Gold Mineralization and alteration of Firoozkuh, NE Iran

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Abstract

The Firoozkuh mineralized area occurs in Khorasan Razavi province, in north eastern Iran .Gold mineralization related to a sulphide-bearing quartz vein has been identified in some plutonic rocks adjust siltstone and shale. Petrographically, the rocks range from Quartz diorite to gabbro diorite. Siltstone, shale changed to hornfels near mineralization zones. Mineralization is locally dominantly fracture-controlled. Quartz veins ranging from a few millimeters to maximum 50cm in thickness occur in a fault zone. Calcite veins have less mineralization and alteration evidence. The vein-hosted mineral assemblage includes principally pyrite, chalcopyrite and arsenopyrite which almost presence together in silica veins. Main mineralization assemblage containing Au, As, Cu, Bi, Mo and Ag show that mineralization has occurred in high temperature condition. The difference in temperature between the cool country rocks and the hot invading fluids causes reactions which results in a new assemblage of minerals. The main products of this mineralization are chlorite, sericite, zeolites, clays, silica and pyrite. Propylitization is the main zone of alteration in which chlorite is the main mineral. Silica, chlorite, sericite and pyrite of the alteration halos are usually restricted to mineralized zones.

Keywords: *Firoozkuh, gold mineralization, alteration.*

Geology

The Firoozkuh indication is located in Khorasan Razavi province, in north eastern of Iran (Fig. 1). This mineralized district is one of metallogenic provinces near Torbat-e-Jam city.

The general geology of study area is composed of Jurassic sediments, Jurassic introsion and Quaternary sediments. Fluid flow in hydrothermally mineralized faults and shear zones is typically associated with brittle deformation in a regime of transiently changing fluid pressure associated with an earthquake cycle close to the brittle-ductile transition.

This area consists of non- or weakly metamorphosed sedimentary rocks. The Jurassic sediments consists of shale, siltstone and sandstone. A series of mafic to intermediate intrusions were emplaced into the sedimentary host rocks. The Intrusive bodies and volcanic rocks consist of gabbro, diorite, quartz diorite and rhyodacite. The Intrusive rocks are distributed along northeast- or north-northeast trending.

Samples of plutonic rocks were analyzed for their major and trace element compositions.

Selected samples have minimum alteration. Petrographic studies show that the samples composed of quartz-diorite and quartz-monzodiorite rocks.

The assemblage minerals are plagioclase, amphibole, minor alkali-Feldspar. Ferromgnesian minerals form belong to gabbroic rocks. Analysis showed FeO, CuO and MgO oxides and Na_2O oxide have descending and ascending trend respectively in Harker diagram but K_2O and Al_2O_3 oxides don't follow any special trend and these oxides are dispersed. The reason of dispersion is alteration of minerals especially sericitization of plagioclase.

In general observed trends on Harker diagram can confirm partial crystallization of plagioclase, clinopyroxene and amphibole. Rare earth element were used to test the partial crystallization of semi-quantitative model.

Plutonic rocks belong to sub-alkaline magma series. The K_2O content is average and they show Tholeitic calcalkaline series on various diagrams. According to mentioned above it seems that studied subvolcanic rocks formed in magmatic arc setting.

