*Available online www.jsaer.com*

***Journal of Scientific and Engineering Research*, 2018, 5(5):22-32**

**Research Article**

**ISSN: 2394-2630**
**CODEN(USA): JSERBR**

# Petrography and Geochemistry of Birimian Gold deposit, NW Ashanti Belt, Ghana

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**Abstract** Petrographic and geochemical investigations have been done on rocks that host the Homase gold deposit located in the northwestern part of the Ashanti Belt in the Birimian of Ghana. The hanging wall and footwall of the gold mineralised zone are made up of phyllite and biotite-chlorite schist with tonalite intrusion in the hanging wall whilst the ore zone is composed predominantly of sheared phyllite and biotite-chlorite schist which are frequently characterised by chlorite, quartz and carbonate alterations. Metamorphism is in the lower greenschist facies. Whole rock geochemical analysis of major oxide concentrations in wt% shows significant variation in total FeO (5.12-7.25 in host rocks and 8.32-17.68 in ore zone). Arsenic content is higher in the ore zone (293.9-4471 ppm) than in host rocks (5.3-114.1 ppm). Probable protoliths for the phyllites and biotite-chlorite schist which have undergone considerable shearing are calc-alkaline basalts which were emplaced in a continental arc environment.

**Keywords** Petrography, Geochemistry, Gold, Ashanti belt, Birimian, Ghana

## Introduction

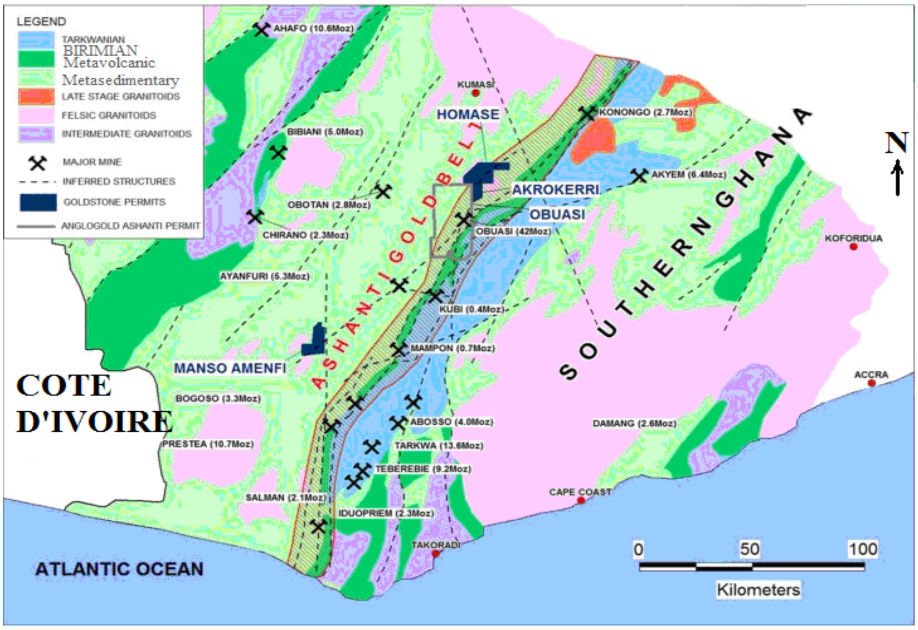


*Figure 1: Geological map of southwestern Ghana showing the location of Homase gold deposit [1]*

The Homase Gold deposit is owned by Goldstone Resources Limited, a South African exploration company in Ghana located about 15 km north-northeast of Anglogold Ashanti, Obuasi mine. The deposit is located in the

Amansie Central District in Ashanti Region. It lies within the area occupied by metasedimentary rocks with associated granitoid intrusions and in contact with metavolcanic rocks.

Due to shearing by a NE trending thrust at the northwestern flank of the Ashanti belt, the rocks which are referred to as phyllites have lost their original fabric. They are therefore classified as metasedimentary rocks. This study is on petrography and geochemistry of the rocks within Homase gold deposit to help describe the rocks, their alteration and to unravel their protoliths.

The deposit occurs in Ghana Survey field sheet number 0602C2 on the northwestern flank of the Ashanti volcanic belt which hosts Anglogold Ashanti Obuasi mine and mines located at Prestea, Bogosu and Konongo (Fig. 1).

The deposit is bounded by longitudes 1° 30´ and 1° 40´ west and latitudes 6° 20´ and 6° 25´ north giving an approximate concession area of 115 square kilometres. The project is accessible from Obuasi in the south and Kumasi to the north through tarred roads. A number of well-maintained second class roads provide good vehicular access through the concession. A railway line that extends from Takoradi to Kumasi passes through the property in north-south direction.

**Regional Geological Setting**

The Birimian forms a greater portion of the Man shield which occupies the southernmost third of the West African craton. On the east and southeast part of the craton is the Pan African domain that has remained stable since 1.7Ga. The Man shield comprises of a western domain consisting essentially of Archaean rocks of Liberian age (3.0–2.5Ga) and an eastern domain consisting of Birimian rocks of early Proterozoic age (2.1Ga) which have been deformed and metamorphosed during the Eburnean Orogeny [2]. This orogeny is characterised by isoclinal folding as well as an intrusion of pre-, syn-, and post-tectonic granites [3].

The Birimian rocks occupy about twenty percent of the total area of Ghana, and forms part of the West African craton that outcrops extensively in other parts of West Africa, including southwestern Niger, Côte d'Ivoire, Burkina Faso and Mali. The Birimian of Ghana is at the eastern portions of the West African craton.

