

Assessment of Weathering Intensity and Pedogenesis of Lithosequence located in Two Agroecological Zones of Nigeria

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ORIGINAL RESEARCH

Abstract- Elemental oxides can help to identify processes of soil formation and the degree of soil development. This study assessed soil development and weathering intensity in soils developed on schist and older granite in upland tropical rain forest and southern guinea savanna agro ecological zones of Nigeria. Soil profile samples were collected in each of the study locations. In the laboratory, total elemental oxides was determined using the energy dispersing X-ray Fluorescence (EDXRF) XRF SPEC (Minipal 4). The relative intensity of weathering of total elemental oxides was determined by choosing titanium as the suitable indexing element and the relative gain or loss of element was estimated using relative retained element (Ro) equation. Result obtained, revealed that SiO₂ was the most abundant in the soils. Distribution of Al₂O₃ and CaO showed the direction of the pedogenic age. Older granite soil had higher values of Al₂O₃ and lower values of CaO. There was negative relationship of SiO₂ with Al₂O₃ and Fe₂O₃. The trace elemental oxides were less than 1% and zirconium oxide was the most retained oxide in the soils. Soil which developed on schist retained more of the trace elements than soil on older granite. There was evidence of alitization, ferritization and desilicification in the soils. Parent materials contributed to loss and gain of trace elemental oxides. Older granite soil was more weathered and pedologically older than schist derived soils.

Keywords- Granite, pedogenesis, soil development, schists, weathering.

1 INTRODUCTION

Weathering is the breakdown and alteration of rocks and minerals which involves physical and chemical processes. Osat *et al.* (2016) defined weathering as the alteration of parent materials by physical, chemical and biotic processes. Physical weathering leads to the disintegration of rocks to produce larger surface area for chemical weathering to take place. Chemical weathering involves various chemical reactions that results to changes in rock composition typically replacing strong minerals with weaker minerals thus hastening the breakdown of rocks and release of rocks minerals (Jeleńska *et al.*, 2008). Weathering is studied in soil science because soil formation depends largely on it. According to Bera *et al.* (2015) the duration and weathering intensity is important in the study of pedogenesis.

The determination of elemental composition is commonly used to evaluate the weathering intensity of soils and evaluate parent material uniformity in soil profile as well as to measure losses and gains of elements as a result of soil development (Bussaca & Singer, 1989; Thanachit *et al.*, 2006; Goydaragh *et al.*, 2019). Weathering and Pedogenic development have been assessed with silica-sesquioxide ratio (Bravard & Righi, 1989; Bussca & Singer, 1989; Yakubu & Ojanuga, 2009).

Oxides of silicon (Si), titanium (Ti) and zirconium (Zr) total elements had been used as index elements (Marshall, 1977; Maniyunda, 2012) due to their presence in both soil and parent materials as well as resistance to weathering processes and relative immobility (Bussaca & Singer, 1989). The use of index elements has contributed greatly to the determination of relative gain and loss of elements in soils due to weathering and soil development processes (Muhs *et al.*, 2001; Aide and Smith-Aide, 2003).

There have been studies on the soil development and weathering intensity with elemental oxides by some researchers in Nigeria in the past years (Agbede, 1998; Idoga & Ojanuga, 2007; Yakubu & Ojanuga, 2009). However, there are few studies on the basement complex (Maniyunda, 2012) and none has been conducted for the soils of the present study locations. Thus, the objective of this study is to evaluate soil development and weathering intensity on total elemental oxides of soils developed on a representative schist and older granites locations in dry upland tropical rain forest and southern guinea savanna agro ecological zones of Nigeria.

2 MATERIALS AND METHODS

2.1 DESCRIPTION OF THE STUDY AREAS

The study was carried out in two agro ecological zones of Nigeria (Figure 1). The dry upland forest zone at Ado-Ekiti and southern guinea savannah zone at Kabba. Ado Ekiti site is located on longitude 7.710802N and 7.713800N and latitude 5.243230E and 5.246470E while Kabba site is located between longitude 7.860376N and 7.862225N and latitude 6.069576E and 6.074468E. The areas have mean annual rainfall of 1470.1 mm and 1329mm, mean annual temperature of 25.5° C and 30°C and mean annual relative humidity of 75 % and 62% respectively. The geology of

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Ado-Ekiti site is of the older granite while that of Kabba is of Schists.

