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GEOLOGICAL AND STRUCTURAL SETTING OF THE GADIR LOW SULFIDATION EPITHERMAL DEPOSIT (LESSER CAUCASUS, AZERBAIJAN)

Abstract

Gadir Low Sulfidation Epithermal Deposit (Gadir LSED) is embedded in cone-shaped Mountain Yogundag at elevation 2085 m. Gadir deposit has complicated geological structure and consists of different aged and different composite intrusive bulks and fracture structure consisted of complicated with Middle and Upper Jurassic sediments. There are 3 groups of fault zones based on strike direction and morphological characteristics: 1) faults-dislocations in north-west direction (Gedabek-Bittibulag deeper fault, Misdag ore-controlling fault). 2) faults in north-east, submeridional direction and reverse faults (Gedabek-Ertepe, Gerger-Arykhdam, Gadir ore-controlling faults); 3) transverse faults (local fault).

Keywords: *Lesser Caucasus, Gedabek, Gadir, low sulfidation deposit, geological setting, structural setting*

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Qədir aşağı sulfidli epitermal yatağının geoloji və struktur quruluşu (Kiçik Qafqaz, Azərbaycan)

Xülasə

Qədir aşağı sulfidləşmiş epitermal yatağı (Qədir LSED) konus formalı 2085 m yüksəkliyə malik Yoğundağ dağında yerləşir. Qədir yatağı mürəkkəb geoloji quruluşa malik olmaqla müxtəlif yaşlı və tərkibli intruziv kütlələrdən, Orta və Yuxarı Yura yaşlı vulkanogen süxur çöküntülərinin qırılma strukturundan ibarətdir. Uzanma istiqamətinə və morfoloji xüsusiyyətlərinə görə 3 qrup qırılma zonası vardır: 1) şimal-qərb istiqamətində olan qırılma-dislokasiyalar (Gədəbəy-Bittibulaq dərinlik qırılması, Misdağ filizsərhədləndirici qırılması); 2) şimal-şərq, submeridional istiqamətdə uzanan qırılmalar və əks qırılmalar (Gədəbəy-Ərtəpə, Gerger-Arıxdam, Qədir filizsərhədləndirici qırılmalar); 3) transvers (eninə) qırılmalar (lokal qırılmalar).

Açar sözlər: *Kiçik Qafqaz, Gədəbəy, Qədir, aşağı sulfidləşmiş yataq, geoloji quruluş, struktur quruluş*

Introduction

The Gadir low sulfidation epithermal deposit is one of the main producing mining of the Gedabek ore district Azerbaijan. It belongs to the Lesser Caucasus, located in the central part of the Tethys metallogenic belt. It is emplaced with in the Jurassic-Cretaceous Lok-Karabakh magmatic arc, resulting from the subduction of the Tethys Ocean along the Eurasian margin (Fig. 1) (Babazade, Makhmoudov, Ramazanov, 1990).