Early Proterozoic Birimian (2100 Ma) constitute a major geological province in Ghana. It is an economically important source of gold, diamonds, manganese and other precious minerals [4]. An interesting feature of the Birimian in Ghana is the parallel NE-SW trending, evenly spaced volcanic belts of folded metavolcanic rocks. These are separated by the intervening isoclinally folded metasedimentary basins. Both the basin and belts are intruded by massive granitoids [5].

The Birimian rocks consist of metamorphosed sedimentary rocks and volcanic rocks which have now been altered and metamorphosed to chlorite zone of the greenschist facies with amphibolite facies assemblage occurring along the margins of granitoids [5, 6].

The sedimentary unit was considered older than the metavolcanic unit [7, 8, 9]. This has, however, been a topic of debate with neighbouring Francophone geologists accepting the reverse of the stratigraphy as they considered the metasedimentary units as older than the metavolcanic units [10, 11, 12]. Recent studies have shown that the Birimian is a supergroup with the two rock units being contemporaneous, deposited in submarine environment and form a lateral facies [5].

**Local Geology**

The Homase concession is underlain by metasedimentary rocks of the Birimian Supergroup predominantly made up of grey and black banded phyllites, silicified phyllites and schists. Large granitoids have intruded the metasedimentary units over the western boundary of the concession. Generally, the rocks dip sub-vertically or steeply to the northwest and strike north-northeast and exhibit up to greenschist facies regional metamorphism with the metasedimentary rocks close to the granitoid batholith displaying various degrees of contact metamorphism [13].

Mineralogical study in neigbouring Obuasi and its environs showed that gold mineralisation was not limited to only the auriferous quartz ore bodies, but that disseminated sulphide mineralisations also occur in sheared schistose and fractured rocks of all lithologies close to the ore channel [14].

Though the Homase area, on the northwestern flank of the Ashanti belt, hosts gold mineralisation in sheared metasedimentary rocks, no detail petrological and mineralogical study was done to understand the textural characteristics and mode of emplacement of the host rocks and orebody as geological information previously was obtained from mapping, soil sampling, trenching and drilling for exploration data.

**Materials and Methods**

Old soil grid lines were opened up, and used for outcrop mapping supplemented by lithological and structural logging of stored RC chips and diamond drill cores to gather geological and structural information. Core from 19 oriented boreholes were logged with three boreholes sampled from central, northern and southern portions of the deposit to give true reflection of the rocks. 16 representative fresh oriented rock samples from the hanging wall through to the footwall of the deposit were selected for thin and polished sections and whole rock geochemical studies.

Preparation of thin and polished sections was carried out at the Department of Geological Engineering of the University of Mines and Technology (UMaT), Tarkwa, Ghana and described using SM Lux Leitz microscope fitted with Sony Cyber Shot digital camera and computer.

Whole rock geochemical analysis was done on representative rock samples after each sample was crushed in rock lab jaw crusher to -2mm size fraction and then milled to -75 microns using a rock lab mill, bagged in an envelope and well labelled. The culture of cleaning was strictly adhered to at every stage to prevent contamination. After the crushing and milling processes were completed, all samples were sent to the office of Geological Survey Department (GSD) in Accra for further preparation and chemical analysis by X-ray fluorescence. At GSD, the samples were oven dried at a temperature of about 105 °C for about 20 minutes after which all samples were removed and put in glass desiccators to prevent moisture from getting into the samples whilst cooling. 4g of each sample was collected and mixed with about 0.9g of wax powder, homogenised in a mill for about 5 minutes and then compressed under a pressure load of 15 tonnes to obtain a 32mm diameter disc which is used for the X-ray florescence analysis. SPECTRO X-LAB 2000 multi-element analyser was used for the analysis.

**Petrography**

Careful description of the rocks involved mineralogy and textures. Mineral abbreviations are after [15].

6.1 *Phyllite*

Phyllite is intersected in both the hanging wall and footwall of the mineralisation. It is intercalated with the other metamorphic rocks and occurs either as banded or sheared.

6.1.1 *Banded Phyllite*

This rock type outcrops at the central and northern portions of the study area intercalated with schist. The rock is dark grey to greenish grey, fine to medium grained with quartz carbonate veinlets parallel to foliation. The rock is characterised by alternating bands of strongly sheared dark grey zones of about 1cm thickness which are marked by chlorite against less sheared zones. The fresh rock is fine grained and made up of grey, dark grey and green bands. Quartz carbonate veinlets are parallel and occasionally cut across foliations.

In thin section, the rock contains fine grained, granular to weakly elongated quartz which shows undulose extinction alternating with dark green and fine chlorite. Pyrite is creamy, pale yellow and elongated due to shearing parallel to foliation.

6.1.2 *Sheared Phyllite*

Sheared phyllite is encountered close to fractured zones especially in the hanging wall and within the ore zones. The rock is dark to very dark grey and generally fine grained. Quartz-carbonate veinlets and veins either cut across or are parallel to foliation (Fig. 2).

