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PIXE Analysis for Elemental Composition and Concentrations of Tantalite Samples from Oke-Ogun, Oyo State, Nigeria

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ABSTRACT
The elemental composition and concentrations of heavy metals in solid mineral may be a reflection of their economic value and their effects on the environment. Tantalite samples from Oke-Ogun were subjected to elemental analysis using Particle Induced X-ray Emission (PIXE) technique. Twelve samples of tantalite ore [(Fe, Mn) Ta_2O_6], were obtained from the mining sites. 500 mg of the pulverized samples were pelletized for their elemental composition and concentrations using the PIXE technique. The total number of elements found in the selected (Komu, Eluku, Gbedu and Sepenteri) falls within the range of 16 −27 elements. Na, Mg, Si, S, K, Ca, Ti, Cr, Mn, Fe, Ni, Zn, As, Sr, Zr, Nb, Ta, W, Bi, Pb. V, P, Mo, Hf, Al, and Rb were reported for the study. Harmful elements like Pb, Cr, As, Zn and Sr were found in samples from the sites with concentrations in the range of (240−3000) ppm which is greater than the limits specified by the abundance elements in average crustal rock (2−311) ppm. The range of tantalite concentrations in all the sites falls within the range of (111,000−370,000) ppm and comparing the range with tantalite samples from other nations reveals that the tantalite from the selected sites are more enriched in tantalite content and by inference will be more of economic values than those from compared nations.

Keywords:
PIXE,
Tantalite,
Elemental composition,
Concentration,
Heavy metals.

INTRODUCTION

Mining activities leads to disequilibrium from the stable state of rocks and solid minerals in the earth crust. These activities release the heavy metals in rocks/minerals such that they find their ways into the streams, rivers and eventually the food chain through absorption by plants of which man and animals are final consumers. Olaleye and Oluyemi (2010), Aigbedion and Iyayi (2007), Mokobia *et al.*, (2006), Mokobia and Balogun (2004) explained the adverse effects of mining activities to include ecological disturbance, destruction of natural flora and fauna, pollution of air, land and water, instability of soil and rock masses, landscape degradation and radiation hazards. Some Tantalite composites are toxic and the lack of standards in its excavation and production can result in pollution to the immediate environment which may be of negative health effect to man and animals. The study area is known for mining of tantalite ore [(Fe, Mn) Ta_2O_6] for its multi-purpose uses with increasing demand due to it usage in capacitor production. Sequel to the dwindling price of crude oil, an expert in the Mining Industry, Abdullahi Usman, popularly called "Dan China", has called on the Federal government to ensure the inclusion of the mining and minerals sector in her developmental agenda, saying if properly harnessed, the sector will generate five times what the country is getting from crude oil (The Daily Dream, 2015). With reference to his passionate statement of purpose in president of Nigeria inaugural speech: **"**unemployment, notably youth's unemployment features strongly in our party's Manifesto. We intend to attack the problem frontally through revival of agriculture, solid minerals mining as well as credit to medium size businesses to kick-start these enterprises**"** (Find Jobs in Nigeria, 2015). The president's plight to invest in solid minerals will be accompanied with increase in mining activities not only in the study area but in Nigeria at large. Hence, the study will be of importance if the elemental composition and concentrations of tantalite can be investigated since it will serve to indicate the quality of tantalite and possibly indicate the toxic heavy metals if any. The work is aimed at determining the elemental composition and concentrations of the tantalite samples from the selected mining site and compares its percentage composition with that of other countries. This aims to identify the mineral potentials for exploration and exportation of the tantalite from the selected sites thereby accessing the economic value and also broadening the existing database on this subject of interest.

MATERIALS AND METHODS

Description of the study location

The study locations are Komu (KO), Sepenteri (SP), Gbedu (GB) and Eluku (EL) villages in Itesiwaju, Saki East, Iwajowa and Saki Local governments respectively all in Oke-Ogun, Oyo State, Nigeria. Oke – Ogun (7°19'60" N and 4°4'0" E) is a populated place in Oyo State with a population of 1.4million according to 2006 population census. It is located at an elevation of 188 meters above sea level (Oke-Ogun, 2015). The residents in the selected mining areas are largely artisan miners and farmers. The Location map is shown in Figures 1 indicating the selected mining sites for the study. The geological map for the sites is shown in Figure 2 indicating the types of rocks that constitute the land scope of the selected sites for the study.