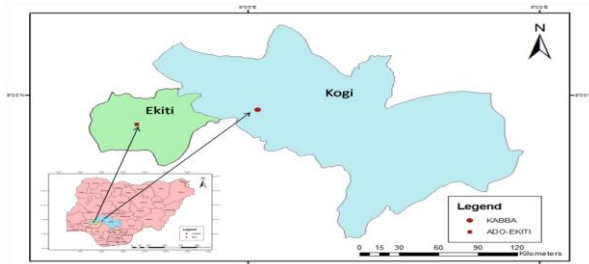


Fig. 1: Map of Nigeria showing the location of the two sites

2.2 SOIL SAMPLING

Sites classified by Babalola (2021) to have been developed on older granite and schists were selected and a profile pit was dug in the representative portion of each site. The soil profiles were described and sampled. A total of ten soil samples (five samples per location) were collected and taken to the laboratory for analysis.

2.3 LABORATORY ANALYSES

The total elemental oxides were determined using energy dispersing X-ray Fluorescence (EDXRF) XRF SPEC (Minipal 4). Soil samples from the soil profiles were crushed with porcelain pestle and mortar and sieved to remove materials greater than 2mm. The <2 mm soil samples were further grinded to 150 μm and the powdered samples were used for the analysis. The conditions for analysis set were as follows:

- (i) Mo filter at 30 kV for rare earth elements.
- (ii) Kapton filter at 20kV for Si, Al, P, and so on.
- (iii) Filter (none) at kV for alkaline and alkaline earth elements.

The relative intensity of weathering of total elemental oxides was determined by choosing titanium as the suitable indexing element (Marshall, 1977; Muhs *et al.*, 2001). The relative gain or loss of element was estimated using relative retained element (R_o) formula (White, 1995; Caspari *et al.*, 2006).

$$R_o = \frac{X_h}{X_p} \times \frac{T_{ip}}{T_{ih}} \quad (1)$$

Where, X_h = element of interest in h^{th} horizon to estimate ($h = 1, 2, \dots$); X_p = element of interest in h^{th} parent material (rock) ($p = 1, 2, \dots$); T_{ih} = index element (Titanium) in h^{th} horizon to estimate; T_{ip} = index element (Titanium) in h^{th} Parent material (Rock).
 $R_o > 1$: Relative accumulation of element (Gain)
 $R_o = 1$: No relative accumulation or depletion of element;
 $R_o < 1$: Relative depletion of element (Loss)
 $R_o = 0$: Element absent in soil.

2.4 STATISTICAL ANALYSIS

T-test was used to compare differences between the soils on schist and older granite and between surface and subsurface horizons. Linear correlation analysis was used to determine the relationship between the soil properties. All the statistical analyses were carried out at 95% confidence level. Analysis was carried out using statistical package for social science (SPSS IBM Statistics 19.0).

3. RESULTS AND DISCUSSION

3.1 MAJOR ELEMENTAL OXIDES

The major elemental oxides from x-ray fluorescence indicated that silicon oxide (SiO_2) was the most abundant in the soils of both parent materials with values ranging from 49.6 to 81.23% (Table 1). This was followed by aluminum (Al_2O_3) and iron oxide (Fe_2O_3) with values ranging from 6.71 to 20.0% and 4.12 to 20.01% respectively (Table 1). Calcium oxide (CaO), potassium oxide (K_2O), titanium oxide (TiO_2) and manganese oxide (MnO) were all less than 4.12%. Differences in parent materials were observed for Al_2O_3 and CaO (Table 2). There were higher values of Al_2O_3 and lower values of CaO in the soils of both parent materials. The highest value of Al_2O_3 and lowest value of CaO were observed in older granite soils. This indicated the leaching of CaO and can be attributed to pedogenic age. This established that the soil on older granite was more exposed to pedogenic processes than the soil on schist in this study.

Silicon oxide decreases with increasing depth; this indicated desilication of SiO_2 in the horizons of the soils at both locations. Also the distribution pattern of CaO , MnO and K_2O was a pointer that bio-cycling and leaching of these oxides took place in the soils studied. Similar observations were made in soils developed on four basement complex rocks in Northern Guinea Savanna of Nigeria (Maniyunda, 2012). There was correlation in the distribution pattern of SiO_2 and CaO (0.754**) (Table 3). Titanium oxide had an inverse relationship with K_2O and not significantly correlated with other major (list them) elemental oxides (Table 3). There was significant relationship between Al_2O_3 and Fe_2O_3 (0.939**). They had similar distribution pattern and there were higher values at the subsurface than the surface horizons, this can be attributed to illuviation.