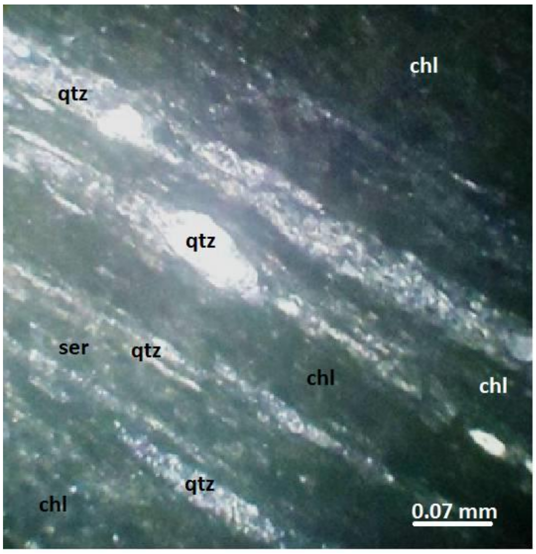


*Figure 2: Photomicrograph of sheared phyllite (sample P2) in thin section showing alternating bands of chlorite and recrystallised quartz. Quartz-1 is elongated or stretched; quartz-2 is a fine granular recrystallised version of quartz-1 whereas quartz-3 is medium to coarse grained and formed by recrystallisation of aggregates of quartz-2 (cross polarised light)*

**Table 1:** Modal percentage of Banded and Sheared Phyllite from Homase deposit

| Mineral/Sample No. | P2 | P7 | P11 | P14 | P13 |
|---|---|---|---|---|---|
| Quartz | 40 | 40 | 47 | 45 | 30 |
| Chlorite | 35 | 24 | 22 | 23 | 25 |
| Sericite | 5 | - | - | - | 3 |
| Biotite | 15 | 35 | 30 | 27 | 40 |
| Py+Aspy+Po+Pn+Cp+Rt | 5 | 1 | 1 | 5 | 2 |
| Total | 100 | 100 | 100 | 100 | 100 |

**Biotite-Chlorite Schist**

Outcrops of this rock are uncommon due to deep weathering in the area and so poorly exposed in trenches. The rock is medium grained and foliated with moderate chlorite, biotite with elongated and fractured quartz along foliation (Fig. 3). Quartz veinlets are also parallel to foliation.

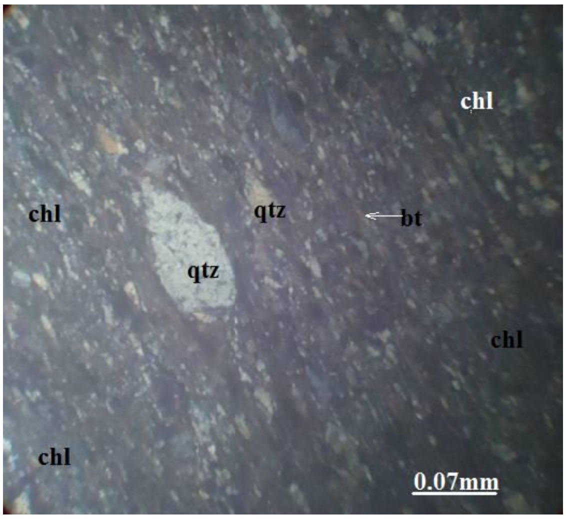


*Figure 3: Photomicrograph of sheared phyllite (sample P12) in thin section showing biotite and chlorite parallel to foliations with quartz-3 as augen porphyroblast from recrystallised aggregates of fine quartz-1 (cross polars)*

**Table 2:** Estimated modal percentage of Biotite-chlorite schist

| Mineral/Sample No | P1 | P4 | P6 | P9 | P10 | P12 | P16 |
|---|---|---|---|---|---|---|---|
| Quartz | 34 | 35 | 44 | 35 | 30 | 25 | 40 |
| Chlorite | 45 | 29 | 40 | 30 | 40 | 39 | 31 |
| Plagioclase | 5 | 15 | 5 | 10 | 5 | 5 | 5 |
| Biotite | 15 | 20 | 10 | 20 | 20 | 30 | 23 |
| Py+Aspy+Po+Cp+Cb+Mkw+Rt | 1 | 1 | 1 | 5 | 5 | 1 | 1 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

**Tonalite**

Outcrops of this rock occur at the western portion of the concession and are mostly found in the hanging wall of the mineralisation. The rock is grey to light green, medium to coarse grained with visible quartz and plagioclase. It is weakly foliated with occasional chlorite alteration.

In thin section, the rock is medium to coarse grained with irregularly oriented, anhedral to subhedral quartz and plagioclase. Elongated amphiboles (hornblende) are altered and deformed into sheared chlorite (Fig. 4). Table 3 shows the modal composition of the rock which plots in tonalite field on a QAP diagram [16].

**Table 3:** Estimated modal percentage of Tonalite

| Minerals | Modal % |
|---|---|
| Quartz | 25 |
| Chlorite | 15 |
| Amphibole | 34 |
| Plagioclase | 20 |
| Biotite | 5 |
| Pyrite | 1 |
| Total | 100 |

**Whole Rock Geochemistry**

Major oxide composition of whole rock geochemical analysis by XRF from the Homase deposit in wt% turned out moderate concentration of $SiO_2$ (58.06-9.84), $Na_2O$ (2.21-0.68), $K_2O$ (3.9–0.74), $Al_2O_3$ (19.24-11.03), $Ti_2O$ (1.39–0.41), total iron as total FeO (17.68-5.12), MnO (0.76-0.06), MgO (6.42-2.8), CaO (6.30–0.81), and $P_2O_5$ (0.30-0.07) (Table 4).

