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THE GEOLOGICAL STRUCTURE AND GENESIS OF QARA ZAGHAN GOLD DEPOSIT (AFGHANISTAN)

Abstract

In this paper, it has been tried to as much as possible to clear the geological structure of the deposit with the consideration of gold mineralization and host rocks, as well as the genesis of the deposits will be considered in the paper.

Keywords: geological structure, mineralization, gold, host rock, deposit, genesis, porphyry.

Research Methodology:

Mostly field and laboratory methods have been conducted in the research for achieving of the aims. Based on the field method, the location form of host rocks of gold mineralization (Rhyiolite – Porphyry which is also termed Quartz Porphyry by some specialists) have been identified, the wide and long of ores have been determined as much as possible. In addition, the locations of ores within host rocks have been described and the different rock samples have been collected and transferred to the center for laboratory analysis.

In case of unavailability of modern lab equipments and facilities, just the thin sections have been provided from obtained specimen and studied under the microscope.

Introduction

Gold is one of the precious metals which is a financial support of world countries in addition of it's mostly usage in different technical and medical fields. Gold deposits are situated in different parts of earth crust in various countries.

Afghanistan is a country which hosts much placer and original types of gold in Northern, Eastern, Central and South Eastern parts.

Recently the Qara Zaghan Gold Deposit has received the considerable attention of influential of the area and government and has been preliminary studied in terms of its geological structure; therefore the geological structure and genesis of this deposit have not been cleared in details (figure 1)..

The Qara Zaghan gold deposit is located 45 Km from Pul-e-khumri city (Baghlan province) and 390 Km North West of Kabul city which is the left bank of Surkh Ab River.

The Qara Zaghan Gold Deposit is one of the gold deposits of Afghanistan which is very important in terms of industrial condition that has not been determined clearly yet. But it has high economical values in our opinion. This deposit has a fair topography and makes the situation simple for exploitation and the main road of Bamyan – Dushi is crossing the area of deposit which increases its economic values.

On the basis of geological structure, Qara Zaghan Gold Deposit has a relatively simple geological structure, as Rhyiolite – Porphyry or Quartz Porphyry are situated within sandstone, argillite, breccias and conglomerates of Upper Triassic (T_3) age. The mentioned rocks are monoclinal with dip angle of 30-35^o which is trending North and North West in the ore field.

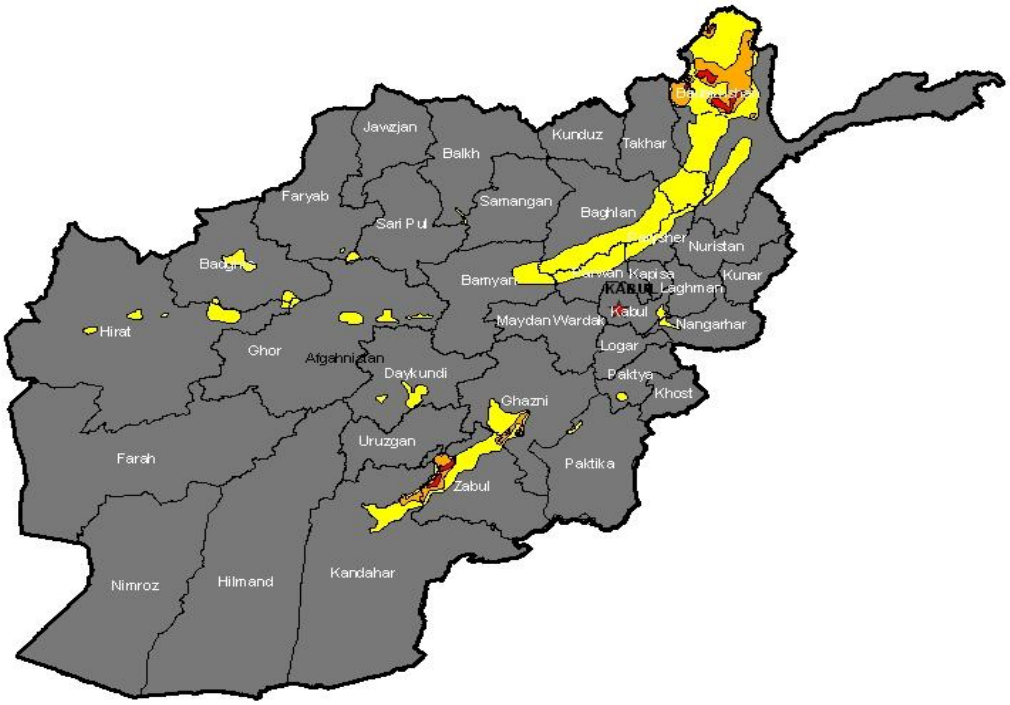

Figure.1. Schematic map of Afghanistan showing the distribution of Gold in the country