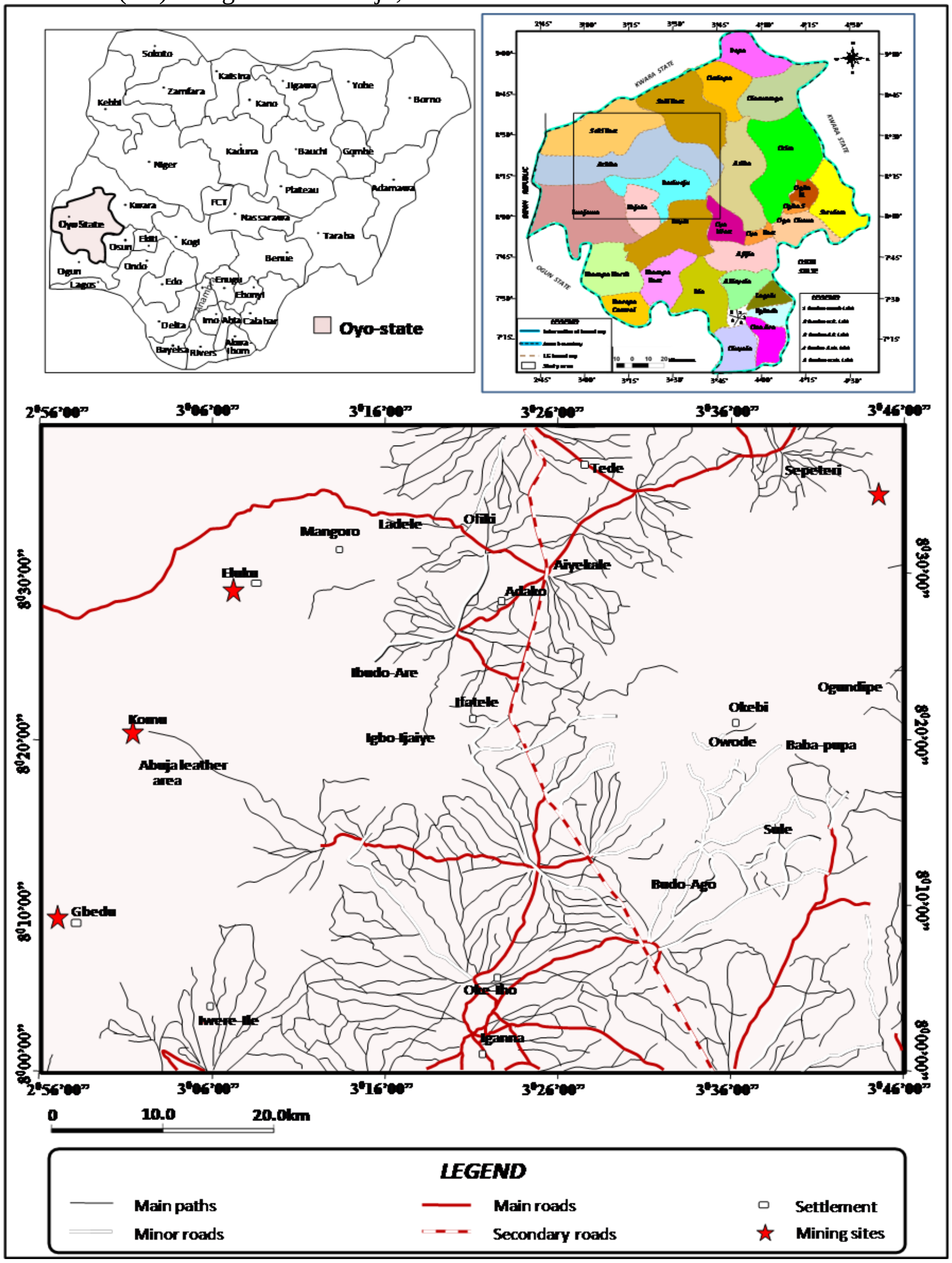

Figure 1: Location Map of the study area

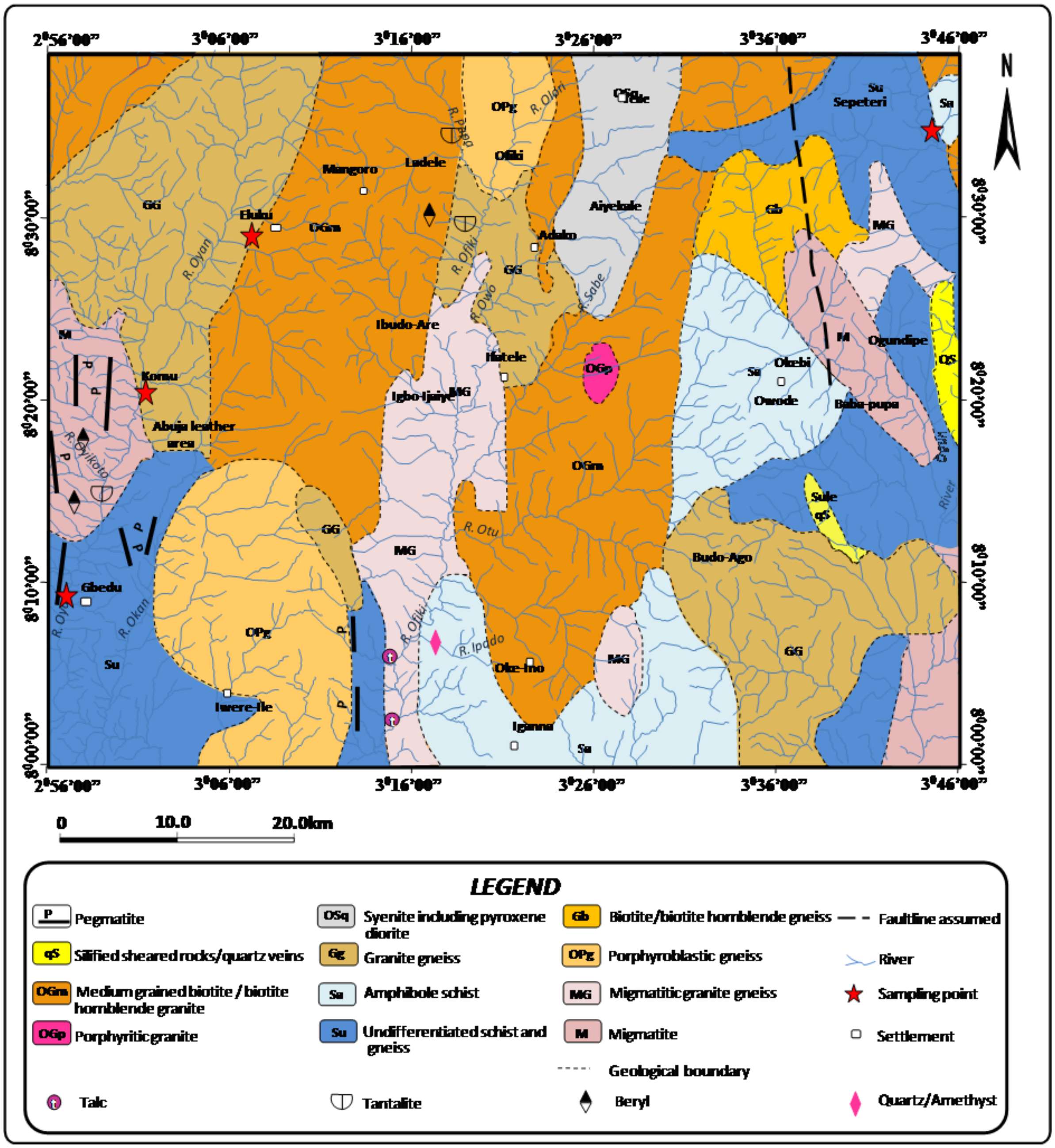

Figure 2: Geological Map of the study area, Oke- Ogun, Oyo State (Abayomi et al., 2022)

Sampling and sample preparations

A total of nine samples were purchased from the miners and dealers of Tantalite at the sites. Appropriate codes (labels) were used to identify these samples and were taken to the Centre for Energy Research and Development (CERD), Obafemi Awolowo University Ile -Ife for analysis. At CERD, the samples were broken into pieces and crushed into powdery form using a small porcelain mortar and piston. They were made into pellets of 500mg and 13mm diameter by using pellet making set that consists of a speck, chop, dice, and hydraulic press (Obiajunwa *et al.*,2002; Obiajunwa and Nwachukwu, 2000).