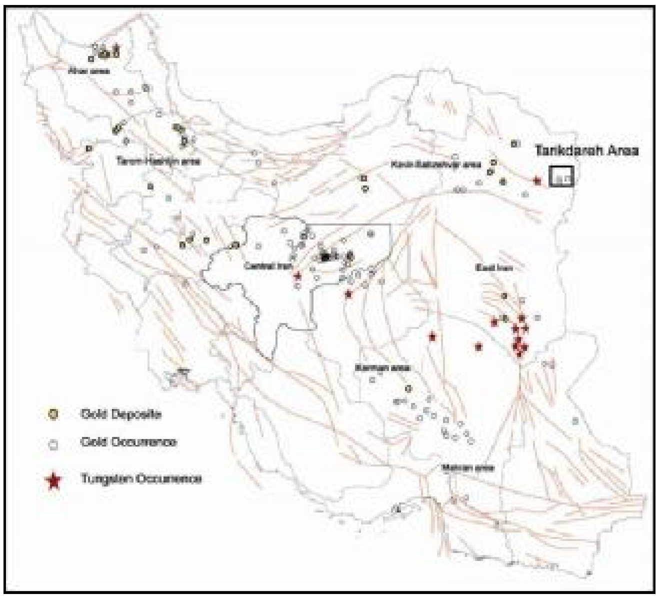

Fig 1. Distribution map of Au-W mine and indication. Location of study area is shown in rectangle.

Alteration

Various alteration recognized in study area around hundred meters. Collected samples indictae argillic, chloritic and sericitic alteration. Propylitization is the main zone of alteration in which chlorite is the main mineral. Secondry Fe-oxide exist in extent area. These alteration mostly appeared as line shape near intrusive unites. Sometimes these zones associated with silicified veins. Mineralized veins extensively occured in gabbroid and gabbrodiorite unites.

In gabbroic unite, plagioclase is altered to clay minerals, sericite, calcite, chlorite and epidote but in dioritic unites it is altered to clay and then sericite and chlorite. Younger dioritic unite is affected more. It seems that quartz-diorite unite is the youngest.

Mafic minerals such as amphibole and biotite are altered completely and the minerals such as calcite and chlorite have been formed. Feldspars are altered to clay mineral, sericite and muscovite. Amphibole is also replaced by chlorite and biotite. Some feldspar is altered to sericite strongly. Sometimes the amphibole, chlorite, biotite and calcite observed as veinlets.

The alterations associated with intrusive bodies are spread extensively but they show more intensity locally. Maximum of their extent is about 100m in wide and less than 200m in length. This alteration is related to gabbrodiorite and gabbro unites and follow the trend of these unites. Surrounded rock of these intrusive bodies are the alternation of shale, siltstone and sandstone which mostly hornsified in contact. Hornfels has about a few meters to less than 50m in wide.

Chlorite, sericite, clay minerals and quartz are the main product of alternation. Silicified vein and veinlets are exposed with millimeter to decimeter in thickness and maximum 5 to 25m in length in fractured regions of contact zone which are associated arsenipyrite or pyrite or the product of their alteration (fig. 2). It seems that the main part of gold mineralization is related to silicification in these structures.

Veins

All the veins hosting mineralization in study area are gray to white in color. Their widths are generally less than a meter and commonly vary over short distances both along strike and up and downdip. The variation in thickness is commonly the result of shear zones parallel to the vein margins, especially where faults cut the veins. The veins typically are laminated. Quartz veins strike East –West. The veins can be followed for about 20 m along strike. They contain up to 33 g/t gold and 228 g/t silver [6].

Mineralogy and Paragenesis

Mineralization is locally dominantly fracture-controlled. Quartz veins ranging from a few millimeters to maximum 50cm in thickness occur in a fault zone. Calcite veins have less mineralization and alteration evidence.

Although the proportions of different minerals in the veins vary, the mineralogy of the veins is simple. The vein-hosted mineral assemblage includes principally pyrite, chalcopyrite and arsenopyrite which almost presence together in silica veins. The ore mineralogy in silica veins is uniform along strike. Arsenopyrite is the most abaoundant mineral in veins. Most of veins have up to 90 % Arsenopyrite. Secondry copper oxide exist in some veins and intrusives.