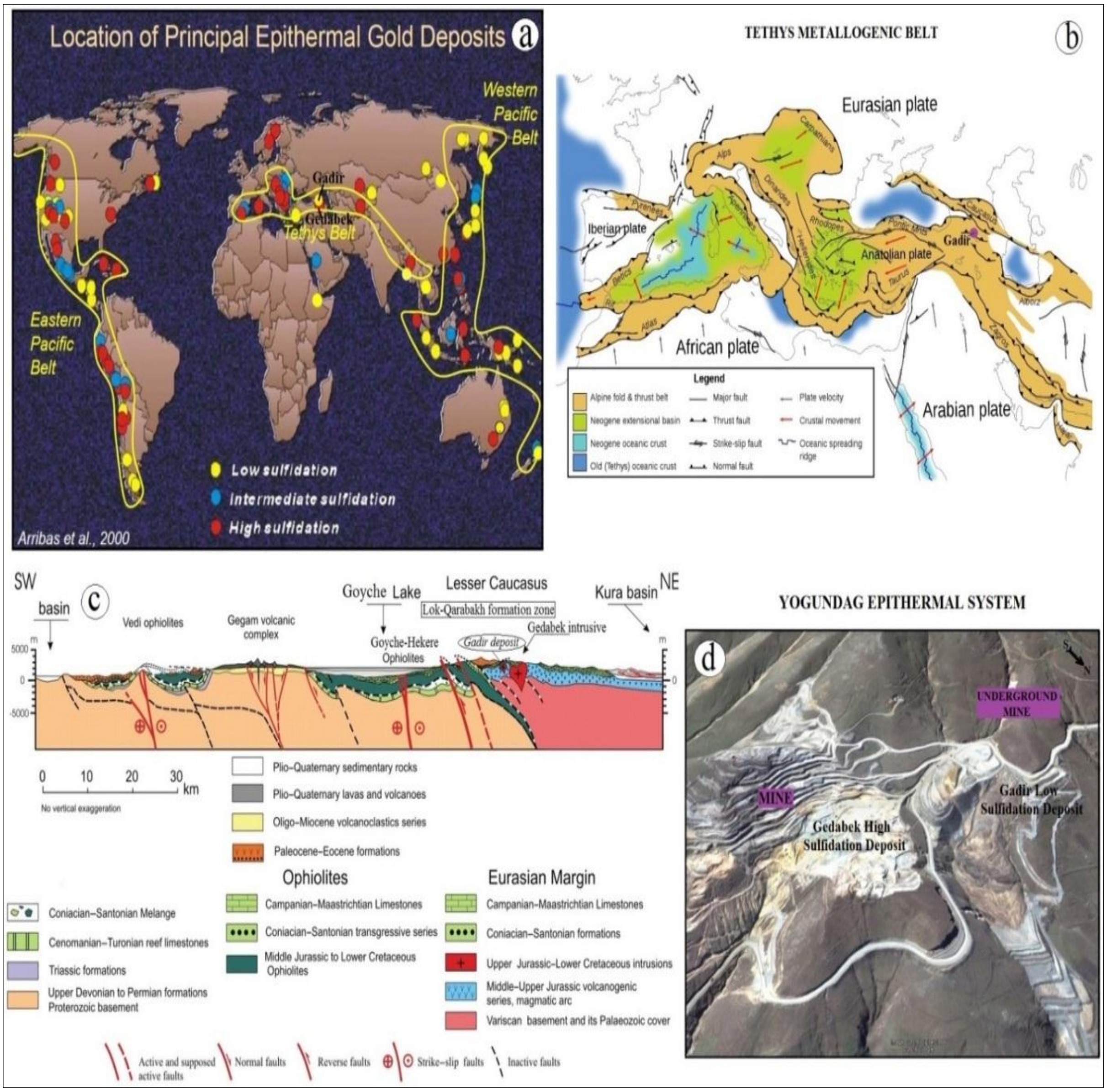

Figure 1. Location of Gadir low sulfidation epithermal deposit: a) Gadir LSED in Tethys metallogenic belt; b) Gadir LSED located in Lesser Caucasus Mega-anticlinorium; c) Lithological-structural cross-section from Vedi ophiolites to Kura basin. d) Gadir LSED near Gedabek high sulfidation epithermal deposit

The NW Flank of Gedabek Mine is located in the Yogundag Mountain area. Yogundag it with respect to tectonics and metallogenic is confined to Gedabek volcano-plutonic structure of Shamkir uplift of Lesser Caucasus metallogenic zone. The ore perspective areas, also Gadir low sulfidation epithermal deposit (Gadir LSED) is embedded in cone-shaped Mountain Yogundag at elevation 2085 m, located approximately 400 m from Gedabek Mine.

While carrying out geological exploration works in the North-West flank of Gedabek Mine, Gedabek Exploration Group (GEG) of Azerbaijan International Mining Company discovered the Gadir low sulfidation deposit in 2012 year. Here is the probable outcrop of hydrothermal eruption breccia pipe, silica sinter and lacustrine siliceous deposit was considered as the main factor. In the aim of discovering the ore formation in contact part of this rhyolite-dacite subvolcanic body was drilled DD-86 drillhole in 2012 year. During geological-structural mapping, it has been defined Gadir Horst structure.

Gadir deposit has complicated geological structure and consists of different aged and different composite intrusive bulks and fracture structure consisted of complicated with Middle and Upper Jurassic sediments. The sediments of Lower Bajocian Substage in Gedabek deposit and NW flank are represented (from bottom to top) by: andesite-basalts, andesite porphyrites, diabases and diabase porphyrites. Upper Bajocian volcanogenic rocks represented by rhyolite-dacite lava facie and rhyolite subvolcanic rocks (Fig. 2). The rocks of this substage on an investigated area are widely developed and traced from the South-East (Gadir Gallery area) to the centre (east contact of Gedabek Hydrothermal Eruption Breccia Pipe) and North-West directions to Umid Area.

