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Geological-Structural Position and Formation Conditions of Gold-Containing Porphyry Copper Deposits of Mekhmanian Ore-Magmatic System (Lesser Caucasus, Azerbaijan)

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Abstract

This article focuses on geological-structural position and formation conditions of gold-containing deposits of Mekhmanian ore-magmatic system (OMS) according to tectonic position of deposits, material composition of ore-bearing and ore-hosting intrusive complexes, specifics of mineral composition, quantity and correlation of main and associated components. There is a new data allowing to estimate formation conditions and matter sources of OMS deposits. Productive mineralization has been determined which occurs by two stages: 1) quartz-molybdenite, quartz-chalcopyrite; 2) quartz-chalcosine-pyrite-chalcopyrite, sphalerite-galena-gold-rare-metal.

At first stage concentrators of gold are pyrite and chalcopyrite, and its content is non-uniform, and at second stage gold-containing are represented by galena, sphalerite and also fahl ores and tellurides. We distinguish three gold-bearing associations according to mineral composition of ores, they are: quartz-molybdenite-chalcopyrite, quartz-pyrite-chalcopyrite and quartz-galena-sphalerite.

Keywords: geological-structural, Mekhmanian ore-magmatic system (OMS)

1. Introduction

According to literature data (Baba-zade et al., 1990) proper porphyry copper (Au – 0,3-0,4 g/t) and copper-gold-porphyry (Au – 0,5-3 g/t) types are revealed among deposits of the Lesser Caucasus porphyry copper family. Porphyry copper deposits besides the main commercial components Cu and Mo often contain a number of associated components by economical quantities and such elements as Bi, Te, Re, Au and Ag take leading a leading role among them and considerably increase total value of ores (Davidson, J., et al., 2007; Dilek, Y., et al., 2009). These deposits are accompanied by numerous polymetallic, gold-silver, pyrite orebody-satellites and placer deposits. Analysis of published materials on porphyry copper deposits shows that they are an important source of copper, molybden and gold in world market. These metals form the basis of mining industry of USA, Canada, Chili, Argentina and Peru. In CIS countries gold-bearing porphyry copper fields include deposits of Kazakhstan (Kounrad, Koksay, Aktoray, Chatyrkul), of Uzbekistan (Almalyk), Azerbaijan (Garadag, Khar-Khar, Paragachay, Demirli), Armenia (Kajaran, Tekhut, Agarak), of Ural (Salavatskoye, Green Dol, of Trans-Baikal (Shakhtamik, Davedinian), of Chukotka (Peschanka). Geological study of gold in porphyry copper orebody of Mekhmanian ore district can be found in many works (Baba-zade et al., 1990; Popkhadze, N., et al., 2014: Richards, J.P., 2009), howeverat present degree of gold content of mineral associations is still not clear perfectly and this is the reason for writing this article.

General description of ore-magmatic system (OMS)

Mekhmanian OMS located in south-east part of Lock-Garabagh insular arc on crossing of Agdam horst uplift with transverse Dalidag-Mekhmanian uplift can be characterized by telescoping of different type mineralizations, in some cases it is expressed by combination of porphyry copper mineralization with later superimposed sulphide mineralization, and in other cases–by considerable concentration sulphide mineralization which at distance form commercial accumulations of veined types ores. Formation of porphyry copper ores deposits of Lock-Garabagh zone including Mekhmanian OMS occurred under island-arc conditions in close connection with volcano-plutonic association in narrow interval of time: Late Jurassic-Early Cretaceous (Baba-zade et al. 1990, 1999). Porphyry copper deposits of this ore district are spatially conjugated with deposits of other genetic types, in particular gold-copper-sulphide, polymetallic and less ore-gold. Gold-ore mineralization often telescopes on porphyry copper ores, and also concentrating at some distance can form own deposits of veined type (Gyzylbulag, Gulyatag, Khatynbeili, Eddikhyrman ore occurrence).

Mekhmanian OMS consists of complex of Middle-and Upper Jurassic volcanogenic and granitoidintrusives volcano-plutonic complex breaking them and also Lower-Upper Cretaceous sedimentary rocks. Mekhmanian (Janyatag) granitoid intrusive of the Upper Jurassic-Lower Cretaceous age is confined to north-east slope of Agdam horst uplift and it is traced in general Caucasia direction at distance of 15 km by average width 5 km.

Results U-Pb dating of Mekhmanian intrusive (quartz diorites, granodiorites)-154÷147MA (Geology of Azerbaijan, 2005) and also Rb-Sr isochronal dating of Kokhb-Shiokh intrusive complex – 164÷156MA (Melkonyan, 2004) show their Upper Jurassic age but not Middle Jurassic.