Differences in major oxides in wt% gave $SiO_2$ (44.10-58.06 in host rocks and 39.84-53.71 in ore zone), $Ti_2O$ (0.41-0.69 in host rocks and 0.57-1.39 in ore zone), total FeO (5.12-7.25 in host rocks and 8.32-17.68 in ore zone), MgO (2.87-6.42 in host rocks and 3.55-5.53 in ore zone), CaO (1.25-4.77 in hanging wall, 1.95-4.58 in ore zone and 0.81-6.30 in footwall).

Sheared phyllite in hanging wall has highest $SiO_2$ and lowest MgO and CaO; in the footwall highest values are recorded for $TiO_2$, $Al_2O_3$, total FeO and $K_2O$. Tonalite recorded lowest $SiO_2$, $TiO_2$, $Al_2O_3$ and $K_2O$ with highest total FeO and CaO. In the ore zone, sheared phyllite and biotite-chlorite schist have lowest values of $SiO_2$, $TiO_2$, $Al_2O_3$, total FeO, MgO and CaO; lowest $K_2O$ composition occurs in biotite-chlorite schist; highest composition in phyllite are for $Al_2O_3$, CaO and $K_2O$; in biotite-chlorite schist, highest values were recorded for $TiO_2$, total FeO and MgO.

Deduction of the protoliths of the rocks at Homase is necessary to know whether they belong to the metasedimentary or metavolcanic units of the Birimian. According to [5], these rocks were deposited about the same time and form a lateral facies with one another. Discriminant geochemical plots show that the rocks on the deposit which are phyllites or schists were initially mostly of basalt–andesite; sub-alkaline to alkaline [17, 18] (Figs. 5 and 6). Major oxides plotted on an AFM diagram shows that these rocks are mainly calc-alkaline with the ore being tholeiitic probably due to higher total FeO composition (Fig. 7) [19].

Trace elements composition of the rocks is found in Table 4. Cr (22-701 ppm in non-mineralised rocks; 21-371 ppm in ore zone) shows moderate positive correlation with $Al_2O_3$ ($r^2$=0.564). At Homase, Co content ranges from 35-130 ppm in phyllite and schist, 1300 ppm in tonalite within host rocks and 48-330 ppm in ore zone. For Ni 29.5-275 ppm content is associated with host rocks and 20-561 ppm in ore zone.

To find the tectonic setting of the rocks at Homase in other to constrain the association of the rocks and environment of emplacement, discriminant plots were used to show that they are calc-alkaline or tholeiitic basalts (Figs. 8 to 10) [20, 21, 22].

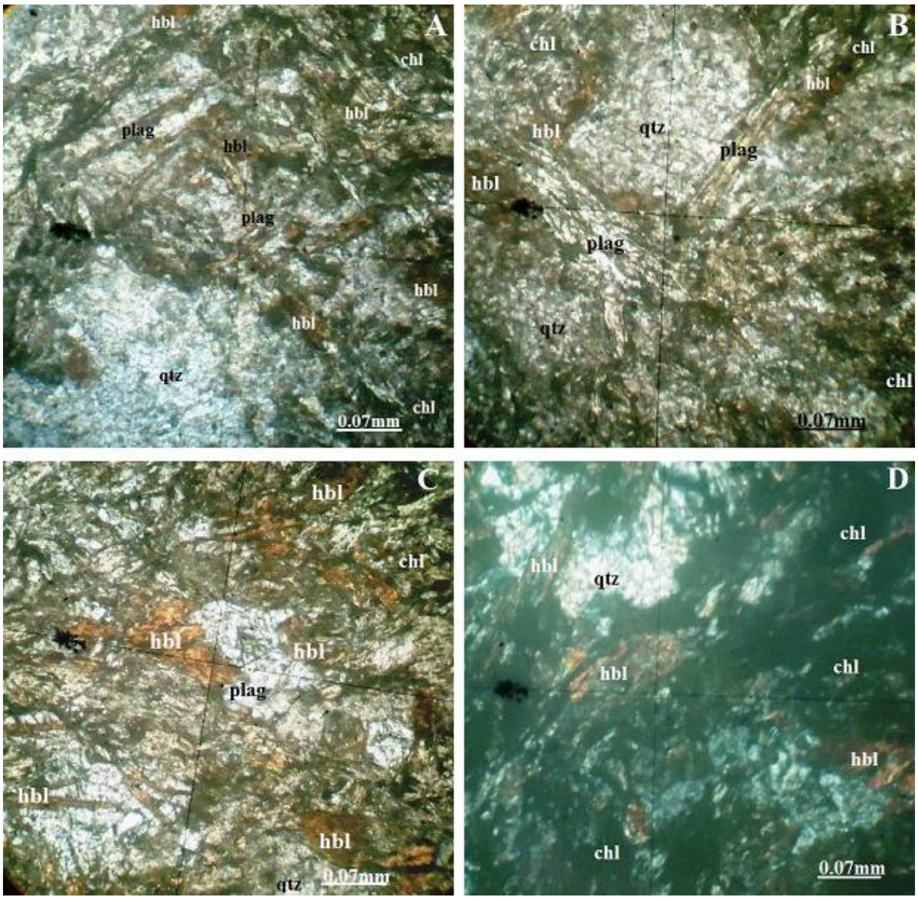


*Figure 4: Photomicrographs of tonalite in thin section (sample P5) showing a) two directions of foliations marked by plagioclase and hornblende (under plane polarised light). b) alteration of amphiboles into chlorite (plane polarised light).*
*c) irregularly oriented elongated amphiboles with intergrowth of plagioclase (plane polarised light). d) chlorite partially replaces amphiboles and forms intergrowth with plagioclase (cross polars)*