On the studied mapping area Lower Bajocian volcanogenic rocks (or sediments) are widely developed and stretch from South-East of Yogundag area (Gedabek deposit) to the center and North-East directions to Zefer area.

The sediments of Lower Bajocian Substage in Gedabek deposit and NW Flank are represented (from bottom to top) by:

1. Andesite-basalts and andesite porphyrites with low-thick interlayers of thin fragmental crystalline-lithostatic tuffs of andesites. The exposure thickness is 119 m.

2. Mantles of diabases and diabase porphyrites. The thickness is 8.0 m. The total thickness of Lower Bajocian formations is more than 147 m.

Andesites are macroscopically represented by taupe (dark grey), greenish-grey thick rocks. They under a microscope have a porphyritic structure. Porphyry exhalations are represented by plagioclase. Plagioclase is also observed in a main bulk as fine, medium and coarse grains. In a main bulk are quite often observed chlorite, epidote and sometimes zeolite (Gadimov, Valiyev, Cafarov, Ibrahimov, Bayramov, Mammadov, 2014: 13).

These rocks represented by rhyolite-dacite lava facie and rhyolite subvolcanic rocks (Agakishiyev, Chalabi, Isazadeh, Gadimov, Akbarov, Alasgarov, 2004: 35). The rocks of this substage on an investigated area are widely developed and traced from the southeast (Gadir Gallery area) to the center (east contact of Gedabek Hydrothermal Eruption Breccia Pipe) and northeast directions to Mubariz minerlisation target (in honor of Azerbaijan national hero Mubariz Ibrahimov).

The rocks of the effusive facies are represented by various fragmental tuffs (from ash to agglomerate) and mantles of rhyolite and rhyolite-dacite porphyrites. They have light grey with pinkish, sometimes yellowish grey color. The rocks under a microscope have felsite structure and contain fragmental individuals of quartz and plagioclase.

On sediments of Upper Bajocian Substage are transgressively occurred formations of Bathonian stage represented by an alternation of fine- and thin-layered, ashy and agglomerated tuffs with rare interlayers of andesitic-porphyritic breccia and andesitic-dacitic lavas.

Within the bounds of the prospecting area are widely developed different facies of contact-metamorphic and hydrothermal-metasomatic rocks. Contact-metamorphic rocks are represented by hornfelses and silicified andesite rocks.

Dyke formations within the ore perspective areas bounds are widely developed and represented by early quartz-diorite, microdiorite and late diabase formations. Diabase dykes are mainly developed and generally confined to latitudinal discontinuities. Andesite and microdiorite dykes are less developed and confined to discontinuities of various directions from the North to the North-West.