In endo- and exocontact zone of intrusive and also along faults host intrusive rocks and volcanogenic rocks are metasomatically changed – silicification, sericitization, kaolinization and carbonatization accompanied by porphyry copper ore deposition which mainly is connected with development of Middle- and often high temperature facies of secondary quartzites. Host intrusive rocks significantly differ by silica acidity value, and mineralization is confined to rocks with less density, frequently to silicified diorites, quartz diorites and different facies of secondary quartzites with density 2,00-2,60 g/sm^3. A significant decrease of porphyry copper mineralization can be found in exocontact zones of intrusives represented by hydrothermal-metasomaticfacies of secondary quartzites and this is along with other features can be used as an important criterion for prediction of porphyry copper mineralization.

Intrusive massives consist of rocks including diorities, quartz diorites and also aplite-like plagiogranites and veined derivatives such as – granodiorite-porphyry, sienite-diorite, quartz-diorites and rhyolite-daciteporphyrites, lamprophyres cross-cutting them. In areas with development of porphyry copper mineralization medium acid varieties of intrusive prevail (Geology of Azerbaijan…, 2003).

Nearly all porphyry copper areas of Agdam horst-uplift are concentrated within Demirli and Khazynchai ore fields which along with ore fields, which include such deposits as Mekhmanian polymetallic profile, Gyzylbulag gold-copper-sulphide profile and Khazinadag copper-sulphide profile, form Mekhmanian ore district.

Demirli ore field covers Janyatag intrusive with its exocontact zone and area which northward of Gabartychai river, and Khazinchai – area southward (Baba-zade et al., 1990; Geology of Azerbaijan, 2005) (Figure 1).

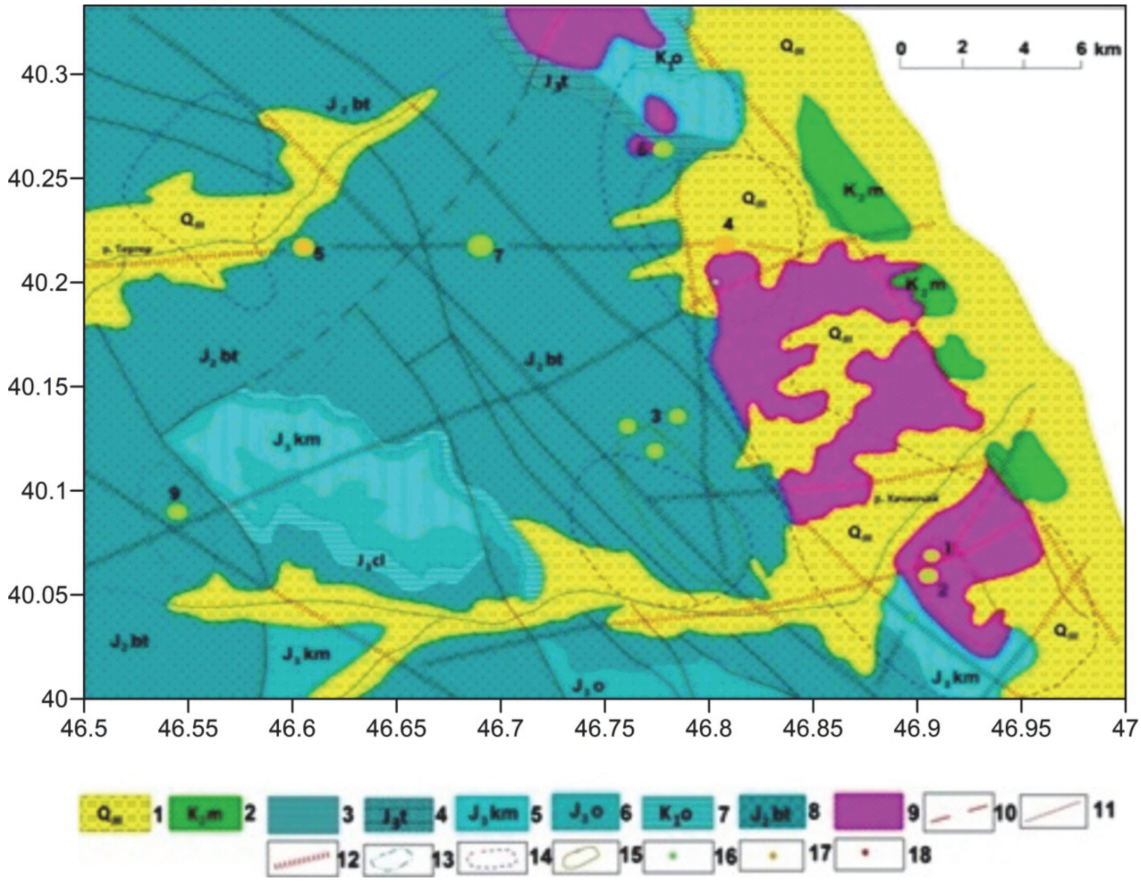

Figure 1. Geological map of Mekhmanian ore district (Compiled on materials of Lesser Caucasian geological prospecting expedition)