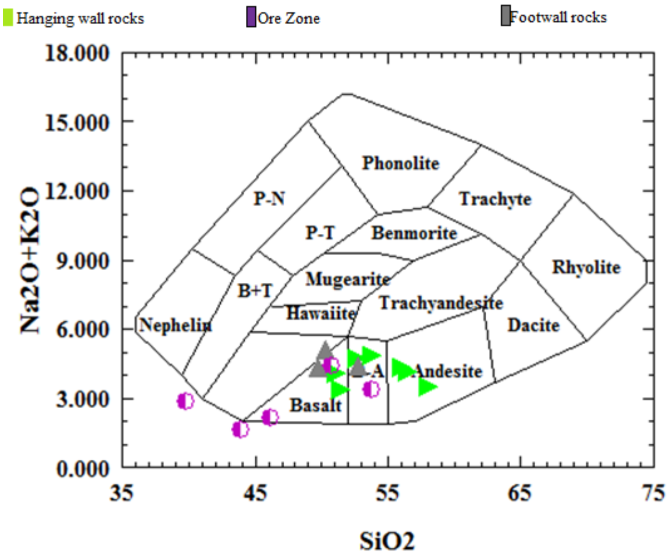


*Figure 5: $SiO_2$ versus $Na_2O + K_2O$ diagram*

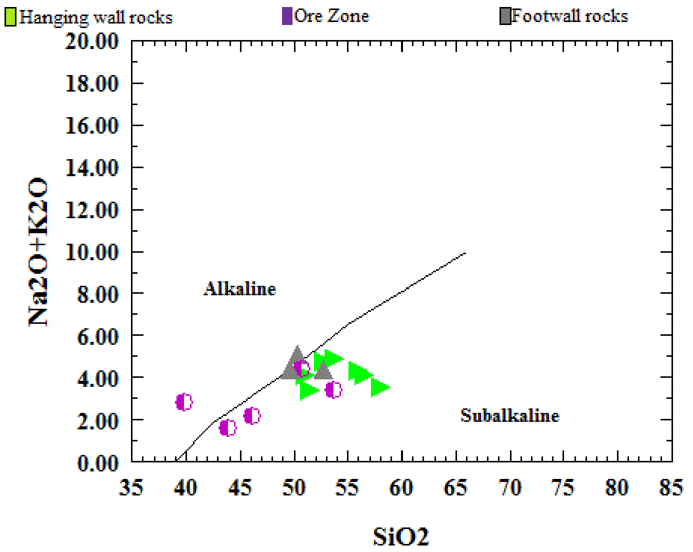


*Figure 6: $SiO_2$ versus $Na_2O + K_2O$ diagram*

**Table 4:** Major Oxide and Trace Elements Composition of Representative Samples from Homase gold deposit

| Lithology | PHYLLITE | | | | | | | | | BIOTITE-CHLORITE SCHIST | | | | | | TONALITE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Hanging Wall | | | | Ore Zone | | | | Footwall | Hanging Wall | | | Ore Zone | Footwall | | Footwall |
| Sample No. | P15 | P3 | P7 | P8 | P9 | P13 | P14 | P2 | P11 | P1 | P4 | P6 | P10 | P12 | P16 | P5 |
| Au Grade (g/t) | 0.01 | 0.02 | 0.04 | 0.01 | 7.51 | 0.57 | 14.5 | 14.7 | 0.05 | 0.01 | 0.01 | 0.02 | 6.8 | 0.02 | 0.01 | 0.01 |
| $SiO_2$ (wt%) | 53.74 | 51.03 | 52.68 | 58.06 | 43.93 | 50.78 | 53.71 | 39.84 | 50.28 | 51.44 | 55.97 | 56.44 | 46.16 | 52.77 | 49.69 | 44.10 |
| $Al_2O_3$ | 17.37 | 17.00 | 16.50 | 13.53 | 13.82 | 17.26 | 15.65 | 13.72 | 19.24 | 14.08 | 15.35 | 16.97 | 14.24 | 14.94 | 15.55 | 11.03 |
| $TiO_2$ | 0.44 | 0.54 | 0.50 | 0.49 | 1.39 | 0.57 | 0.95 | 1.12 | 0.69 | 0.57 | 0.46 | 0.53 | 1.39 | 0.41 | 0.42 | 0.41 |
| $Fe_2O_3$ | 6.65 | 6.96 | 6.29 | 5.95 | 16.35 | 8.32 | 10.15 | 13.76 | 8.49 | 7.20 | 5.12 | 7.19 | 17.68 | 5.47 | 5.56 | 7.25 |
| MgO | 2.97 | 3.61 | 2.91 | 2.96 | 4.93 | 3.55 | 4.67 | 3.77 | 3.62 | 3.47 | 2.93 | 3.46 | 5.53 | 3.59 | 2.87 | 6.42 |
| CaO | 1.58 | 1.96 | 1.25 | 2.19 | 4.03 | 1.95 | 4.58 | 4.74 | 0.81 | 3.37 | 1.43 | 1.67 | 4.35 | 2.23 | 6.30 | 4.77 |
| $Na_2O$ | 1.78 | 1.71 | 1.89 | 1.93 | 0.68 | 1.38 | 1.22 | 1.01 | 1.23 | 1.71 | 2.12 | 2.21 | 1.03 | 2.10 | 1.60 | 1.15 |
| $K_2O$ | 3.07 | 2.36 | 2.84 | 1.56 | 0.94 | 3.01 | 2.13 | 1.82 | 3.90 | 1.67 | 2.21 | 1.92 | 1.11 | 2.29 | 2.75 | 0.74 |
| $P_2O_5$ | 0.18 | 0.17 | 0.15 | 0.18 | 0.25 | 0.21 | 0.30 | 0.30 | 0.15 | 0.20 | 0.18 | 0.20 | 0.30 | 0.18 | 0.22 | 0.07 |
| MnO | 0.17 | 0.07 | 0.07 | 0.10 | 0.22 | 0.12 | 0.14 | 0.30 | 0.06 | 0.10 | 0.06 | 0.08 | 0.76 | 0.08 | 0.14 | 0.65 |
| $SO_3$ | 0.17 | 0.14 | 0.17 | 0.25 | 1.26 | 0.68 | 2.26 | 3.39 | 0.27 | 0.74 | 0.16 | 0.32 | 1.96 | 0.33 | 0.74 | 0.10 |
| CI | 0.14 | 0.15 | 0.14 | 0.15 | 0.16 | 0.14 | 0.16 | 0.16 | 0.14 | 0.14 | 0.14 | 0.15 | 0.16 | 0.14 | 0.14 | 0.13 |
| LOI | 12.00 | 14.50 | 14.50 | 13.00 | 12.50 | 12.50 | 4.50 | 16.50 | 11.50 | 15.50 | 13.50 | 9.00 | 5.50 | 15.50 | 14.50 | 23.50 |
| Total | **100.26** | **100.20** | **99.89** | **100.35** | **100.46** | **100.47** | **100.42** | **100.43** | **100.38** | **100.19** | **99.63** | **100.14** | **100.17** | **100.03** | **100.48** | **100.32** |
| **Trace Elements (ppm)** | | | | | | | | | | | | | | | | |
