.
Source: Field work.

The areas without information were also visited and adequately mapped where possible. The result of the classification of the mapping units' cognisance of the landform characteristics yielded the genetic or factual regolith map shown in Figure 9.
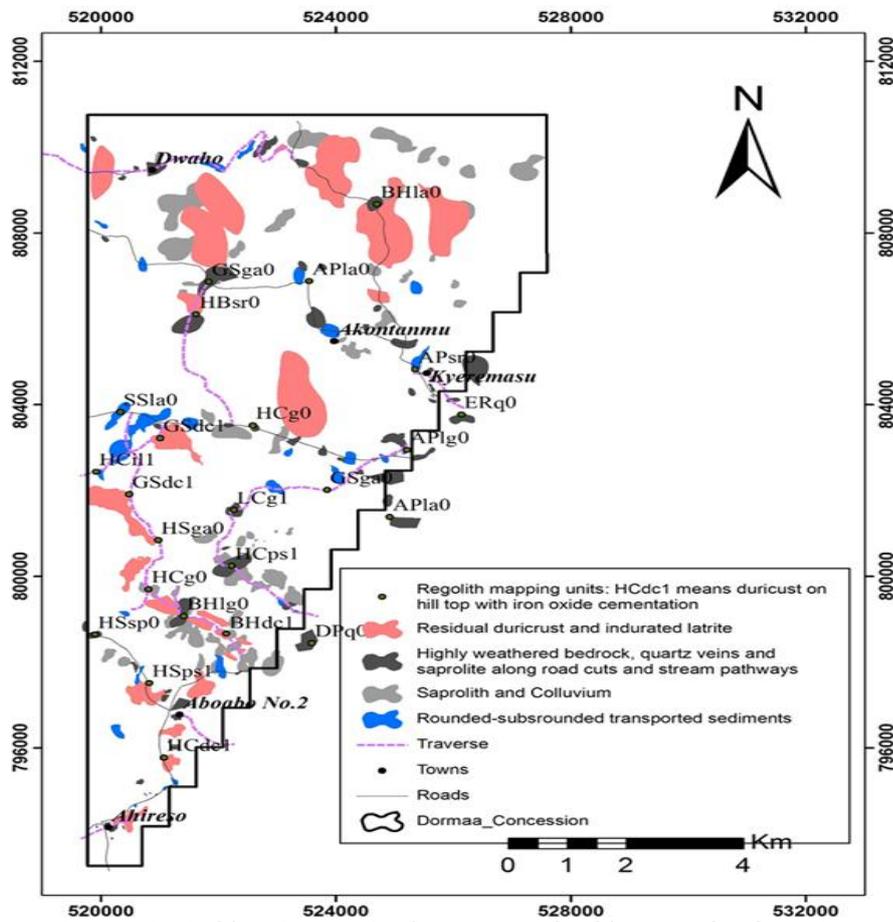
Figure-9. Digitized factual genesis classification map produced from ground truth mapping.