recent, alluvial, deluvial deposits; 2- maastricht. Monolithic pelitomorphiclimestones; 3- albanian. Tuff sandstones, tuff breccia, marl; 4- tithonian. Fragmental limestones; 5- kimmeridgian. Tuff conglomerates, Tuff breccias, Tuff gravelstones; 6- oxfordian. Fragmental-sandy limestones; 7- callovian. Tuff sandstones, tuff gravelsotnes; 8- bathonian. Tuff conglomerates, tuff sandstones, tuff breccias, porphyrites, quartz porphyrites; 9- granodiorites, granodiorite-porphyres. Tectonic faults; 10- Known faults; 11- assumed faults; 12- faults marked according to complex of distance data (geophysical, aerospace).

Anomalous areas: 13- on CP; 14- on positive anomalies of magnetic field which correspond to buried intrusive bodies of medium composition; 15- areas with multiplicative geochemical anomalies on the secondary aureole: Cu x Mo x Ag + Pb + Zn + Co (more than $500x10^{-11}$% on background of $50x10^{-11}$%). Deposits and occurrences: 16- porphyry copper (1- Demirli; 2- Khachinchai; 3- Kazanchin; 6- Agdere); 17- Complex ores; (4- Gulyatag; 5- Gyzylbulag; 7- Mekhmanian); 18- copper-sulphide; (8- Khazinadag).

2. Gold Mineralization of Porphyry Copper Ores Deposits

The problem of study, prediction and assessment for Cu-Mo porphyry deposits in the Lesser Caucasus not only important today but is complex according to polygenesis of ore deposits represented by complex Cu x Mo, and also Au, Ag – elements of platinum group, polymetals, rare and rare earth elements. Such deposits are accompanied by numerous polymetallic, gold-silver, antimonic-mercury deposits and occurrences (Moritz R., et al., 2012). Porphyry copper and copper-molibden-porphyry and also proper gold-porphyry ore objects are related to integrated gold-bearing porphyry deposits. They are found in different geological environments but they mostly are typical for island-arc and marginal-continental formations. Such ore bodies were forming by appearance of bodies of basalt-andesite volcanic and gabbro-diorite-plagiogranite plutonic formations of natrium series in areas with active occurrence such processes as rifting and tectonic-magmatic activization of some crust blocks. Among them are the following: magnetite-sericite-quartz, pyrite-quartz, chalcosine-bornite-chalcopyrite-quartz-carbonaceous, sphalerite-galena-gold, rare-metal and polysulfide mineral types (Baba-zade et al., 1990; Geology of Azerbaijan., 2005; 2006). According A. I. Krivtzov et al. (1985) gold-bearing ores of porphyry copper deposits form the raws: molibden-porphyry weak gold-bearing, gold-bearing copper-molibden-porphyry, gold-bearing molibden-copper-porphyry and gold-copper-porphyry corresponding to definite geotectonic positions.

Lock-Garabaghmetallogenic zone, being porphyry copper mineralization and by the main features determing type models of ore districts, correspond to gold-bearing copper-molybdenum-porphyry type. Gold distribution in porphyry copper deposits of Mekhmanian OMS mostly is defined by their mineralogical and geochemical appearance caused by systematic combination of several ore types in mineralized medium (Krivtsov A.I., 1985). The composition of latter can be determined by set of definite mineral associations which constantly repeat in mostly areas and differ by gold-bearing degree.

3. Geological and Structural Environment for Formation of Gold-Bearing Porphyry Copper Deposits.

Porphyry copper deposits of Mekhmanian OMS belong to representatives of Hollister “diorite” model which are characterized by high values of copper-molibden ratio and relatively higher composition of noble metals in ores. Within Mekhmanian OMS the larger is Demirli porphyry copper deposit with dyke formations represented by different pre-ore porphyries of diorite, quartz diorite, granodiorite compositions cutting Mekhmanian intrusive and volcanogenic complex of the Middle Jurassic. Intrusive breaks Bathonian volcanogenic series and overlaps transgressively with basal conglomerats at the base of the Upper Senonian-Carbonaceous deposits (Geology of Azerbaijan, 2003; 2005). Analysis of represented material on porphyry copper deposits of Mekhmanian OMS allows to conclude of real influence of deep factor for deposit formation on level of gold-bearing ores corresponding to subvolcanic or hypobyssal-subvolcanic formation conditions (Babazade, 1990; Ramazanov, 1993). Well-defined features of minimal depth or bodies appearance enriched by gold are frequently subvolcanic outlook of source granitoids by full absence of phanericfacies, availability of metasomaticquartzites, adulatory modification of potassium feldspar, hydromica, etc. (Volkov et al., 2006). Causes of gold concentration from Mekhmanian OMS at subvolcanic level can be clear during observation of gold behavior on proper porphyry copper type of deposits. Sulphides from the latter in comparison with sulphides of copper-gold-porphyry deposits normally and contain gold by one-two order less. Gold in impregnated pyrite of hydrothermally modified granitoids concentrates due to the same from silicates, therefore according to bulk content of gold-sericitizedgranitoids don’t differ much from unchanged propylitizedgranitoids.