| V | 678 | 113 | 993 | 72 | 284 | 97 | 202 | 249 | 97 | 95 | 844 | 102 | 35 | 102 | 749 | 843 |
| Cr | 484 | 254 | 472 | 464 | 371 | 346 | 194 | 31 | 457 | 216 | 535 | 701 | 21 | 157 | 571 | 22 |
| Co | 130 | 42 | 66 | 79 | 111 | 157 | 48 | 172 | 61 | 67 | 40.2 | 52 | 330 | 50 | 35 | 1300 |
| Ni | 39 | 47.2 | 35.9 | 29.5 | 21.2 | 20 | 35.5 | 43 | 58.9 | 34.5 | 32.5 | 35.5 | 581 | 32.6 | 40 | 275 |
| Cu | 12 | 21.9 | 20 | 16.3 | 47.1 | 31.4 | 39.2 | 87.2 | 18.2 | 25.2 | 14.7 | 20 | 25 | 23.5 | 45.1 | 19 |
| Zn | 61.1 | 70.6 | 59 | 81.7 | 99.8 | 69 | 97.4 | 98 | 92.3 | 65.6 | 68.1 | 69.5 | 24 | 62.8 | 73.5 | 17 |
| Ga | 6.8 | 14.4 | 9.8 | 11 | 18.1 | 13.3 | 18 | 7.5 | 17.9 | 15 | 14.6 | 19.2 | 12 | 17.6 | 17.2 | 10 |
| As | 49.9 | 16.9 | 36.9 | 15.1 | 293.9 | 602.3 | 4471 | 3087 | 81.7 | 871.7 | 14.2 | 114.1 | 2412 | 5.3 | 8.5 | 18 |
| Rb | 73.3 | 45.1 | 64.7 | 33.8 | 21.7 | 66.6 | 41.9 | 42.3 | 72.4 | 37 | 48.6 | 41.9 | 23.5 | 40.6 | 50.1 | 35.7 |
| Sr | 262.4 | 222.7 | 230.3 | 251.6 | 124.8 | 189.3 | 196.9 | 192.9 | 115.5 | 199.3 | 217 | 190.3 | 137.4 | 289.3 | 263.8 | 332.5 |
| Y | 6.3 | 0.6 | 2.1 | 2 | 9.3 | 4.6 | 1.5 | 6.4 | 3.9 | 2 | 0.7 | 1.9 | 11.1 | 0.8 | 0.8 | 5.8 |
| Zr | 205 | 225 | 204 | 307 | 156 | 173.1 | 177 | 136 | 216.2 | 207 | 255 | 228 | 145 | 189 | 184 | 155.1 |
| Nb | 5.2 | 4.9 | 8.5 | 4.4 | 6.6 | 5.5 | 5.9 | 6.7 | 9.7 | 11 | 5.3 | 6.3 | 10.1 | 4.8 | 5.2 | 4.7 |
| Mo | 3.5 | 4.7 | 3.9 | 4.2 | 6.7 | 4.3 | 4.8 | 5.2 | 3.7 | 4 | 4.3 | 4.5 | 6.3 | 3.8 | 4.2 | 4 |
| Sb | 1.9 | 3.9 | 1.9 | 1.9 | 2.3 | 2.2 | 13.3 | 8.1 | 2 | 3.1 | 1.3 | 2.1 | 2.5 | 1.9 | 2.1 | 1.8 |
| I | 6.1 | 6 | 6 | 5.9 | 6.7 | 6.1 | 6.1 | 6.3 | 6 | 5.9 | 5.6 | 6 | 5.9 | 6.2 | 6 | 5.4 |
| Cs | 9.6 | 9.9 | 9.7 | 9.4 | 11 | 9.9 | 10 | 10 | 9.8 | 9.6 | 9.4 | 9.9 | 10 | 10 | 9.7 | 8.5 |
| Ba | 672 | 452 | 581 | 418 | 166 | 592 | 332 | 223 | 564 | 294 | 494 | 493 | 156.5 | 862 | 614 | 243.1 |
| La | 47 | 20 | 29.5 | 38.4 | 22 | 34.9 | 23.6 | 20 | 21.5 | 20 | 39.5 | 20 | 20 | 39.6 | 19 | 25.5 |
| Ce | 94 | 86 | 59 | 90 | 61 | 68 | 68 | 27 | 26 | 62 | 67 | 83 | 27 | 64 | 79 | 25 |
| Hf | 26 | 5.2 | 12 | 11 | 9.6 | 19 | 8 | 33 | 10 | 9.2 | 5.3 | 7 | 53 | 7.6 | 7.6 | 49 |
| Ta | 20 | 5.3 | 11 | 9.1 | 9.2 | 16 | 7.9 | 29 | 9.4 | 8.5 | 5.2 | 6.7 | 44 | 7.1 | 7.8 | 31 |
| Pb | 6.4 | 1.3 | 5.9 | 2.6 | 2.4 | 4.1 | 1.6 | 5.6 | 2.5 | 2.1 | 3 | 1.7 | 12 | 1.9 | 5.2 | 9.6 |
| Bi | 9.1 | 1.1 | 4 | 2.8 | 3.5 | 15 | 9.8 | 47 | 3.6 | 7.4 | 1.3 | 2.2 | 79 | 1.6 | 1.5 | 12 |
| Th | 11.1 | 1 | 2.5 | 1.7 | 1.8 | 2.7 | 1.6 | 5.1 | 1.9 | 1.7 | 1 | 1.4 | 8.7 | 1.3 | 1.2 | 8.7 |
| U | 6.9 | 9.7 | 9.9 | 8.3 | 12 | 10 | 9.6 | 11 | 9.7 | 9 | 6.1 | 9.4 | 8.3 | 8.7 | 6.5 | 7.5 |