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The final regolith map which integrated the RLU and factual map was presented in Figure 10. The spatial distribution and extent of the regimes were also presented in Figure 11. The mosaic of different regolith units coexisting in the same geochemical terrain for anomaly detection required proper distinctions of the individual units in order to properly analyze and interpret the geochemical results obtained from the soil survey. Anything other than incorporating the regolith in the gold geochemical interpretation will lead to data interpretation challenges.
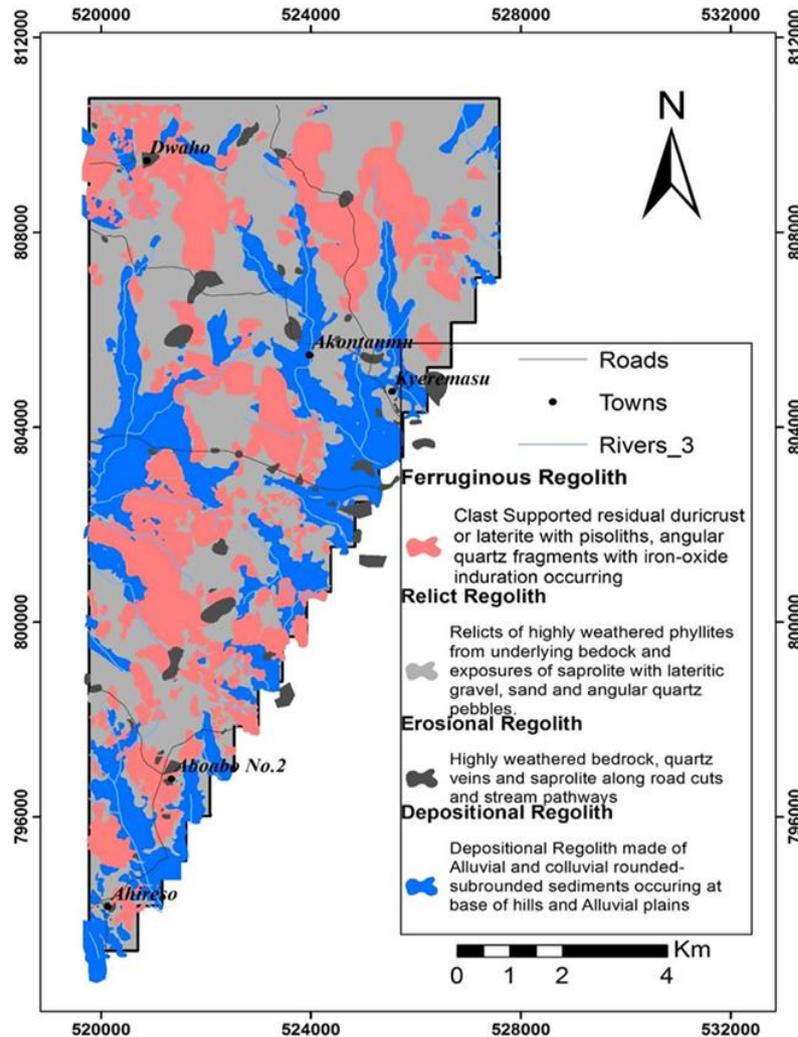
Figure-10. Final regolith map of the study area.
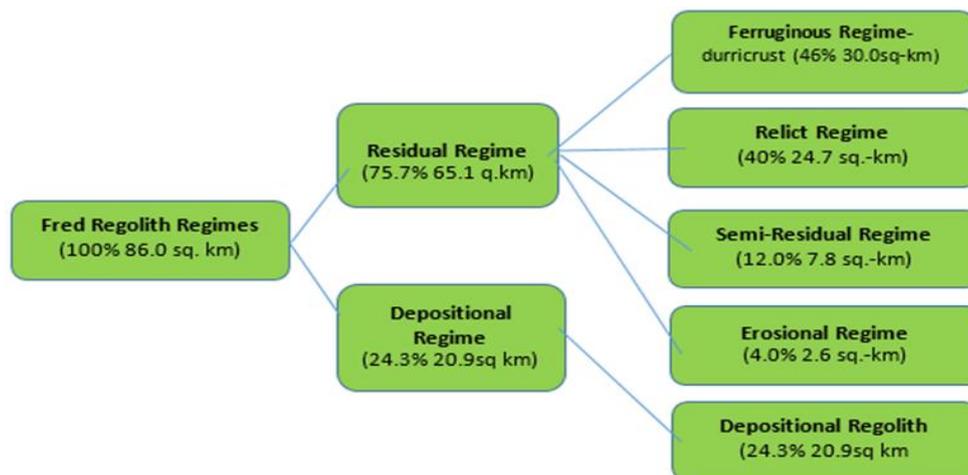
Figure-11. Spatial distribution of the regolith regimes in the study area.