Demirli deposit of porphyry copper ores is located in north-east slope of Agdam horst-uplift complicated by Gulyatag deep fault associated by series of disjunctive dislocations of north-west and submeridional extension, among which Demirli ore conduit fault is more considerable and located in a central part of deposit. In fault zone the rocks are split and hydrothermally modified till their transformation to the different facies of secondary – quartzite metasomatites, and stockwork fracture systems appearing in process of conjugation are filled by ore material, i.e. favourable conditions formed for appearing stuccowork mineralization (Baba-zade et al., 1990; Mansurov et al., 2014) (Figure 2).

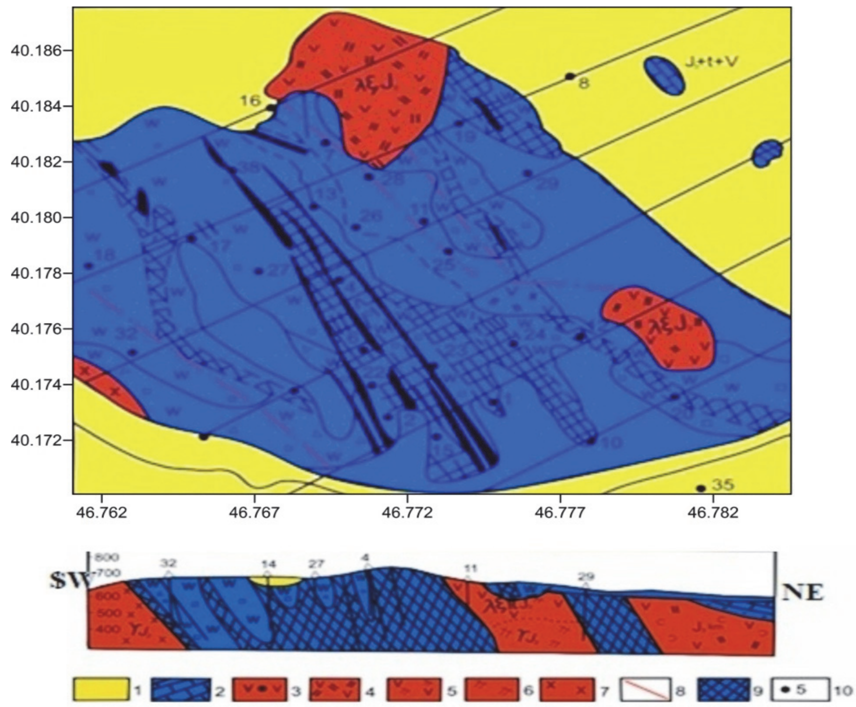

Figure 2. Geological map Demirli deposit

1-recent eluvial-deluvial deposits; 2- tithonian-valanginian. Rift related limstones; 3- basal conglomerates; 4- porphyry-like andesite-dacites; 5- transition rocks between andesite-dacites and tonalite-porphyries; 6- quartz-diorite, tonalite, granodiorite porphyries; 7- quartz diorites, granodiorites; 8- faults; 9- ore bodies with copper content 2% and more, 10- wells.

In endo- and exocontact zone of intrusive and along faults intrusive and effusive rocks were intensively hydrothermally processed and they were accompanied by formation of different metasomatites till the secondary quartzites (Baba-zade et al., 1990). Secondary quartzites are studied as a new perspective gold-bearing formational type copping the section of porphyry copper deposits. In this case deposits and ore occurrences dealing with Mekhmanian intrusive complex don't refer to porphyry copper but they refer to gold-containing porphyrycopper type (Babazade, 1990). Within Demirli porphyry copper deposits 6 new stock-like ore zones are traced consisting of intensively split-jointly silicified intrusive rocks, in some places are transformed into secondaryquartzites with dense pyrite impregnation, chalcopyrite penetrated by thin quartz-chalcopyrite veins. Average content of copper, molybdenum, gold and silver are in table 1.

Besides ore zones traced on the surface, in prospecting wells on NW and SE flanks of the deposits where metasomatites are well represented, about 20 blind ore bodies with industrial content of copper and molybden were intercepted on instrusive rocks of Janyatag massif. For example, Galaichylar stockwork confined to intensive hydrothermally-modified tonalities refers to the same. By thickness of more than 10m it is traced at distance about 200m and consists of veined-impregnated mineralization of pyrite and chalcopyrite. Chemical analysis of samples revealed the availability of 0,83% copper. Prospecting wells with depth 300m are drilled in central area of Demirli deposit. Gold and silver contents in minerals of porphyry copper ores are in table 2.