Particle Induced X-Ray Emission (PIXE) Analysis

The Particle Induced X-Ray Emission (PIXE) analysis was carried out using proton beams produced by the Channels of Particle Induced X-ray Emission Equipment of the 1.7 MeV Tandem accelerator located at the CERD, Nigeria shown in Figure 3. The PIXE system was calibrated using an in-house calibration system and the National Institute of Standards and

Technology (NIST) geological standard NBS 278 and Obsidian rock was used for the quality assurance and control of results (Obiajunwa and Nwachukwu, 2000). The IBA facility used in this analysis consists of a 5SDH modeled NEC Tandem Pelletron accelerator completed with an end station made up of an aluminum chamber of about 150 cm in diameter and 180 cm high. The samples were irradiated by a 4 mm diameter beam of protons with energy of 2.5 MeV and beam current of 0.2 nA for 900 seconds. The chamber of the accelerator has four ports and a window. Port 2 which is inclined at 135^0 to the horizontal is used for the PIXE detector. This detector is an ESL X30-150 model of a Cambera Si (Li Detector Resolution 175 eV at 5.9 keV), coupled to a Canberra Inspector-2000 Digital Signal Processor. Canberra Genie-3.1 software was used for the acquisition of the PIXE data (Obiajunwa *et al.*, 2005; Alhassan *et al.*, 2010) while the Cupxwin computer code was used for fitting the experimentally generated PIXE spectrum before quantitative analysis (Campbell *et al.*, 2002). A filter placed between the detector and the samples cuts off unwanted signal frequencies.

Figure 3: Channels of Particle Induced X-ray Emission Equipment

RESULTS AND DISCUSSION

The section presents the result of the elemental compositions and concentrations of tantalite samples using Proton Induced X-ray emission (PIXE).

Concentrations of elemental components of Tantalite

The percentage composition of elements and their corresponding oxides in the tantalite from the selected mining sites are also presented. The percentage analysis of the elemental components and their respective oxides is of industrial importance to various industries, telecommunication companies, and electronics companies that use tantalite for diversified purposes.

In Table 1, a total of 24 elements were detected in the Tantalite samples from the Komu (KO) mining site. These include Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Zn, Rb, Sr, Zr, Nb, Sn, Hf, Ta, W, Pb, and Mo. The results showed that the elements Ta, Nb, Mo, and Mn are preferentially enriched according to the order of arrangement with percentage compositions of 28.2%, 17.66%, 14.83 and 10.42% respectively.

Some elements that can be harmful to humans and the environment were also detected but with low concentrations. Such elements include Pb, Ti, S, Rb, P, Cl, Zn, Sr with percentage compositions of 0.03%, 1.61%, 0.33%, 0.01%, 0.19%, 0.01%, 0.01% and 0.02% and concentrations of 2163.14 ppm, 16136.80 ppm, 2928.42 ppm, 1000.18 ppm, 762.04ppm, 807.79 ppm, 562.40 ppm and 245.60 ppm respectively. These values are greater than the average abundance of chemical elements in crustal rock/ continental crust with values of 12.5 ppm, 0.57%, 260ppm, 900ppm, 1050 ppm, 130ppm, 70 ppm, and 375 ppm respectively, Taylor,1964. The crustal rocks/continental crust are major sources of minerals to humans via the plants grown using fertilizers made from phosphate and potash, meat and poultry animals that eat fodder grown with mineral-based fertilizers that may be supplemented with selenium, phosphorus, or zinc. The drainage map (Figure 2) of the study area showed enormous underlying river pathways that can enhance the dissolution of minerals in rocks, soil, tantalite ores, and other solid minerals and there is an established link between the mining sites and nearby villages during the rainy season. With the established link, the effluents from the sites can easily access the food chain, and the measured concentrations of these heavy metals may be detrimental to humans.

The Rare element Mn (104218.60 ppm) and its oxide MnO (134570.00 ppm) are present in the samples and with percentage compositions of 10.42% and 13.46% respectively. According to Hambidge *et al. (*1987) and Adejumo *et al.* (1994), rare elements can be harmful to health if the concentrations exceed some limit. Elements Hf, Zr, Cu, Pb, and Rb were detected as impurities and according to Alhassan *et al. (*2010), the presence of these impurities determines the separation method used for extraction of metals that co-exist with naturally occurring radionuclides. Cu and Zn are essential for living organisms but elements like Pb and Al are toxic to living organisms (Virha *et al.*, 2011). In the case of inadvertent ingestion of particles of tantalite by the miners during work activities, the concentration (2163.14 ppm) of tantalite is greater than the abundance of chemical elements in the continental crustal rock set by Taylor, 1964, (2.0ppm) which is the closest comparison for tantalite in the solid form.