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The characteristics of the surface gold values from each regolith regime were displayed by probability Q-Q plots in Figure 12. The complexity of the regolith portrayed in Figure 11 and its impact on the gold values Figure 12 required the establishment of different threshold values to be used in the identification of gold anomalies in the varying regolith regimes. The summary statistics of gold geochemical values from the four regolith regime and the estimated threshold values have also been presented in Table 2.
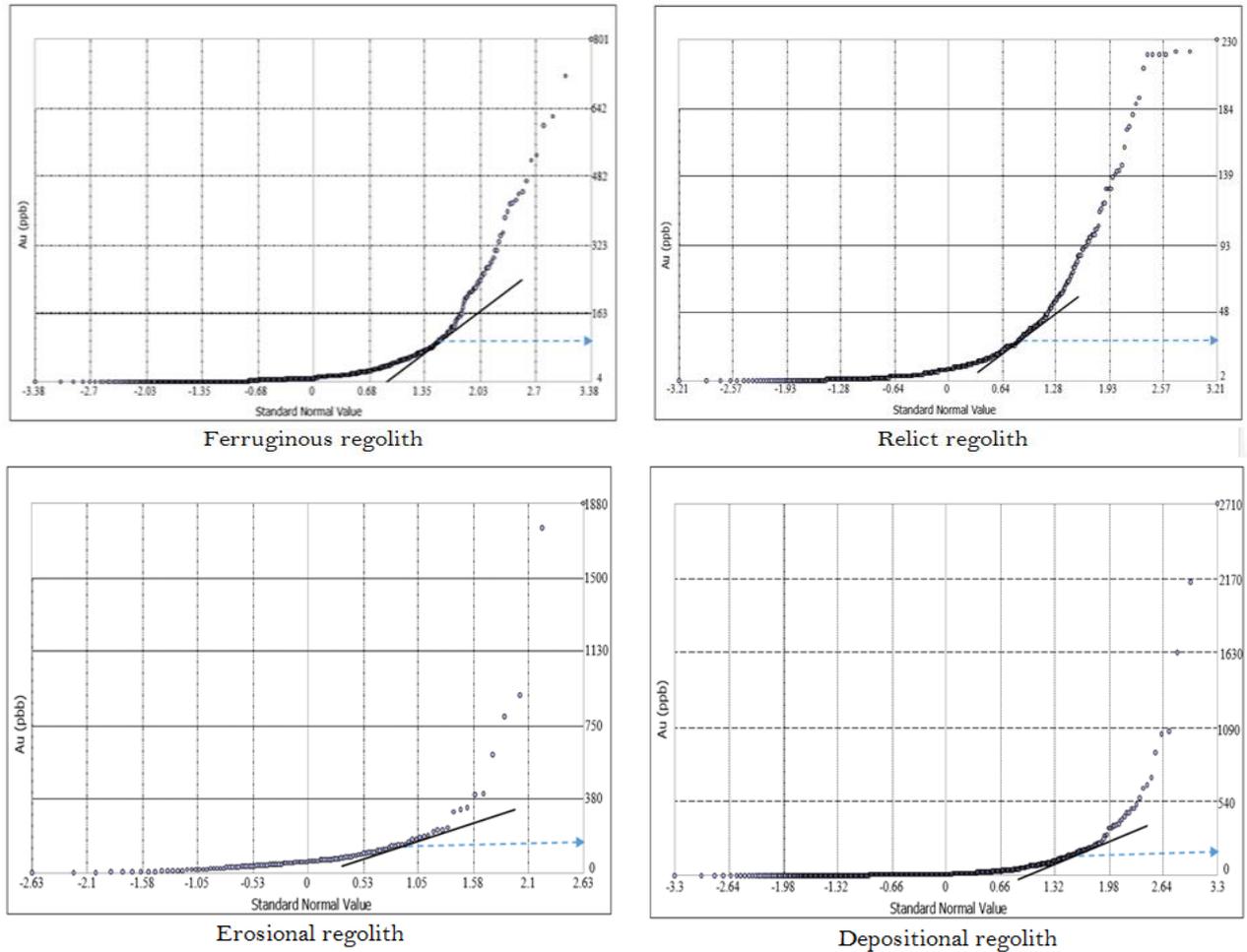
Figure-12. Probability Q-Q plots of the four regolith types showing the estimated threshold values.