Table 1. Results of analysis or channel samples of ore stocks of Demirli porphyry copper deposit

№ ore stocks	Number of samples	Thickness of the tested interval, in m	Average content of metals			
			Cu, %	Mo, %	Au, gram /ton	Ag, gram /ton
№ 1	15,0	21,0	$\frac{1,21}{0,22-3,03}$	$\frac{0,006}{0,001-0,008}$	$\frac{0,5}{0,4-0,8}$	$\frac{10,4}{4,2-16,0}$
№2	15,0	21,0	$\frac{1,1}{0,2-1,5}$	$\frac{0,004}{0,001-0,006}$	$\frac{1,1}{0,1-3,0}$	$\frac{16,5}{2,0-26,04}$
№3	120,0	55,0	$\frac{0,9}{0,45-2,1}$	$\frac{0,004}{0,001-0,006}$	$\frac{0,8}{0,1-1,8}$	$\frac{5,5}{5,0-15,0}$
№4	13,0	7,0	$\frac{1,1}{0,7-2,0}$	$\frac{0,003}{0,002-0,005}$	$\frac{0,2}{0,1-0,5}$	$\frac{4,5}{1,2-8,02}$
№5	5,5	6,0	$\frac{2,1}{0,8-2,3}$	$\frac{0,001}{0,002-0,003}$	$\frac{0,2}{0,1-0,2}$	$\frac{5,0}{1,4-8,0}$
№6	15,0	7,0	$\frac{0,9}{0,05-1,98}$	$\frac{0,003}{0,001-0,005}$	-	$\frac{1,0}{1,2-2,8}$

Table 2. Content of the main components of the ore of the Demirli copper-porphyry deposit

№ Well	Thickness, m	Number of samples	Results of the analysis			
			Cu, %	Mo, %	Au, gram /ton	Ag, gram /ton
№ 1	56-70	1,4	2,3	0,09	2,9	2,0
	147-153	6,0	6,5	0,10	4,1	2,1
	153-305	152	0,2	0,06	0,3	6,6
№ 2	115-138	23	0,2	0,05	0,5	3,2
	138-152	14	0,5	0,03	2,5	6,6
	152-169	17	0,3	0,02	0,7	4,1
	169-177	8	1,0	0,01	2,6	6,5
	177-298	121	0,2	0,01	0,5	3,1
№ 3	110-140	30	0,7	0,06	1,3	5,6
	140-230	90	0,4	0,03	0,9	4,2
№ 4	47-58	11	6,5	0,09	3,1	8,9
	58-145	87	0,4	0,03	1,5	6,3

4. Content of the Main Ore Components of Demirli Porphyry Copper Deposit

There are 8 gold-containing sulphide-quartz veins and vein zones with thickness 1-10m by extension from 30-50 to 100-150m characterizing by gold content from 0,2 till 5,2 g/t and silver-1,8-63,8 g/t, and also by high – copper. Often these veins and vein zones are traced up to depth of 100-150m (wells #3, #6). According to data of A.M.Krivtzov et al., 1985 the higher gold concentrations for porphyry copper deposits which exceed the content in primary ores by 5-10 times, are typical for hypergenesis zone. These conclusions are supported by Demirli porphyry copper deposit as well. Where in many core samples from primary ores (well №1-18) gold content is up to 0,6 g/t from traces, silver up to 10,2 g/t from traces and this is less by several times than in rocks of hypergenesis zone. Mineral composition of porphyry copper ores of Mekhmanian OMS differs by big diversity. Among hypogene ones the main ore minerals are the following: pyrite, chalcopyrite, molybdenite, magnetite. Less spread are bornite, chalcosine, digenite, rutile, muschketowite. The rare and very rare minerals are the following: sphalerite, galena, fahl ore, native gold, native silver, argentite, renierite, crednerite, clausthalite, bismuth tellurate, silvanite, altaite, marcasite, pyrrhotine. Among vein minerals the following minerals are spread: quartz, sericite, carbonate, kaolinite, chloride, biotite, gypsum, calcite, bassanite.