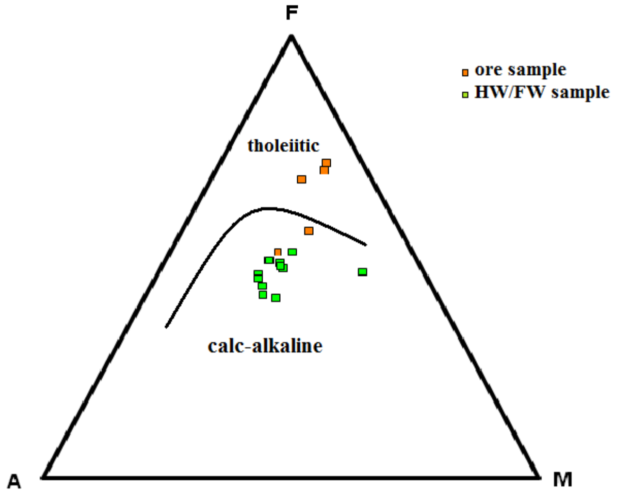


*Figure 7: AFM diagram of the rocks from Homase Gold deposit*

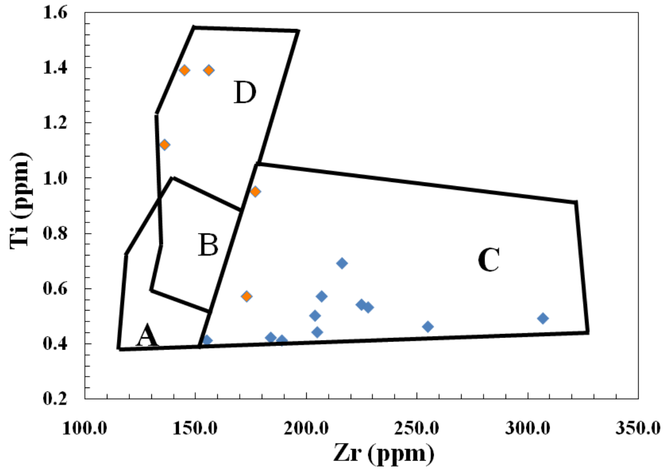


*Figure 8: Zr-Ti diagram of Metasedimentary rocks and Intrusives from Homase Gold deposit. (A=Island arc basalts, B= within plate basalts C=calc-alkaline basalts, D= MORB)*

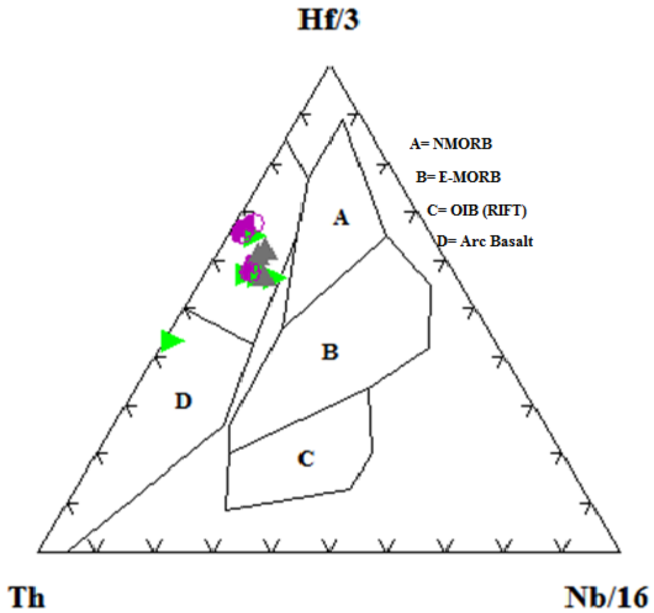


*Figure 9: Ternary plot of Hf/3-Th-Nb/16 Tectonic Discrimination Diagram showing that the Rocks from Homase were Arc Basalts*