3.2 RELATIVE RETENTION (GAIN/ LOSS) OF MAJOR ELEMENTAL OXIDES

In soil on the older granite, there were accumulations of SiO_2 and Al_2O_3 , depletion of CaO , K_2O and MnO and depletion of Fe_2O_3 at the surface, portions of subsurface horizons and accumulation of SiO_2 , Al_2O_3 and Fe_2O_3 at the lowest part of the soil profiles (Table 4). There were accumulations of SiO_2 , depletion of Al_2O_3 , CaO and K_2O at the schist. There was depletion of Fe_2O_3 at surface horizon and accumulation of SiO_2 , Al_2O_3 and Fe_2O_3 in the entire subsurface horizons. MnO accumulated at the surface horizon and was depleted at the subsurface horizon (Table 4). The trend of accumulation and depletion of elemental oxides can be attributed to inherent nature of the parent materials and their exposure to pedogenic processes.

Evaluation of the relative retention (gain/loss) indicated that parent materials significantly ($P \leq 0.05$) influenced relative weathering intensity of Al_2O_3 and CaO (Table 5). The non-significant negative relationship between SiO_2 with Al_2O_3 , TiO_2 , Fe_2O_3 , Rb_2O , BaO and NiO seem to signify that the decrease of SiO_2 enhances the increase of these elements in the studied soils. Decrease in SiO_2 had been reported to increase some elemental oxides in soils (Caspari *et al.*, 2006; Maniyunda, 2012). There were positive correlations of SiO_2 with CaO (0.754**), Zr_2O

(0.744**) and Cr₂O₅ (0.704**) (Table 3) these could be due to similarities in their pattern of distribution.

There were evidences of allitization and ferritization in the soils studied. This was observed in the negative relationship of SiO₂ with Al₂O₃ and Fe₂O₃ and positive significant relationship of Al₂O₃ with Fe₂O₃ (0.939**) in Table 3. Alitization (i.e. Al₂O₃ enrichment), ferritization (i.e. Fe₂O₃ enrichment) and desilicication (i.e. SiO₂ depletion) processes have been reported to occur simultaneously in tropical soils (Mohr *et al.*, 1972; Buol *et al.*, 1980). In the soil on schist, SiO₂, Fe₂O₃ and MnO were relatively enriched while Al₂O₃ was depleted. In the older granite soils, SiO₂ and Al₂O₃ were relatively enriched. This can be attributed to weathering of parent materials and advancement in pedogenesis. Soil on older granite was more pronounced in intensity of weathering of CaO and Fe₃O₂ compared to soils on schists. This implies that soils

on older granite were more advanced in age than soils derived from schist, according to this study. The trends of weathering intensity assessed by mean of relative retention of major elemental oxides are in the following order:

Schist: SiO₂<Fe₂O₃<MnO< Al₂O₃<K₂O<CaO
 Older granite: SiO₂< Al₂O₃<Fe₂O₃<MnO<K₂O<CaO

This trend revealed that both soils were relatively old in their pedogenic age and development; this was established by the observation of CaO being the most relatively depleted in both parent materials; this is an indication of high weathering and leaching. Calcium had been reported to be the most sensitive to weathering and leaching and has been used to predict pedogenic age of soils (Beavers *et al.*, 1963; Jones and Beavers, 1966; Maniyunda, 2012).