It is noteworthy if in primary ores a definite correlation connection is observed between copper and gold content then it is absent in rocks of hypergene zone. Probably it is connected with the fact that the main mineral-carrier of gold is chalcopyrite which is less in oxidation and enrichment zone than other copper minerals (bornite, chalcosine and covelline). Usually gold concentrates by free form in oxidation zone, and in zones of hypergenesis – included in grains of new-formed copper sulphide. Oxidation of sulphides often leads to isolation and enlargement of native gold (Krivtzov, 1985). Native gold is found in all studied porphyry copper occurrences of Mekhmanian OMS. Mostly it is represented by isomorphic alloy in chalcopyrite and other sulphides with size up to 0,01mm and also among quartz-sericite aggregates with size thousandths mm up to 0,06mm. Morphologically native gold is represented by irregular, cloddy-like, skeleton formations or cluster crystals, sometimes (isolated problems) – dentritic form. Purity of gold varies 850-950 and can be characterized by heterogeneity caused by zonal structure. Silver is present in proper silver minerals (native silver, argentite).

In oxidation zone among hypergene minerals the main are the following: hydrous ferric oxides, chalcosine, malachite, azurite, native copper. The less spread – maghemite, chrysocolla, rare minerals – cuprite, delafossite.

Analysis of ore deposition process is porphyry copper deposits of Mekhmanian OMS shows long-term and multiple stage nature of mineralization which can be characterized by the following formation order: 1) Pre-productive (quartz-magnetite-sericite, quartz-pyrite associations); 2) I productive (quartz-molibdenite, quartz-chalcopyrite association; 3) II productive (quartz-chalcosine-pyrite-chalcopyrite, sphalerite-galena-gold-rare-metal associations); 4) post-productive (carbonaceous-bassanite associations). Quartz-magnetite-sericite type of ores forms at early more high temperature stage of mineral forming and has a little spread in porphyry copper ores. Frequently it is found as impregnations, rarely it formsveinlets and nests. Gold forms alloy in magnetite. Quartz-molibdenite association has a wide spread especially on Demirli and on Agdere deposits where it forms chalcopyrite-molibdenite veins, often characterizing by industrial molybden content.

Quartz-chalcosine-pyrite-chalcopyrite association occurs as impregnation. It can be found in Demirli deposit as veinlets in molybden copper veins. Chalcopyrites differs by considerable high content of gold, sometimes by its capping values. Sphalerite-galena-gold-rare-metal association frequently is typical for peripheral parts of porphyry copper deposits. Often it is found in fractured zone and zone of jointing taking a cross-cutting position relatively ore bodies. The same conditions are for Agdere, Khachynchai and other deposits of porphyry copper ores.

The distribution, the sequence of ore formation, probably owes much to the paragenetic connection of individual ore stages with the corresponding phases of magmatism (Figure3).

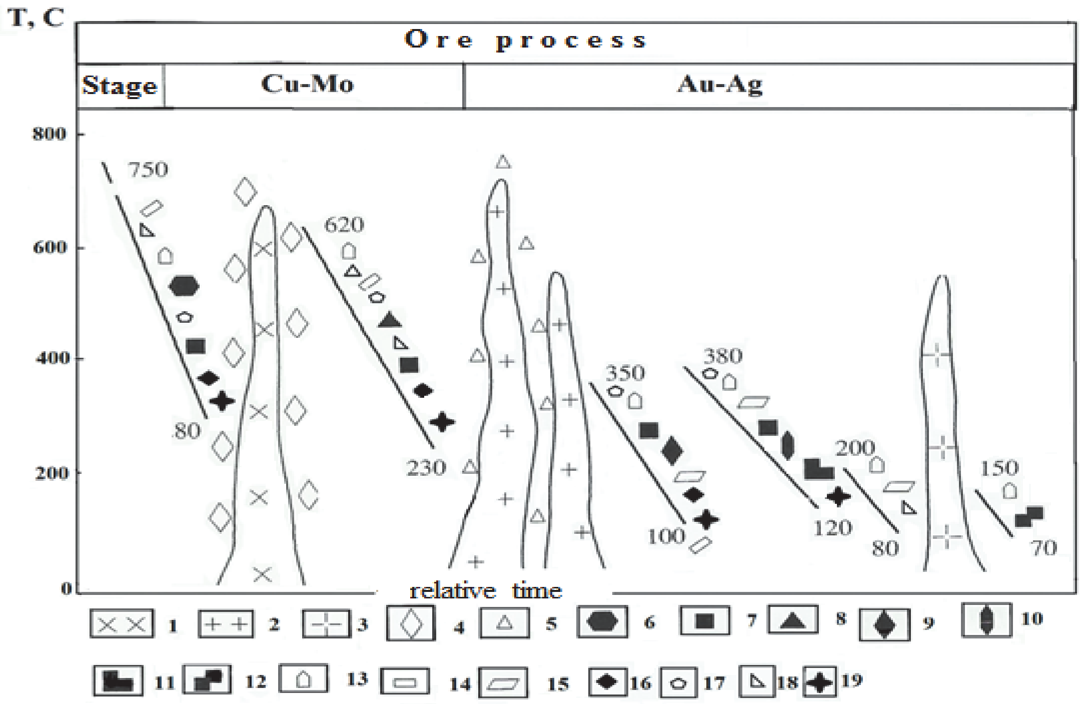

Figure 3.Intra ore magmatism and sequence of ore formation Mekhmanian OMS (Volkov et al, 2006 with the addition of the author)