Table-2. Thresholds using mean plus two standard deviation and probability plots on Au values in ppb.

Regolith Regime	Count	Min	Max	Mean	Std.	U+2sd	Q-Q plot
Ferruginous	1357	4	801	33.25	66.7	166.65	110
Relict	756	2	230	22.3	35.1	92.5	32
Erosional	116	2	1880	128.9	262.7	654.3	130
Depositional	1023	2	2710	48.0	148.61	345.22	180

4. DISCUSIONS

From Figures 2 and 3 the stream network which is concomitant with the depositional arrears appear to be sporadic and quite narrow. Meanwhile, the classification indicates a rather large extent of the sediments in several places such as the extreme left and right flanks of the concession. The relatively flat nature of the terrain might have been the reason for this large extent since it makes it possible for sediments to be washed and transported to far places during the peak raining seasons. In Figure 4 the residual environment could not be separated into relict and erosional at the early stages of the classification so the residual environment was used to represent both regimes. The laterites occupied the soe of the hilltops and at the low-lying areas Figure 7. Those found at the low lying areas contained fragments from diverse sources and with diverse matrix materials. Those on the hilltops and

at the elevated areas were found to have uniform matrix suggesting they were formed from in situ weathered materials. McQueen and Scott (2008) and Anand and Paine (2002) referred to laterite with uniform and equigranular groundmass as lateritic duricrust whilst laterite with different matrix with framework having materials from diverse sources as ferruginous duricrust. The ferruginous duricrust were prevalent and were found to be dominated with quartz fragments, pisoliths and occasionally with some relics of argillaceous rocks embedded within the matrix Figure 7. Figure 8a and Figure 8b reveal areas covered by saprolith and truncated units along some road cuts. Exposures of highly weathered phyllitic rock units with quartz intrusions within some communities such as Kyeremasu and Aboabo No. 2 were also mapped. Fig 8 C and D also show some depositional and lateritic pans in the area. Figure 9 confirms (Arhin et al., 2015) regolith classification scheme to consist of ferruginous, relict, erosional and depositional regolith. At this stage of the classification, the residual regolith could be differentiated into relict and erosional regimes. The superposition of the Figure 9 on Figure 6 helped to resolved areas fraught with controversies in Figure 10. For example, areas where two different units overlapped on the RLU map were resolved.

In Figure 11, 46% of the study area is overlain by ferruinous regolith, which the environments of formation could be either residual or transported. Gold geochemical expressions in this regolith regime may be subdued and erratic or subdued and subtle in such away that anomaly detection may be challenging without proper understanding of the regolith environment. 24% of the entire landscape were also covered by depositional regolith. This regime had similar influence on metal ion migration beause of the uneven ditributions due to the surface processes that moved sediments and minerals around Figure 12. The dopositional regime also have the tendency to obscure mineral anomaly when it overlays a preexisting preserved surface (Cohen et al., 2010). Both ferruginous and depositional regimes covered close to 70% of the entire area and have capabilities impacting negatively on gold transport in the surficial environment. Again, regolith materials from both ferruginous and depositional have the tendency to either enhance or dilute the mineral concentration, distort geochemical dispersion of Au. This interpretation is in line with Arhin et al. (2015); McQueen (2004) and Cohen et al. (2010) position that gold poor sediments dilute gold signatures in preserved and pre-existing surfaces whilst Fe-oxide, pisoliths and clay minerals generally encrust the detrital gold grains thereby subduing the gold expressions in sample.