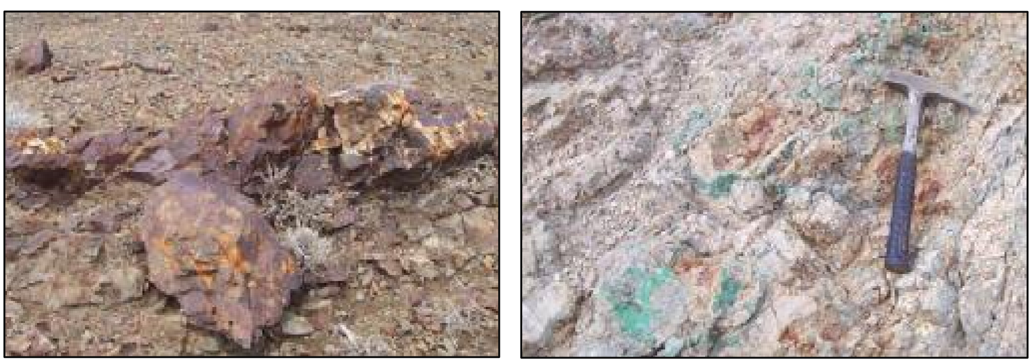

Fig2. Secondry Fe oxide (left) and Copper oxides (right) in mineralized zone.

Geochemistry

Geochemical analysis is one of the best method for findind main deposit. Chip samples were cllected from mineralization zone analyzied for Au, As, W, Cu, Bi, Mo and Ag by Zaernab Company. Result showed anomalis in Au, As, W and Cu[6].

Distribuiton of Au (ppb) in rock samples has been shown in Fig3. Distribuiton of W (ppm) and distribuiton of Cu (ppm) in rock samples has been shown in Fig 4 and Fig5. As shown in maps, main anomalie for Au, W and Cu occurred in western part.

Conclusion

In Firoozkuh area, Mineralization is locally dominantly fracture-controlled. Gold mineralization has ocuured in sulphide-bearing quartz veins. The mineral assemblage includes principally pyrite, chalcopyrite and arsenopyrite. The main products of alteration are chlorite, sericite, zeolites, clays, silica and pyrite. Geochemical investigastion showed high anomalies in west of study area. So this area have a good potential for Au-W exploration.

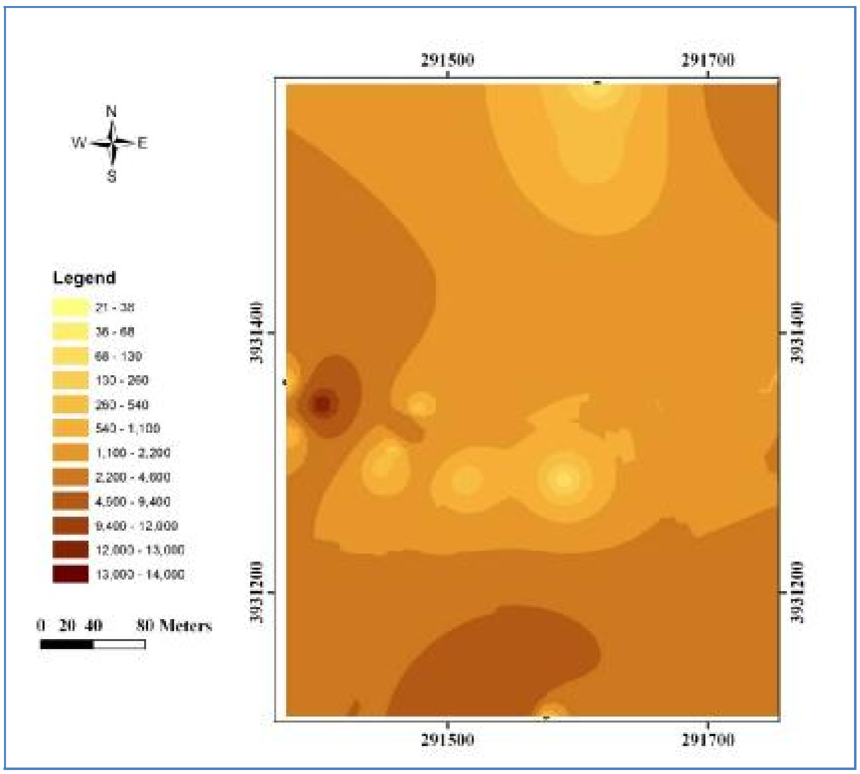

Fig3. Distribuiton of Au (ppb) in rock samples.