Table 1. Percentage total elemental oxides of soils on schist and older granites

Horizon	Depth (cm)	SiO ₂	Al ₂ O ₃	CaO	K ₂ O	TiO ₂	Fe ₂ O ₃	MnO	Rb ₂ O	SrO	BaO	ZrO ₂	V ₂ O ₅	Cr ₂ O ₅	ZnO	CuO	MoO ₃	PbO	NiO	
Profile KE (Kabba) Schist belt 7.860811N 6.072108E																				
Ap	0 – 21	81.23	6.71	2.86	0.41	1.59	6.59	0.05	0.02	0.01	0.16	0.55	0.05	0.02	0.02	0.01	Trace	0.01	0.02	
Btc1	21 – 41	60.1	16.61	2.97	0.50	1.92	17.03	0.09	0.04	Trace	0.19	0.36	0.09	0.03	0.02	0.02	Trace	0.01	0.03	
Btc2	41 – 70	51.7	15.91	3.13	0.30	1.87	16.11	0.04	0.05	Trace	0.20	0.38	0.10	Trace	0.01	0.02	Trace	0.01	0.07	
Btc3	70 – 86	58.2	17.10	2.81	0.20	1.87	17.96	0.04	0.04	Trace	0.20	0.37	0.09	Trace	0.01	0.01	Trace	Trace	0.14	
Bt _g x	86 – 120	55.4	16.93	5.73	0.10	1.99	17.62	0.06	0.05	Trace	0.19	Trace	0.08	Trace	0.01	0.01	Trace	Trace	0.16	
Profile AB (Ado-Ekiti) Older Granites 7.710876N 5.245183E																				
Ap	0 – 15	79.5	9.40	1.27	0.29	2.13	4.12	0.07	0.01	0.03	0.09	0.33	0.11	0.02	0.01	0.03	0.00	Trace	0.01	
Bt1	15 – 38	56.3	17.0	1.30	0.29	2.74	18.07	0.11	0.01	Trace	0.12	0.31	0.13	0.02	Trace	0.03	0.00	Trace	0.01	
Bt2	38 – 69	51.2	20.0	1.49	0.20	1.06	17.66	0.14	Trace	Trace	0.10	0.30	0.14	0.02	0.01	0.02	0.00	0.02	0.02	
Btc	69 – 100	50.2	19.0	1.30	0.30	2.13	20.01	0.09	Trace	Trace	0.03	0.14	0.31	0.13	0.02	0.01	Trace	0.00	0.01	0.02
Btx	100 – 114	49.6	19.0	0.85	0.20	2.27	20.01	0.05	Trace	Trace	0.03	0.13	0.13	Trace	0.01	Trace	0.00	0.02	0.02	

Ap= ploughed/tilled horizon, Bt= horizon with clay accumulation, Bt_gx= horizon with clay accumulation, gley and fragipan, Btc= horizon with clay accumulation and concretions, Btx= horizon with clay and fragipan

Table 2. T-test for percentage total elemental oxides of sub-surface soils

Parameter	Schists	Older Granite	t-value	P(two tailed)
SiO ₂	61.360	57.360	0.304	NS
Al ₂ O ₃	14.652	16.880	-3.716	0.021
CaO	3.500	1.243	3.442	0.026
K ₂ O	0.316	0.302	-0.234	NS
TiO ₂	2.066	1.848	-3.581	NS
Fe ₂ O ₃	16.374	15.970	-1.278	NS
MnO	0.092	0.560	-1.935	NS
Rb ₂ O	0.040	0.004	1.453	0.041
SrO	0.018	0.002	-2.359	0.048
BaO	0.188	0.106	8.458	NS
ZrO ₂	0.292	0.312	-1.358	NS
V ₂ O ₅	0.082	0.114	-2.579	NS
Cr ₂ O ₅	0.010	0.016	-1.000	NS
ZnO	0.014	0.008	1.500	NS
CuO	0.014	0.016	-0.343	NS
NiO	0.006	0.010	-0.667	NS
Ga ₂ O ₃	0.084	0.016	2.581	NS
Y ₂ O ₃	0.012	0.040	2.138	NS

*P ≤0.05 level, NS>0.05

Table 3. Correlation matrix for percentage total elemental oxides

	SiO ₂	Al ₂ O ₃	CaO	K ₂ O	TiO ₂	Fe ₂ O ₃	MnO	Rb ₂ O	SrO	BaO	ZrO ₂	V ₂ O ₅	Cr ₂ O ₅	ZnO	CuO	PbO	NiO	Ga ₂ O ₃
Al ₂ O ₃	-0.449																	
CaO	0.754**	-0.429																
K ₂ O	0.097	-0.381	-0.164															
TiO ₂	-0.114	0.486	-0.012	-0.743**														
Fe ₂ O ₃	-0.449	0.939**	-0.427	-0.418	0.554													
MnO	0.092	0.374	-0.159	-0.273	0.569	0.325												
Rb ₂ O	-0.024	-0.596	-0.066	0.854**	0.657**	-0.615*	-0.534											
SrO	0.180	-0.280	0.251	-0.692**	0.356	0.097	-0.059	-0.599										
BaO	-0.183	-0.306	-0.152	0.838**	-0.761*	-0.324	-0.495	0.841**	-0.628*									
ZrO ₂	0.744**	-0.425	0.618*	-0.162	0.126	-0.498	0.332	-0.009	-0.101	-0.132								
V ₂ O ₅	0.088	0.371	0.029	-0.805**	0.789**	0.308	0.443	-0.689*	0.445	-0.720*	0.432							
Cr ₂ O ₅	0.704*	-0.151	0.706*	-0.141	0.121	-0.151	0.720*	-0.318	0.081	-0.253	0.566	0.166						
ZnO	0.382	-0.436	0.427	0.391	-0.678*	-0.428	-0.212	0.233	0.099	0.260	-0.109	-0.578	0.348					
CuO	0.563	-0.376	0.350	0.031	0.126	-0.514	0.372	0.179	-0.390	-0.057	0.897**	0.314	0.404	-0.247				
PbO	0.039	0.397	0.046	-0.169	0.000	0.410	0.124	-0.491	0.215	-0.326	-0.196	0.107	0.108	0.337	-0.368			
NiO	-0.596	0.006	-0.521	0.780**	-0.631	-0.050	-0.529	0.718*	-0.524	0.795**	-0.578	-0.708*	-0.531	0.283	-0.388	-0.081		
Ga ₂ O ₃	0.139	-0.480	-0.042	0.257	0.052	-0.494	-0.056	0.347	0.075	-0.038	0.223	0.133	-0.150	-0.086	0.333	-0.178	0.018	
Y ₂ O ₃	0.197	-0.191	0.034	0.713*	-0.549	-0.304	0.083	0.414	-0.568	0.394	0.126	-0.422	0.185	0.492	0.224	0.408	0.412	0.267