The geochemical data obtained from the depositional regolith recorded the highest assay values as compared to the other regimes. These values could have a huge influence on anomaly definition by overshadowing the low anomalies from being detected. This also confirms Arhin's assertion that geochemical interpretation with total disregard of regolith environment leads to following 'false' anomalies. The real geochemical expressions can only occur in areas covering close to 30% of the study area. This represent the fraction of the area with potential to host realistic gold mineralization. However, it may be patchly dtributed because of the presence of semi-residual regolith that may tend to occur in proximity to erosional and relict regimes. The above assertion strongly substantiate the necessity of separating the regolith regimes prior to geochemical interpretations in terrains with unrestrained spatial dispersal of regolithic units. Again, the geochemical expression and anomaly in each regime will have the opportunity to be detected so as to prevent situations where the expression in one regime subdue the others. This confirms reports by Butt and Zeegers (1992); Smith (1996); Bolster (1999); McQueen (2006); Cohen et al. (2010); Craig (2001) and Arhin et al. (2015) which suggest that each of these regolith-landform associations are characterized by unique geochemical expressions and have equal tendency of hosting realistic anomalies.

The complexity of the regolith complicates geochemical data interpretation especially in areas characterized by laterite and transported sediment cover. The regolith knowledge strongly suggested the need for the multiple threshold approach. A fix threshold chosen for this data may end up subduing low but realistic anomalies in other regimes. The thresholds estimated for the different regolith regimes displayed in Table 2 depicts the behavior of gold in each regime. The q-q plots will be able to define broad anomalies as compared to the other methods. The first natural break on the curve chosen as a threshold represented a particular population which affects

mineralization. For example, in Table 2 the 180 ppb threshold from the q-q plot in the depositional regime will define broad anomalies as compared to 345ppb. Similarly anomaly definitions set up to prioritize high assay threshold areas (e.g., like those defined by mean plus 2std) may overlook potential low concentration Au anomalies. The regolithic influence in each regolith will be nullified if each regime is transformed by their respective thresholds. The Au deposit discovered on the Dormaa concession extends across residual, lateritic residuum and laterite cap areas as well as depositional environments (Torkornoo, 2017). This suggests it is inappropriate to use a single threshold gold value for Au exploration in complex regolith terrains. This follows again that meaningful geochemical interpretation can be deduced from such environment when the regolith environment is understood and results are well incorporated in the geochemical interpretations. With this understanding the patchy nature of the geochemical anomaly can be explain and realistic and broad anomalies can be determined.

5. CONCLUSION AND RECOMMENDATIONS

Integration of methods such as the one used in this study has proven to accurately discriminate regolith regimes for mineral exploration purposes. The study was able to map all the four broad classes of regolith in the study area. With this mapping approach, the area has been classified into Ferruginous, Relict, Erosional and Depositional regimes and an interpretative regolith map of the Dormaa concession has also been developed. The study revealed that clast supported in-situ lateritic duricrust and other regolith units such as sediments of deposition were prevalent.

The study showed that over 70% of the area overlain by materials from diverse sources such as ferruginous and depositional regimes have negative impact on gold in the surficial environment. It also reveals that irrespective of the tendency of some areas to have unusually enhancement in gold values, it may or may not host realistic anomalies. The study also showed that 27% of the terrain overlain by relict and erosional regolith. The geochemical values obtained from these regimes were not enhanced as compared to the ones from the depositional regimes yet hosted realistic anomaly. Knowledge of the regolith environment was essential to understanding the distribution of gold anomaly on the Akroma gold project. The understanding of the behavior of the gold geochemical data was heightened and the genetic relationship between each regolith type and associated mineralization has been established. The need for multiples thresholds to be used for anomaly determination was as a result of the understanding of the regolith.

From these results, the study proposes that knowledge of regolith information is essential for any area dominated by highly weathered regolith materials. It further suggest that such regolith knowledge should be integrated into the gold geochemical data interpretation to enhance the understanding of the data. This will mitigate the challenges of following 'false' anomalies. And because each regolith unit is capable of hosting mineralization in the area, equal weight of importance should be accorded to each. This means that appropriate threshold should be selected for each regime and analysis should be done separately. It can be concluded that the integration of multisource data have allowed for the delimitation of the regolithic environment into the FRED scheme to develop the regolith map of the study area.

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