The subject of our research is the identification of mineralogical composition, structure, texture and location regularity of gold ore body (Quartz Porphyry sill) in host rocks, in addition, It has been tried to identify the depth of gold mineralization in ore veins and also the signs of gold mineralization within host rocks (drillings in exocontact of ore body) have been found.

In case of determination of material composition (mineralogical and chemical composition) and structure of gold ore body (structure and texture), the samples have been collected from the different profile of different areas, that the petrographic studies of some significant thin sections are as follow: in thin section No (T – 41) (figure 2), the rock is composed of plagioclase (Pl), quartz (Q) and volcanic glass. The porphyritic grains are almost from plagioclase and if the porphyritic grains accepted as 100%, then 90 – 95 % of them are composed of plagioclase (Pl), and the remains are quartz (Q) (5 – 10%).

The matrix of gold ore body (Porphyritic Quartz) is mainly composed of volcanic glass and often the microlites of Pl and Q are also can be seen. The volcanic glasses are tolerated to the secondary changes and have been replaced to small and isometric aggregates of quartz and feldspar. Some grains of sericite and rarely the secondary muscovite faces are seen in the current composition of rock.

The porphyritic grains of plagioclase are idiomorphic and hypidiomorphic and their sizes reach to (0.2 – 1.2) mm, and the porphyritic grains of quartz are xenomorphic which are the same on the basis of size. The porphyritic particles of plagioclase often are replaced to pilite and sericite, polysynthetic twins are seen on them which are thought to be oligoclase.

In the matrix, in addition to microlites of feldspars and quartz, the chlorite faces and clay materials with dark color (black) can be also considered the dark clay materials have been deposited in small joints formed as a result of post tectonic movements.

The main structure of the rock is porpyritic and the structure of matrix is hyalopiliticm while the texture of the studied rock is massive, hence on the basis of the aforementioned petrographic characteristics, the rock itself is called Rhyiolite – Porphyry or Quartz Porphyry.

The post tectonic movements affect the host rocks including ore body that this issue is mostly realized by the study of thin section No (T – 33). As all the rock forming minerals have been destroyed, in which some small and isometric grains of quartz with size between 0.1 – 0.4 mm can be seen in the background of the rock.

The rock has slate (shale) structure, and sericite particles with clay materials and some chlorite have been oriented in a definite direction which can be considered during the rotation of microscope table. (sericite particles generally become dark and bright in a definite direction), feldspars within composition of the rock have been completely replaced to fine grains and powder due to pushed pressure and quartz in case of having high hardness has been replaced to small isometric particles.

In some separated areas, the relative large masses of carbonates can be seen; in addition, the secondary joints formed after the process of becoming shale and cut the micro slate structures of the rocks are filled also by clay materials. Gold bearing ore body of Qara Zaghan in some areas are made of the rocks which has the current composition of 90 – 95% quartz. (T – 44).

Structure and the mineralogical composition of the interested rock is almost different from the aforementioned rocks, matrix of the primary rock is made of microlites and volcanic glasses while the porphyrictic grains are existed in rare, the primary rock which is probably rhyiolite as a result of secondary changes has been replaced to quartz – porphyry. Microlites of quartz and feldspar are considered in some separated areas of the rock, and also availability of quartz – feldspar aggregates, carbonates, sericites are signs of the volcanic glasses formed in primary state of the rock.

The narrow joints of studied rock has been filled by secondary quartz (most probably hydrothermal) in the post processes. It is be mentioned that good crystals of carbonate (calcite) has been also together formed with quartz, that such quartz secondary veins can be found macroscopically in hand specimen.