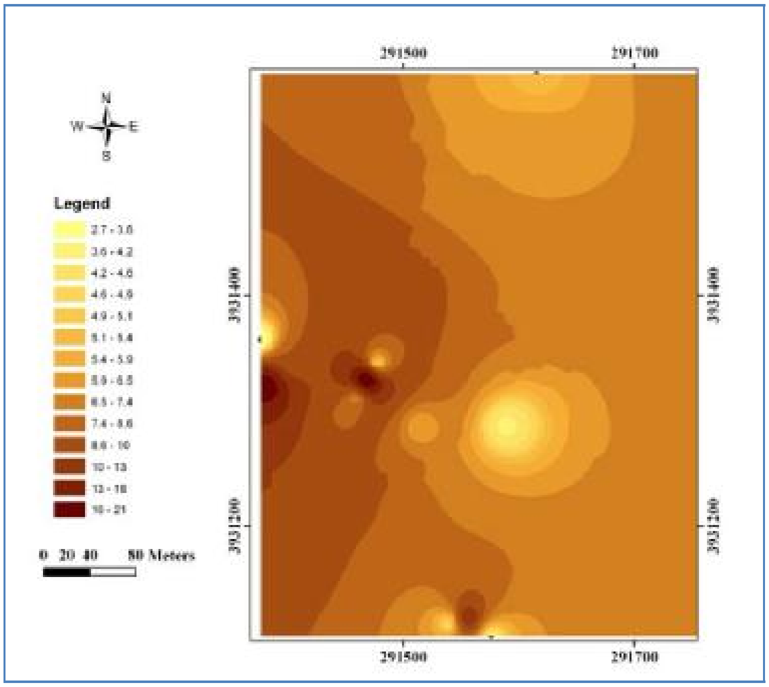

Fig4. Distribuiton of W (ppm) in rock samples.

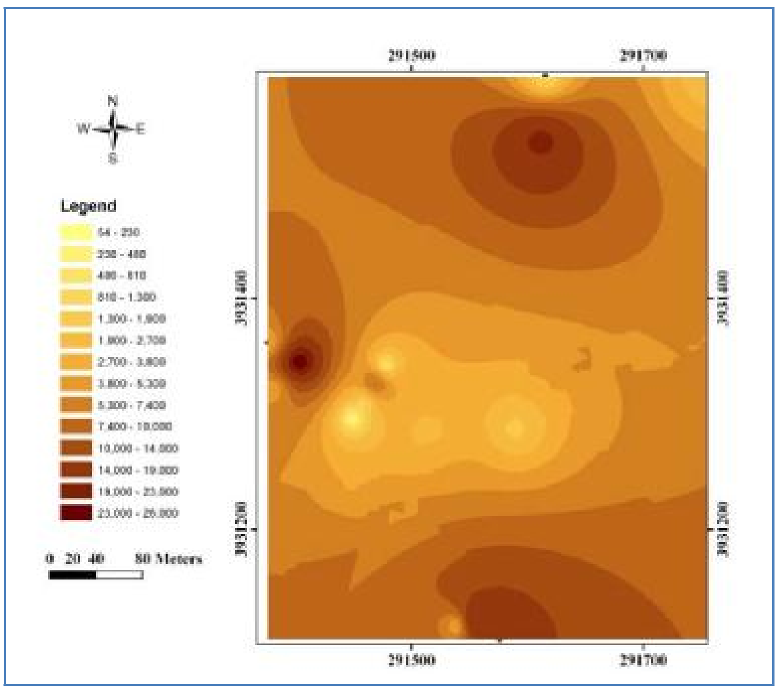

Fig5. Distribuiton of Cu (ppm) in rock samples.

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