1-syenite-diorite porphyrites; 2-granodiorite-porphyry, diorite porphyrites; 3-granite porphyry; 4-eruptive breccias; 5- tectonic breccias; 6-molybdenite; 7-pyrite; 8-chalcopyrite; 9 - faded ore; 10-sphalerite; 11-galena; 12-magnetite, hematite; 13 quartz; 14-orthoclase; 15-carbonates; 16-altaite; 17-argentine, 18-marcasite; 19-tellurovismo

Analysis of spatial distribution of mineral associations of porphyry copper ores in studied area shows that quartz-sphalerite-galena mineral association is expressed poorly within industrial porphyry copper ores and as a whole forms independent sheet-like and pod-like ore bodies often maginal porphyry copper ores into host volcanogenic, volcanogenic-sedimentary rocks and due to this gold included in this mineral association could not be determing. Early magnetite-sericite-quartz and later Carbonaceous-bassanit associations are scarcely gold (Baba-zade et al., 1990; Geology of Azerbaijan, 2005).

Gold distribution in porphyry copper depositsof studied OMS mostly can be defined by their mineralogical and geochemical appearance caused by systematic combination of several types of ores in bulk of mineralized space. Ores composition can be defined by set of definite mineral associations constantly repeating at mostly objects and differing according to gold-content degree.

Analysis of geochemical data of bulk earth values of elements content and also ore ones allowed to defined availability of vivid direct correlation between these elements (Figure4). It is seen from graphs that relationship between copper and molybden, molybden and gold has a linear nature. Correlation between copper and molybdenum in studied deposits has near-hyperbolic nature with relationships' curve nearby the lower flank of industrial significance of copper.

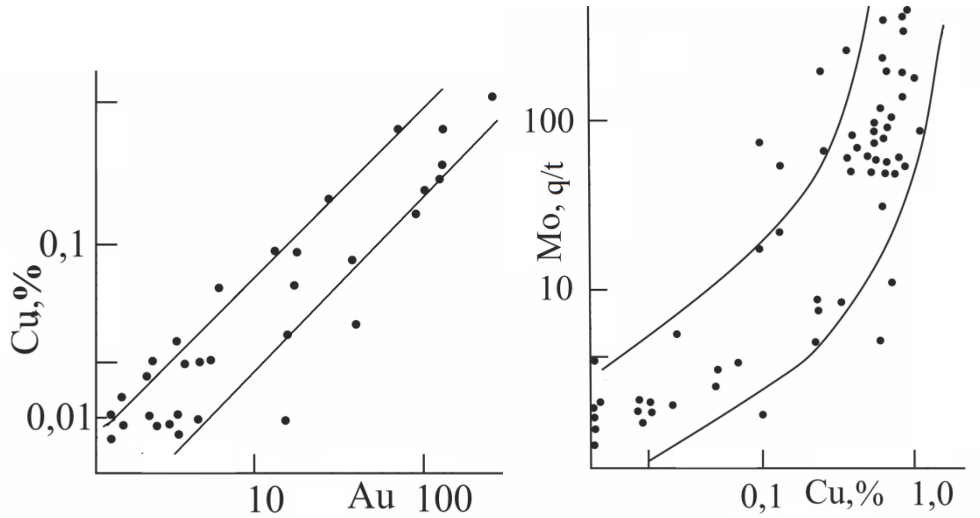

Figure 4. Dependence between the contents of copper, molybdenum and gold in the rocks of the Demirli deposit

It is noteworthy according to availability of direct connections between elements, spread of points on graphs is very significant. So, by the same copper content molybdenum and gold amounts can increase by 2-6 times, and in ore intervals – much more.

General insignificance of geochemical connections of ore elements within porphyry copper objects or some areas can be explained by a considerable difference of geochemical properties of studied elements (Hou, Z., et al, 2012). By distinct differentiation of solution due to its long evolution zones with maximum concentrations of copper, molybdenum and gold can be different, and this can be found in many large deposits with complex formation history.

As a whole mineralization zonation of OMS is caused by a change pattern of time and space in main ore-forming mineral associations and describes by empirical series, such as: Fe-Mo (Cu)-Cu (Mo)-Te, As, Sb (Cu, Au, Ag)-Au, Ag, Zn, Pb (As, Sb, Bi)-Fe (Sb).