Table 1: Results of PIXE Analysis for Tantalite Samples from KO Mining Site

Elements	Concentration (ppm)	% Composition	Oxide	Concentrations (ppm)	% Composition
Na	684.25 ± 97.70	0.081	Na_2O	713.66 ± 131.70	0.063
Mg	286.40 ± 18.79	0.034	MgO	475.00 ± 196.99	0.042
Al	2172.6 ± 157.71	0.258	Al_2O_3	4091.68 ± 297.99	0.360
Si	65026.00 ± 257.67	7.7152	Si_2O	139111.80 ± 714.85	12.245
P	762.04 ± 515.82	0.090	P_2O_5	1745.94 ± 1181.93	0.154
S	2928.42 ± 907.17	0.347	SO_2	7311.79 ± 1812.47	0.644
Cl	807.79 ± 102.59	0.096	Cl_2O	999.20 ± 125.74	0.088
K	2120.80 ± 120.24	0.252	K_2O	2554.60 ± 144.84	0.225
Ca	12800.40 ± 78.30	1.519	CaO	17910.20 ± 109.56	1.577
Ti	16136.80 ± 78.25	1.915	TiO_2	22576.80 ± 130.57	1.987
Cr	241.80 ± 41.34	0.029	Cr_2O_3	192.79 ± 60.39	0.017
Mn	104218.60 ± 182.09	12.365	MnO	134570.00 ± 235.12	11.846
Fe	26948.80 ± 281.63	3.197	Fe_2O_3	38531.20 ± 404.66	3.392
Zn	562.40 ± 47.19	0.067	ZnO	700.00 ± 58.74	0.062
Rb	1000.18 ± 50.15	0.119	Rb_2O	109.5 ± 54.84	0.010
Sr	245.60 ± 35.18	0.029	SrO	290.4 ± 41.60	0.026
Zr	2503.60 ± 104.69	0.297	ZrO_2	3381.80 ± 141.39	0.298
Nb	208266.80 ± 337.30	24.710	Nb_2O_5	252561.60 ± 1930.04	22.232
Sn	5827.79 ± 1562.34	0.091	SnO_2	7398.78 ± 1983.48	0.651
Hf	1208.20 ± 938.88	0.143	HfO_2	1424.60 ± 1101.03	0.125
Ta	287043.80 ±619.84	34.057	Ta_2O_5	350506.00 ± 756.86	30.854
W	10597.80 ± 2214.24	1.257	WO_3	13364.80 ± 2406.94	1.176
Pb	2163.14 ± 757.00	0.257	PbO	2330.22 ± 815.51	0.205
Mo	88765.85±12439.91	10.474	MoO_3	133174.77±18663.51	11.7

Detectable Limits for Na, Al, P, Cr, Rb and Mo are 162.87, 260.20, 465.30, 57.4, 92.30 and 26735.20 respectively.

Molybdenum (Mo) was also detected in the tantalite sample and when extracted and refined, it can be used as glass furnace electrodes due to its high melting point. It can also be used in the petroleum industry, to catalyze the removal of organic sulfur compounds in coal liquefaction and gas liquefaction processes.

The percentage composition of the Tantalite and its Oxide, Ta_2O_5 (34.06% and 30.85%) from this site is greater than the values reported by Alhassan *et al.* (2010), (13.10% - 31.99%). Ruiz *et al.* (2004) reported 10% Ta_2O_5 while Funtua (1999a) reported 21 - 30% Ta_2O_5 and Adetunji *et al.* (2005) reported 8% - 59.8% Ta_2O_5. Tantalite from this site is also rich in Niobium and its oxide with percentage composition of 24.71% and 22.23% respectively. Niobium oxide has a high index of refraction, high dielectric constant, and transmission light optimization and it's used for camera lenses, computer screen coatings, and ceramic capacitors. It can also be a substitute for tantalum.

A total number of 23 elements were detected from the Tantalite sample from the EL mining site (table 2). These include the following: Na, Si, P, Cl, S, K, Mg, Sr, Zr, Sn, Mn, Fe, Cr, Zn, As, Ta, W, Bi, Nb, Ca, Ti, V and Pb. Tantalite samples from this site are preferentially enriched in the order W, Fe, Mn, Sn, Si, Pb, and Cr with their percentages in the order 49.39%, 10.34%, 10.10%, 9.63%, 6.97%, and 2.47% respectively.