Based on existence of narrow veins of secondary quartz related to hydrothermal solutions, it can be concluded that gold mineralization in studied ore body is also related to the activity of aforementioned solutions, hence as mentioned above, the genesis of Qara Zaghan Gold Deposit is most probably hydrothermal.

There is no porphyritic quartz grains in some samples obtained from the gold ore body of Qara Zaghan Gold Deposit (T – 46b), while all the porhpyritic grains are made of feldspar which is altered by secondary change of pilitization, carbonation and sericitation. The quantity of feldspar and quartz microlites is more than volcanic glasses. In most parts, the secondary carbonates are seen as spells and spots which may replace the volcanic glasses and are existed within vacuums and vents.

In some samples (thin section No (T – 47b), porphyritic grains of feldspar are effected by hydrothermal solutions, and some signs of dissolution (around the mineral particles have been toothed) can be considered. The secondary quartz and carbonates are distributed in most parts formed as a relative deformation caused by low pressure. In addition, within the studied thin section, separated particles of muscovite and idiomorphic particles of pyrite can also be seen.

From the study of aforementioned and several other thin sections, it is concluded that the effects of hydrothermal solutions within gold ore body (Rhyiolite – Porphyry) at all

points are not the same, in some parts the solutions act extremely and replace the primary rock up to the metasomatite boundary while in some parts, the activity of solutions are limited, even the relict of porphyritic grains are clearly seen within the rock.

The hydrothermal solutions have been ascended from depth after the secondary changes of the primary rocks, and mostly affect the parts with extremely system of joints, but have minor impact on the parts which contain the massive structures, accordingly, it is to be mentioned that gold mineralization is not uniform and homogeneous over the ore body and it is possible that in some area, there are large contents and distribution of gold mineralization with pure grains of gold which have the size of pea and form the lens – like structure while in some parts , the content is insignificant. This regularity of gold mineralization should be considered during the conducting of prospecting and exploration of the mentioned ore body and the costs will be decreased remarkably.

Based on tectonic movement, folds and fault have been considered in all parts of lithological units. Hence many faults are seen within rocks layers and the fault surface is cleared in many areas which is a sign for movement of rock blocks along each other.

There are many major and minor faults with the Qara Zaghan gold deposit. The village in Northern part of Jamsayed village, is a fault with 4m amplitude, and is one of the early faults which has a role in emplacement of mine materials. And all veins rich in gold are found in continuation of this fault.

Figure 2. Rhyiolite – Porphyry with porphyry structure and different association of minerals.

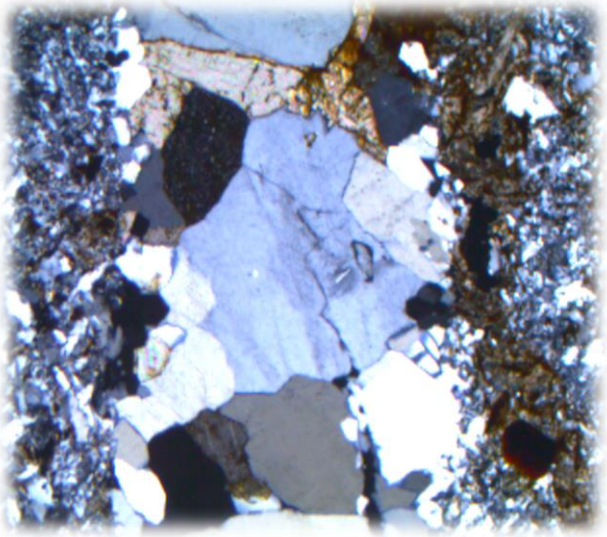

Figure 3. The photograph of a thin section showing the replacement of volcanic glass to Quartz and feldspar to Carbonates, Sericite and Chlorites

Genesis of the deposit

As the research are in preliminary stage regarding the genesis of Qara Zaghan gold deposit, but based on the short field studies and observation of several points on the site, the following statements are concluded:

The large Rhyiolitic sill which has been formed after the formation of Granit and Granodiorite masses in starting of Jurassic period within Flysch formations of upper Triassic – Cretaceous (T_3 –K) age, has more than 10 Km long, and this sill has been directly

observed in the study area by authors up to 5 – 7 Km (from the Eastern end of Qara Zaghan village to Karimak trench) (figure 4).