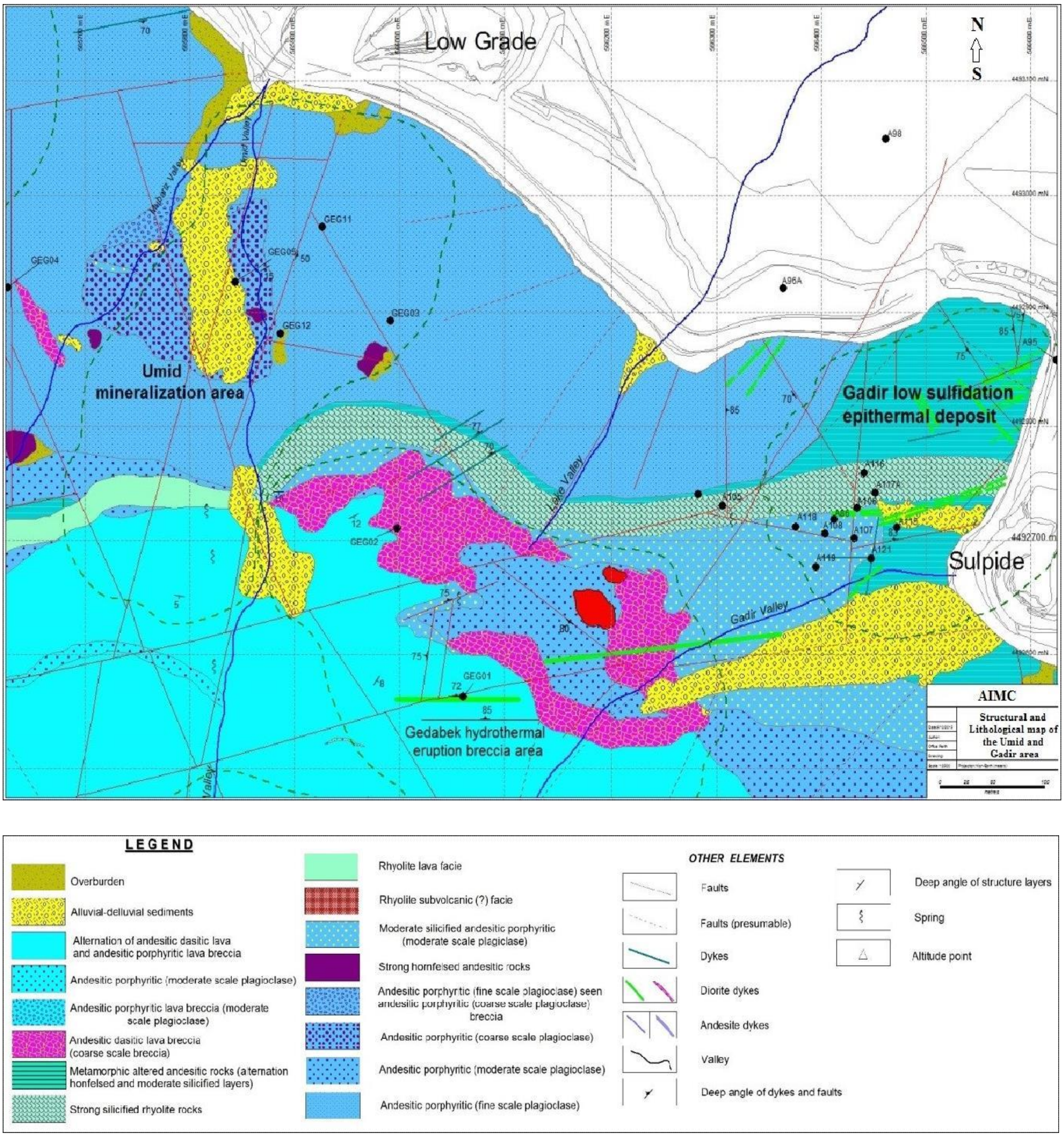

Figure 2. Lithological-structural map of the Gadir low sulfidation epithermal deposit

The Gedabek hydrothermal eruption breccia pipe (GHEB pipe) is located in the central-eastern part of the Yogundag Mountain around the Gadir low sulfidation deposit. The present shape of the pipe with about 50m diameter resulted from both volcanic and erosional processes. Erosion has reached the deep levels of the pre-pipe stratovolcano at the bottom of the depression and the hills forming the margins of the pipe. Breccia pipes are mostly consisting of after Bathonian andesitic lava and tuffaceous rocks. A rhyodacite dome is well preserved in the center of the volcanic structure (White Noel, Hedenquist Jeffrey, 1995: 11).

The total thickness of the volcanic pipe is not known exactly. The lower part of the Pipe is drilled (GEGDD 01, 02) and South part of the pipe consists of submarine dacitic and andesitic lava and tuff of after Bathonian age.

Gadir Silica Sinter forms from discharging alkali chloride hot springs and provide evidence at the surface of a deeper geothermal reservoir. Long after hot spring discharge ceases, sinter textures are preserved, and an exploitable geothermal system may remain at depth. Therefore, sinters may be the only evidence at the surface of a hidden geothermal resource (Simmons, White, John, 2005: 496).

Gadir Lacustrine Siliceous Deposit. The sedimentary sequences of the lacustrine basin are in East of Gadir outcrop over an approximately 85000 m^2 area. The original size of the basin is not known because it is bordered by normal faults to the west and south. The basin history was reconstructed by GEG (2015) from observations of more than 12 drill holes. The upper parts of the lava beds show shallow subaqueous accumulation with breccia (Fig. 3). The siliceous layers show bedding in which the individual layers have very variable thickness from a few centimeters up to 1-2 meters. The thick siliceous layers also contain interbedded rhyolitic tuff without silicification. These sulfides occasionally correlate with the distribution of organic material. The siliceous beds are generally characterized by high concentrations of Sb, and lesser As and Hg, as well as some Ag (based on assay results of drill holes).