Comparing the concentration of Ta (367618.80 ppm), As (117.05), Cr (380.30), and Pb (1492.70) in the Eluku (EL) site are higher than the values for an average abundance of chemical elements in average crustal rock/ continental crust, (AEACR) set by Taylor (1964) with values 10ppm,2ppm, 100ppm, and 10 ppm respectively. This suggests that work scenarios like the crushing of tantalite can be a source of exposure to heavy metals (As) for miners and dealers in tantalite. The U.S. Occupational Safety and Health Administration (OSHA) mandates permissible limits for arsenic occupational exposure. The permissible exposure limit recommended for arsenic is no greater than 10 micrograms of inorganic arsenic per cubic meter of air, averaged over any 8 hours for a 40-hour workweek (OSHA, 2001; NIOSH, 2005).

Arsenic is a natural component of the earth's crust and is widely distributed throughout the environment in the air, water and land. It is highly toxic in its inorganic form. Contaminated water used for drinking, food preparation and irrigation of food crops poses the greatest threat to public health from arsenic. Prolonged exposure to arsenic from drinking-water and food can cause cancer and skin lesions. It has also been associated with developmental effects, cardiovascular disease, neurotoxicity and diabetes (WHO, 2012).

Table 2: Results of PIXE Analysis for Tantalite Samples from EL Mining Site

Elements	Concentrations (ppm)	% Composition	Oxide	Concentrations (ppm)	% Composition
Na	258.35 ± 130.18	0.035	Na_2O	348.25 ± 214.37	0.040
Mg	415.95 ± 155.97	0.056	MgO	688.18 ± 550.30	0.079
Si	71651.35 ± 412.38	9.628	Si_2O	5530.61 ± 5279.62	0.638
S	914.20 ± 212.35	0.123	SO_2	1826.51 ± 424.26	0.211
K	319.80 ± 78.99	0.043	K_2O	265.48 ± 214.78	0.031
Ca	2585.45 ± 70.66	0.347	CaO	3617.58 ± 3545.77	0.417
Ti	18345.5 ± 111.09	2.465	TiO_2	30756.13 ± 29373.54	3.548
Cr	380.30 ± 40.37	0.051	Cr_2O_3	555.83 ± 59.00	0.064
Mn	76978.10 ± 231.67	10.344	MnO	99396.16 ± 38621.46	11.467
Fe	59812.90 ± 326.49	8.037	Fe_2O_3	84415.79 ± 79420.27	9.738
Ni	151.41 ± 49.52	0.020	NiO	192.71 ± 63.03	0.022
Zn	1067.75 ± 72.65	0.143	ZnO	1329.99 ± 708.30	0.153
As	117.05 ± 95.33	0.016	AS_2O_5	179.54 ± 146.05	0.021
Sr	168.35 ± 46.22	0.023	SrO	199.09 ± 177.71	0.023
Zr	1383.75 ± 115.91	0.186	ZrO_2	1869.13 ± 1181.71	0.216
Nb	75172.85 ± 499.91	10.101	Nb_2O_5	107536.6 ± 102192.40	12.406
Sn	237.78 ± 112.26	0.032	SnO_2	301.87 ± 142.52	0.035
Ta	367618.80 ± 969.7	49.395	Ta_2O_5	448880.9 ± 141044.60	51.784
W	10134.55 ± 3790.93	1.362	WO_3	12780.55± 7182.07	1.474
Bi	51843.80 ± 3375.03	6.966	Bi_2O_3	57797.5 ± 3762.62	6.668
Pb	1492.70 ± 1069.37	0.201	PbO	1607.96 ± 1151.94	0.185
V	568.80 ± 134.92	0.076	V_2O_3	836.77 ± 198.42	0.097
P	2585.20 ± 297.57	0.347	P_2O_5	5923.64 ± 681.84	0.683

Detectable Limit for P, S, Ni, Sn and Pb are 331.90, 418.4, 49.52, 112.26 and 1069.3

Seventeen elements were detected in the tantalite samples from the GB mining site (Table 3). These include Na, Mg, K, Ca, Ti, Mn, Fe, Zn, Sr, Zr, Nb, Hf, Ta, W, Pb, V and Bi. The preferential enrichment of the Tantalite from the site is Nb, Ta, Bi, W, Si, and Fe with percentage composition of 41.08%, 28.69%, 11.06%, 11.03%, 6.61%, and 6.37% respectively. It is worth noting that in the Tantalite sample from the GB site, the percentage composition of Niobium (41.08%) is greater than that of Tantalite (28.69%). The Tantalite mined in this site is rich in Niobium. Niobium is used with iron and other elements in stainless steel alloys and also in alloys with a variety of nonferrous metals, such as zirconium. Niobium alloys are strong and are often used in pipeline construction. The metal is used in superalloys for jet engines and heat-resistant equipment. Similarly, the percentage composition of Niobium oxide (33.27%) is quite greater than that of Tantalite (19.83%).