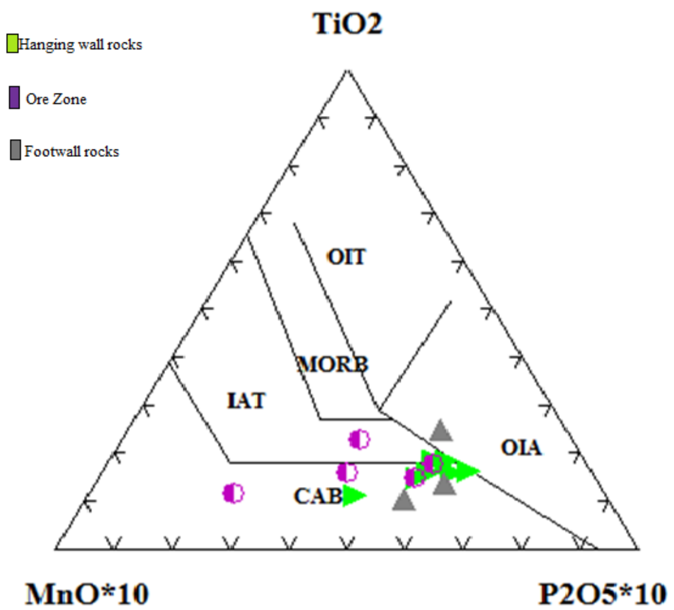


*Figure 10: MnO*10-$TiO_2$-$P_2O_5$*10 Tectonic Discrimination showing that the Rocks from Homase were mainly Calc-Alkaline Basalt*

**Discussion**

Homase Gold deposit is located on a thrust fault that extends for about 4km along NE strike and dips steeply at about 65° towards the NW. Gold mineralisation is largely constrained between the two shear zones which are occupied by quartz veins. Phyllite and biotite-chlorite schist mark the shear with drawn out quartz which has been recrystallised by additional two generations of quartz (quartz-2, quartz-3) which were introduced syn- to post faulting/shearing and so show isoclinal folding of foliations which are smeared by chlorite (Figs. 2 and 3). Later brittle deformation parallel to the general foliation probably was accompanied by chlorite alteration.

Metamorphism is in lower greenschist facies with metamorphic minerals being chlorite, amphibole and biotite (Tables 1-3). Alteration types are carbonatisation and silicification, though partial alteration of plagioclase to quartz and sericite occur.

Gold mineralisation at Homase deposit (0.5-14.7g/t) is associated with disseminated sulphides of arsenopyrite, pyrite, pyrrhotite, pentlandite, chalcopyrite, cubanite, mackinawite and rutile. The mineralisation is more closely related to arsenopyrite and pyrite.

The rocks are co-genetic and possibly crystallised from partially melted subducted crust (calc-alkaline basalt) deposited in an island arc environment after an oceanic-oceanic subduction (Figs. 6 to 9) [19, 21, 22]. According to [23], ferromagnesian elements (e.g. Fe, Cr, Ni) are enriched in mafic and ultramafic igneous rocks though high concentration of Cr could also be found in sedimentary rocks derived from mafic igneous rocks [24]. Positive correlation of Co and Ni with total FeO and MgO ($r^2$=0.758, 0.678 and 0.593 respectively) are characteristic of the rocks at Homase area.

Some values of major oxides in wt% are $SiO_2$ (44.10-58.06 in host rocks and 39.84-53.71 in ore zone), $Ti_2O$ (0.41-0.69 in host rocks and 0.57-1.39 in ore zone), total FeO (5.12-7.25 in host rocks and 8.32-17.68 in ore zone), MgO (2.87-6.42 in host rocks and 3.55-5.53 in ore zone), CaO (1.25-4.77 in hanging wall, 1.95-4.58 in ore zone and 0.81-6.30 in footwall). Arsenic composition is higher in the ore zone (293.9-4471 ppm) than non-mineralised rocks (5.3-114.1 ppm) and so can be used as a path-finder for gold (Table 4).

**Conclusions**

The rocks from Homase consist of banded and sheared phyllites, and tonalite intrusive into biotite-chlorite schist. These rocks which were deposited in island arc setting are calc-alkaline basalts metamorphosed to greenschist facies. The deposit is also located on a northeast trending thrust/shear which is steeply dipping towards the NW.

Total FeO composition is lower in host rocks than in the ore zone. This trend may be due to higher pyrite composition in the ore zone while higher arsenic content in the ore zone compared to the non-mineralised rocks is probably linked to presence of arsenopyrite. Arsenic can therefore be used as a path-finder in gold exploration.

**Acknowledgements**
The Directors of GoldStone Resources Limited and the Exploration Manager, Mr Johan Ingwersen gave permission for the research to be conducted on the deposit. Mr Thomas Mensah (Country Manager-GoldStone Resources) provided field assistance and Mr Clement Benyarko assisted with thin and polish section preparation. Dr Daniel Boamah and Mr Emmanuel Mfum of the Ghana Geological Survey Department, Accra helped in X-ray fluorescence analysis. University of Mines and Technology provided logistic support.

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