* Correlation is significant at 0.05 level (two tailed)

** Correlation is significant at 0.01 level (two tailed)

Table 4. Relative retention (gain/loss) of total element oxides in schist belt and older granites

	SiO ₂	Al ₂ O ₃	CaO	K ₂ O	TiO ₂	Fe ₂ O ₃	MnO	Rb ₂ O	SrO	BaO	ZrO ₂	V ₂ O ₅	Cr ₂ O ₃	ZnO	CuO	PbO	NiO	Ga ₂ O ₃
Al ₂ O ₃	-0.449																	
CaO	0.754**	-0.429																
K ₂ O	0.097	-0.381																
TiO ₂	-0.114	0.486	-0.164															
Fe ₂ O ₃	-0.449	0.939**	-0.427	-0.418	0.554													
MnO	0.092	0.374	-0.159	-0.273	0.569	0.325												
Rb ₂ O	-0.024	-0.596	-0.066	0.854**	0.657**	-0.615*	-0.534											
SrO	0.180	-0.280	0.251	-0.692**	0.356	0.097	-0.059	-0.599										
BaO	-0.183	-0.306	-0.152	0.838**	-0.761*	-0.324	-0.495	0.841**	-0.628*									
ZrO ₂	0.744**	-0.425	0.618*	-0.162	0.126	-0.498	0.332	-0.009	-0.101	-0.132								
V ₂ O ₅	0.088	0.371	0.029	-0.805**	0.789**	0.308	0.443	-0.689*	0.445	-0.720*	0.432							
Cr ₂ O ₃	0.704*	-0.151	0.706*	-0.141	0.121	-0.151	0.720*	-0.318	0.081	-0.253	0.566	0.166						
ZnO	0.382	-0.436	0.427	0.391	-0.678*	-0.428	-0.212	0.233	0.099	0.260	-0.109	-0.578	0.348					
CuO	0.563	-0.376	0.350	0.031	0.126	-0.514	0.372	0.179	-0.390	-0.057	0.897**	0.314	0.404	-0.247				
PbO	0.039	0.397	0.046	-0.169	0.000	0.410	0.124	-0.491	0.215	-0.326	-0.196	0.107	0.108	0.337	-0.368			
NiO	-0.596	0.006	-0.521	0.780**	-0.631	-0.050	-0.529	0.718*	-0.524	0.795**	-0.578	-0.708*	-0.531	0.283	-0.388			
Ga ₂ O ₃	0.139	-0.480	-0.042	0.257	0.052	-0.494	-0.056	0.347	0.075	-0.038	0.223	0.133	-0.150	-0.086	0.333	-0.178	0.018	
Y ₂ O ₃	0.197	-0.191	0.034	0.713*	-0.549	-0.304	0.083	0.414	-0.568	0.394	0.126	-0.422	0.185	0.492	0.224	0.408	0.412	0.267

* Correlation is significant at 0.05 level (two tailed)