A low percentage of Bismuth was detected in the analysis of the samples using PIXE. Bismuth has no known biological role and is non-toxic. Other heavy metals are generally known to have negative health effects if present in high concentrations such as Pb, Zr, e.t.c have a percentage composition of less than 1%. Once again, the concentration of Lead in the Tantalite is higher (2391.2ppm) than an average abundance of chemical elements in crustal rocks (12.5 ppm, Taylor,

1964) and hence if particles of tantalite are ingested unknowingly during work activities can be negative health effect. The percentage composition of Tantalite and its oxide is greater than (28.69 % and 19.83%) that of Ruiz *et al.* (2004) which reported 10% Ta_2O_5.

Table 3: Results of PIXE Analysis for Tantalite Samples from GB Mining Site

Elements	Concentration (ppm)	% Composition	Oxide	Concentrations (ppm)	% Composition
Na	148.40 ± 181.15	0.027	Na_2O	199.50 ± 244.18	0.020
Mg	200.70 ± 188.80	0.036	MgO	332.82 ± 313.08	0.033
Si	36833.90 ± 357.29	6.613	Si_2O	78800.06 ± 764.36	8.008
K	663.50 ± 93.82	0.119	K_2O	799.26 ± 113.02	0.081
Ca	3655.00 ± 90.64	0.656	CaO	5114.10 ± 126.82	0.519
Ti	6527.80 ± 92.04	1.172	TiO_2	10890.39 ± 153.55	1.107
V	220.00 ± 65.63	0.039	V_2O_3	323.64 ± 96.55	0.033
Mn	13081.80 ± 313.95	2.349	MnO	168991.57 ± 405.38	17.174
Fe	35502.50 ± 415.38	6.374	Fe_2O_3	50105.77 ± 586.24	5.092
Zn	597.30 ± 59.97	0.107	ZnO	721.04 ± 74.64	0.073
Sr	73.00 ± 60.10	0.013	SrO	86.33 ± 71.07	0.009
Zr	1055.30 ± 154.81	0.189	ZrO_2	1425.47 ± 209.11	0.145
Nb	228813.10 ± 1928.78	41.081	Nb_2O_5	327322.79 ± 2759.17	33.265
Ta	159826.50 ± 687.25	28.695	Ta_2O_5	195156.24 ± 839.17	19.833
Pb	2391.20 ± 1078.19	0.429	PbO	2575.84 ± 1161.44	0.262
Bi	61646.70 ± 2860.41	11.068	Bi_2O_3	68726.15 ± 3188.90	6.984
W	5742.40 ± 2059.80	11.031	WO_3	72421.66 ± 2597.59	7.360

Twenty elements were detected in the sample from the SP site as seen in Table 4 and these include Na, Mg, Al, Si, K, Ca, Ti, V, Mn, Fe, Zn, As, Sr, Zr, Nb, Hf, Ta, W, Pb and Bi. The preferential enrichment of the elements in the sample is of the order 49,92%, 14.62%, 9.64%, 8.57%, 6.18%, 4.87%, and 3.32% for Bi, Ta, Mn, Nb, Fe, Ti, and Si respectively. The percentage composition of the corresponding oxide is as follows: 44.21%, 14.18%, 9.88%, 9.75%, 6.93%, 6.46%, and 5.65% for Bi, Ta, Nb, Mn, Fe, Ti, and Si respectively. The percentage composition of the remaining elements and their corresponding oxides are less than unity. The toxic heavy metals are also in low concentration such that they may not pose any serious health implications for the workers and the general public if they find their way into the surrounding environment.