According to residents' statements, this sill is continuing up to Bamyan province (Center of Afghanistan), that residents are exploiting the gold unprofessionally from this sill. The thickness of the sill reached from one to tens meters.

In our opinion, after the formation of the mentioned sill which is also subdivided into two parts (Karimak trench), the hydrothermal solution which rich of the elements e.g Cu, Ag, As, Hg, Pb, Zn is permeated along this sill that is a good chamber for permeation of solutions, and transfer with itself the high amount of gold (Au), and is caused the secondary change of Rhyiolitic sill, therefore the formation of pure gold and the mineralization of Malachite, Azurite, Gallium, and Carbonates (Calcite and Dolomite) have been occurred within already formed joints and fractures or those which formed as a result of chemical interactions of the mentioned solutions with Rhyiolitic components.

The strata situated above the motioned sill is a good protection covers for gold hydrothermal solutions and is blockade for exiting of foregoing solutions from the sills, and is composed of Clay Schists.

On the basis of the high specific gravity of gold (Au), we believe that the mineralization of gold is increased to depth and the Qara Zaghan gold area may have the abundant amount of this useful material, which needs for further and accurate research in the future.

Determination of genesis of different mineral deposits is different which need for continual and accurate field and lab research, that in the mentioned study, the authors were faced with luck of such equipments, but with that, the two days field visit and study of provided thin sections from host rocks and ore body giving us an opportunity to relatively determine the genesis of Qara Zaghan gold deposit as hydrothermal on the basis of the following factors.

Figure 4. Natural photograph of the study area showing the Rhyiolitic sill

1. Existence of more quantity of quartz (magmatic and hydrothermal) in the studied samples which form more than 50 % in all samples.
2. Existence of carbonates (definitely calcite) in all samples which reach up to 10 % in average.

3. Existence of idiomorphic particles of pyrite with samples which help to determine the genesis.
4. Existence of considerable quantity of sulfur and arsenic in samples which chemically analyzed.
5. Existence of depth fault in northern part of the deposit, in which a mineral water spring with relatively high temperature and is available all around the year.
6. Existence of the large masses of granite and granodiorite of Hindu Kush large pluton around the Qara – Zaghan Gold Deposit.

The economic importance of Qara Zaghan Gold Deposit

As it was mentioned before, that gold is a precious metal and day to day its economic importance is increasing, in case of its usage in different affairs of modern techniques and medical instrument, jewelry and financial support.

Qara Zaghan Gold Deposit which has been formed in ore body with 2 – 8 m thickness with hydrothermal genetic type and continues up to several kilometers. On the basis of preliminary information, it has an extraordinary high economic value.

The average content of gold is situated in an ore body in north of Qara Zaghan village and is divided into three parts: Naderi, Jam Sayed, and Karimak.

From here, it is concluded that there are extraordinary contents of gold with gold ore body with the aforementioned dimensions, and this content is increasing to depth in ore body. Therefore with conducting of accurate exploration in the area of deposit with estimation of resources, this deposit will have an extraordinary importance for development of economic of Afghanistan.

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The geological structure and genesis of Qara Zaghan gold deposit (Afghanistan)

Summary: In the paper, the geological structure and genesis of Qara Zaghan gold deposit on the basis of preliminary conducted field research have been considered. After the analysis of the structures and thin sections of the obtained specimen, it is concluded that the genesis of the deposit is hydrothermal with relatively simple geological structure but needs for further and accurate research to be done.
Keywords: geological structure, mineralization, gold, host rock, deposit, genesis, porphyry.

Ахмади Хемаятулла, Юсуфи Атал, Амир Мохаммад Мусазай, А.Б. Байбатша

Геологическое строение и генезис месторождения золота Кара Заган (Афганистан)

Резюме: В статье были рассмотрены геологическое строение и генезис месторождения золота Кара Загар (Афганистан) на основе предварительного исследования, проведенного на местах. После анализа структур и шлифов полученных образцов, он пришел к выводу, что генезисом месторождения является гидротермально с относительно простой геологической структурой, но нуждается в дальнейшей и точные исследования, чтобы быть сделано.
Ключевые слова: геологическое строение, минерализация, золото, вмещающая порода, месторождение, генезис, порфира.