** Correlation is significant at 0.01 level (two tailed)

Table 5. T-test for relative retention (gain/loss) of total element oxides

Parameter	Schists	Older Granite	t-value	P(two tailed)
SiO ₂	1.112	1.672	3.636	NS
Al ₂ O ₃	0.634	1.531	-6.039	0.048
CaO	0.157	0.066	0.675	0.023
K ₂ O	0.349	0.136	6.778	NS
Fe ₂ O ₃	0.944	0.776	1.805	NS
MnO	0.894	0.774	0.778	NS
Rb ₂ O	0.688	0.016	1.509	0.031
SrO	0.370	0.020	2.178	0.045
BaO	16.742	12.318	2.295	0.033
ZrO ₂	8.714	1.628	-20.479	0.000
V ₂ O ₅	8.340	2.776	5.720	0.005
Cr ₂ O ₃	6.926	1.480	-3.643	0.022
ZnO	33.832	22.380	0.926	0.040
CuO	60.948	19.06	-0.921	0.049
PbO	2.012	0.120	1.307	0.461
NiO	0.905	0.054	-4.536	0.011
Ga ₂ O ₃	1.139	0.029	-3.583	0.023
Y ₂ O ₃	0.570	0.151	2.052	0.040

*P ≤0.05 level, NS>0.05

Considering the significant difference observed in CaO between the parent materials and the highest value recorded in soils derived on schist, the soil can be adjudged to be younger than the older granite soil. This can also be related to the dominance of SiO₂, Al₂O₃ and Fe₂O₃ in the older granite soils. This seem to establish earlier reports that as weathering advances, relative retention of sesquioxide and their minerals dominate in soils (Blume & Schwertmann, 1969; Alexander, 1974; Lekwa and Whitside, 1986; Muhs *et al.*, 2001; Yakubu & Ojanuga, 2009; Maniyunda, 2012).

3.3 TRACE ELEMENTAL OXIDES

Oxides of trace element were generally less than 1% in all the soils studied (Table 1). The distribution pattern of most of the trace elements down the soil's depth were irregular. There were higher values of Zirconium oxide (ZrO₂) than other trace elements. This could be attributed to its resistance to weathering as a result of its more stable and less mobile nature. This agreed with the reports of other workers in different parts of the world (Barshad, 1965; Marshall, 1977; Smeck and Wilding, 1980; Bussca & Singer, 1989; Muhs *et al.*, 2001; Aide & Smith-Aide, 2003; Thanachi *et al.*, 2006). The different pattern of distribution of the trace elements could be attributed to the nature and rate of weathering of parent materials. There was significant difference (P≤0.05) in Rb₂O and SrO between the parent materials (Table 2) while there was no

significant difference for the other trace elemental oxides (Table 2) BaO and CaO were irregularly distributed, V₂O₅, and NiO increased with soils depth.

3.4 RELATIVE RETENTION (GAIN/LOSS) OF TRACE ELEMENTAL OXIDES

Relative weathering intensity indicated that soil on schist retained more trace elements than soil on older granite (Table 4). This implied that soils on older granite were more exposed to weathering and pedogenic processes. In both locations, it was observed that the values for Rb₂O, SrO, V₂O₅ and NiO at the surface horizons were lower than the subsurface horizons. This indicate that illuviation occurred in the soils.

The trend of relative weathering was assessed by the mean values and it was arranged in the following order: Schist: CuO>ZnO>BaO>ZrO₂>V₂O₅>Cr₂O₃>Ga₂O₃>NiO>Rb₂O>SrO>PbO>Y₂O₃
Older granite: ZnO>CuO>BaO>V₂O₅>PbO>ZrO₂>Cr₂O₃>Y₂O₃>NiO>Ga₂O₃>SrO>Rb₂O.

CuO, ZnO, BaO and V₂O₅ were more accumulated in the soils while Rb₂O, SrO, NiO and Y₂O₃ were more depleted. Elements that were more depleted in schist derived soils were NiO, Rb₂O, SrO, PbO and Y₂O₃ while in older granite soils, the list were: Y₂O₃, NiO, Ga₂O₃, SrO and Rb₂O. There was indication that both soils were highly weathered, however the lowest values observed in the older granite soil signifies that it was the oldest. The trend showed that inherent nature of the parent materials and pedogenic age strongly influenced weathering of trace elements (Thanachit *et al.*, 2006; Maniyunda, 2012). Parent materials significantly (p≤0.05) contributed to variation in relative weathering retention of all trace elemental oxides (Table 5).

4 CONCLUSION

There was evidence of alitization, ferritization and desilication in the studied soils. Parent materials contributed to loss and gain of trace elemental oxides. The soil on schist retained more trace elements than soil on older granite. The older granite soil were more subjected to weathering and pedogenic processes therefore the older granite soil is pedologically older than schist derived soil.

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