Again, comparing the concentration of arsenic (137.60 ppm) in tantalite from the SP mining site with the limit set by Taylor, 1964 for abundance elements in average crustal rock, the concentration value exceeds the limit (2.0 ppm). The concentration of Lead in tantalite is higher (4086.00 ppm) than the known average abundance of chemical elements in crustal rocks (10.1 ppm, Taylor, 1964). The concentration of arsenic (137.60) in the SP mining site is greater than the average abundance of chemical elements in crustal rock (1.8 ppm)

Table 4: Results of PIXE Analysis for Tantalite Samples from SP Mining Site

Elements	Concentration (ppm)	% Composition	Oxide	Concentrations (ppm)	% Composition
Na	140.80 ± 111.60	0.018	Na_2O	189.79 ± 150.73	0.020
Mg	211.40 ± 121.49	0.028	MgO	350.56 ± 210.46	0.036
Al	1851.30 ± 159.21	0.242	Al_2O_3	3497.97 ± 300.82	0.363
Si	25433.20 ± 239.07	3.324	Si_2O	54410.14 ± 511.45	5.648
K	260.90 ± 105.58	0.034	K_2O	216.59 ± 87.87	0.022
Ca	5445.60 ± 89.85	0.712	CaO	7619.52 ± 125.72	0.791
Ti	37321.10 ± 167.94	4.877	TiO_2	62263.17 ± 280.18	6.464
V	2595.40 ± 151.57	0.340	V_2O_3	3818.12 ± 222.98	0.396
Mn	73748.90 ± 228.62	9.638	MnO	95226.53 ± 295.20	9.885
Fe	47302.70 ± 312.20	6.182	Fe_2O_3	66759.76 ± 440.62	6.930
Zn	112.20 ± 38.09	0.015	ZnO	139.65 ± 47.41	0.015
As	137.60 ± 164.29	0.018	AS_2O_5	211.06 ± 251.10	0.022
Sr	340.80 ± 55.11	0.046	SrO	403.03 ± 65.17	0.042

Zr	3758.40 ± 167.99	0.491	ZrO_2	3725.97 ± 226.92	0.387
Nb	65622.25 ± 481.29	8.567	Nb_2O_5	93874.25 ± 688.49	9.745
Hf	356.70 ± 512.44	0.047	HfO_2	420.65 ± 604.31	0.044
Ta	111888.00 ± 503.49	14.622	Ta_2O_5	136620.5 ± 614.79	14.182
W	2593.00 ± 1391.40	0.339	WO_3	3269.10 ± 1754.68	0.339
Pb	4086.00 ± 1920.01	0.543	PbO	4401.51 ± 2068.27	0.457
Bi	382022.00±3132.58	49.923	Bi_2O_3	425894.30 ± 3492.33	44.211

Table 5: Characterization of Percentage Composition of Tantalite and its Oxide from the selected Mining Sites with other Countries Mining Tantalite

Deposit	Location	Concentration of Oxide (ppm)	Concentration of Tantalite (ppm)
Anita	Canada	190	155.60
Motzfeldt	Greenland	110-130	90.09-106.47
Kanyika	Malawi	180	147.41
Abu-Dabbab	Egypt	250	204.74
Upper Fir	British Columbia	190	155.60
Marropino	Mozambique	230	188.36
Nuweibi	Egypt	140	114.66
Crevier	Canada	230	188.36
Komu	Nigeria	350506	287043.80
Eluku	Nigeria	44881.0	367619.00
Gbedu	Nigeria	195156	159826.00
Sepenteri	Nigeria	136620.0	111888.00

Source: British Geological Survey(https://www.bgs.ac.uk/mineralsuk/statistics/world-mineral-statistics/world-mineral-statistics-archive/) and Present Study

The Tantalite from the selected mining site KO, EL, GB and SP has concentrations in the range of (111,000‒370,000) ppm. Comparing this range with the concentrations from the countries listed above, it is obvious that the Tantalite from the sites is of notable higher economic value due to the fact that they are richer in its Tantalite content thereby facilitating their importance in multi- purposes uses of Tantalite.

CONCLUSION

Na, Mg, Si, S, K, Ca, Ti, Cr, Mn, Fe, Ni, Zn, As, Sr, Zr, Nb, Ta, W, Bi, Pb. V, P, Mo, Hf., Al, and Rb were reported using PIXE for elemental composition and concentration of tantalite samples from the study area. The concentrations of these metals are generally greater than the average abundance of chemical elements in crustal rocks/ continental crust and greater than concentrations of samples from other nations. This suggests a strong reason for the exploration and exportation of tantalite from the selected mining sites for the study.

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