Data on isotopic composition of sulpho-sulphides and on composition of gas phase of hydrotherm at gold-bearing quartz-pyrite-chalcopyrite, quartz-chalcopyrite and non-goldbearing quartz-sphalerite-chalcopyrite stages. It is defined directional fractionation of sulfur isotopes towards sulphidesenrichment by light isotope from earlier Productive stage of ore deposition to later as a result of systematic increase of oxidizing potential of hydrothermal system. Sulphides ending ore process of quartz-sphalerite-chalcopyrite stage are characterized by noticeable enrichment of heavy sulphur isotope δ S34 with rather narrow range of variations δ S34 from +0,1 ‰ to + 0,7 ‰ and medium value 0,35 ‰.

In this case there is no typical differences in correlation of sulphur isotopes in pyrite from impregnation in wallrock alteration of rocks, from veinlets in host rocks and pyrite from richer areas of mineralized zones. Therefore, it is assumed there was the only source of sulphur pyrites formed under similar conditions and absence of sulphates in direct association with sulphides relatively homogeneous isotopic composition of pyrite, and at last, lack of directional separation of isotopes during ore-forming process show homogenization of heavy sulphur under definite high temperature conditions.

According to our research correlation of ore elements in many deposits of Mekhmanian OMS and other areas can to a certain extent show joint supply of copper, molybdenum, gold, silver by juvenile fluids. Ore elementsof the latter miss spatially disconnected during process evolution in relatively small deposits but often provide independent maximum of concentrations during long-term spatial differentiation of large fluid systems. This can determine a possible significant concentration of gold and silver in frontal and lateral parts of porphyry copper columns.

The same concentration of gold and silver can occur due to numerous fluid supply from deep areas of porphyry copper column and this is very typical for them. Possible significant gold concentration in fluid is caused by variety of complex combinations of this metal and by their stability in wide PO2-pH-T interval. In this case the important condition of preservation for considerable gold concentrations in fluid is a high temperature of the process (more than 200°C).

The most opposite tendency of change for studied characteristics in sulphides of quartz-sphalerite-chalcopyrite stage shows the discreteness of ore process and availability of other magmatic source of ore matter because otherwise ƒO2 would increase further and as a result of it – sulphides enrichment by isotope S32 (Sosson, M., et al, 2010.). Analysing abovementioned data of gold- bearing ores of porphyry copper deposits of Mekhmanian OMS one can note that Mekhmanian intrusive consists of two-phase rocks: 1) successively differentiated diorite, quartz diorite, tonalite, banatite and their hornblendbiotite difference; 2) porphyry diorite, veined malachite, spessartine, odinite. Here are greisenized quartz diorites, pegmatite-aplites.

Metasomatic formations consist of mainly secondary quartzites, quartz-sericite, quartz-kaolinite facies and argillizated rocks.

Porphyry copper mineralization as stock-works is localized in contact zones of Mekhmanian intrusive with host rocks. Gold is connected with chalcopyrite, pyrite and in many cases with maghemite and hematite probably corresponding to chalcopyrite-pyrite association, connected with hydrothermal solutions of diorite-tonalite-banatite and granodioritefacies of Mekhmanian intrusive. Galena-sphalerite type of mineralization localized among sericite-quartz metasomatites. Probably pyrite-chalcopyrite-gold mineralization is connected with the main phase of Mekhmanian intrusive, and galena-sphalerite association – with granite-pegmatite.

5. Conclusions

Finally we can make the following conclusions:

1) porphyry-copper deposits of Mekhmanian ore area according to tectonic position of deposits, composition of ore-bearing intrusive, quantity and correlation of main and associated components, refer to gold-bearing copper-molybdenum-porphyry and gold-bearing porphyry copper types of ores formed due to porphyry intrusive of gabbro-diorite-granodiorite complex;

2) deposits of porphyry ore formation differ by various contents of Cu, Mo, Au, Ag, Se, Te, Re in ores and sulphide accumulations;

3) gold distribution in porphyry copper deposits chiefly can be defined by their mineralogical-geochemical appearance caused by systematic combination of several types of ores in mineralized-space volume. Analysis of gold content of mineral associations of porphyry copper deposits in this area shows that Productive mineralization can occur by two stages: 1) productive (quartz-molybdenite, quartz-chalcopyrite); 2) II productive (quartz-chalcosine-pyrite-chalcopyrite, sphalerite-galena-gold-rare metal). Gold concentration in them is up to 4,1 g/t from traces;

4) high gold content of porphyry copper deposits can be connected with development of imposed polysulfide and proper gold-ore mineralization within ore bodies;

5) Expected exploration works dealing with noble metals first of all should be carried out in apical areas of porphyry intrusive and in those regions where subvolcanic activity of granitoid intrusive was intensive due to process of tectono-magmatic activization of structures.

6) Mekhmanian ore region besides above-studied deposits possesses a considerable amount of perspective deposits and ore occurrence. In future a new large mining and smelting interprise of Cu, Mo, Zn and noble metals can be built in this ore region.

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