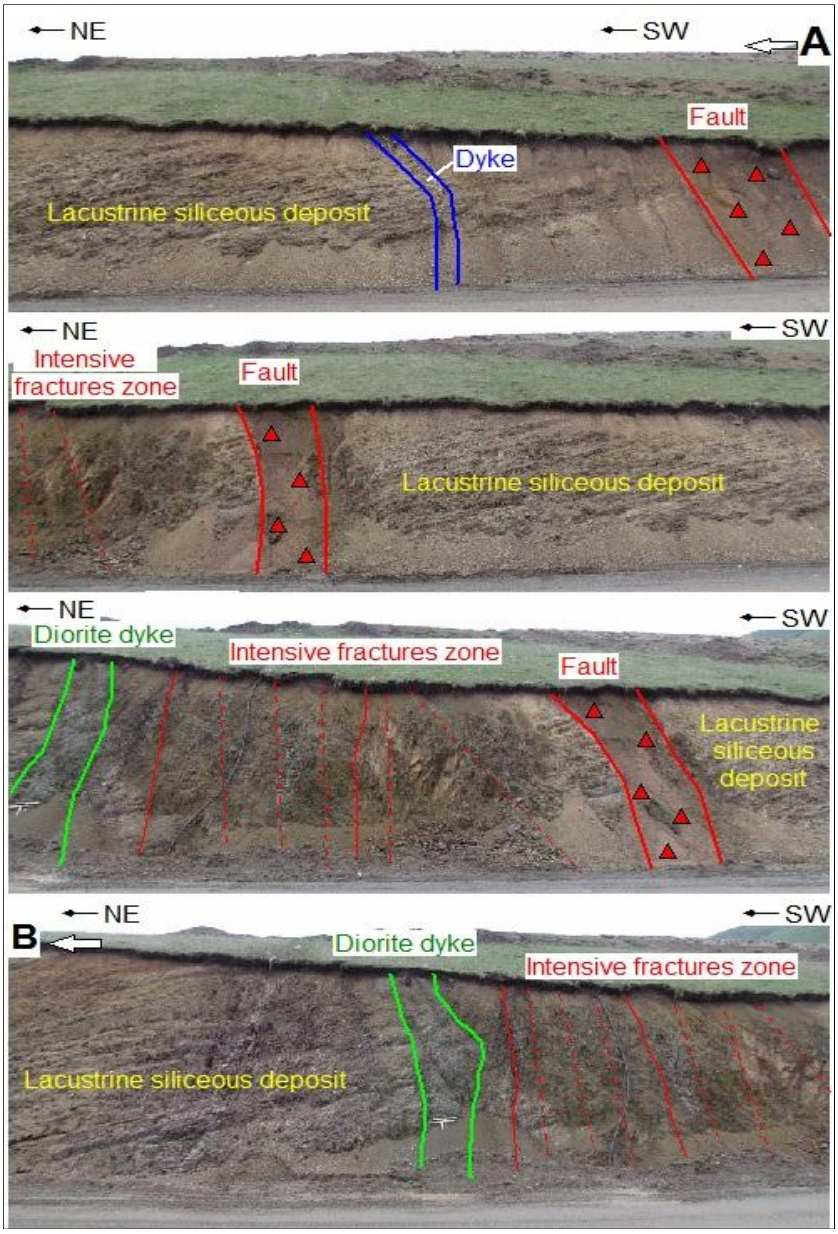

Figure 3. The road to Gadir; AB line section (SW-NE direction (75^0)).

Close to the centers, the thickness of siliceous deposits is up to 10-12 meters, while on the margins they totally pinch out. In feeder zones within the basin, also outlined subaerial hydrothermal centers around the depression. These centers now form small hills with strongly silicified and brecciated rocks.

The following folded structures were described by numerous researchers within the bounds of NW Flank of the Gedabek Mine: Arykhdam-Shekarbek anticline and Godekdere-Yenikend syncline (Gedabek Exploration Group, 2015: 43).

Arykhdam-Shekarbek anticline fold axis is observed from a confluence of rivers Gedabekchay and Shamkhirchay, passes across village Arykhdam and stretches in a northwest direction to village Shekarbek. In a structure core are cropped out effusive and effusive-pyroclastic sediments of Lower Bajocian substage being overlapped by vulcanites of Upper Bajocian Substage on extrusive.

Godekdere-Yenikend syncline is traced from northwest of village Godekdere across villages Gozgaraly, Saryhesenli to an east edge of village Yenikend. At the NW Flank of the Gedabek Mine, along on Yogundag Mountain it is shaded by a like volcanic structure. The syncline is composed of volcanogenic, volcanogenic-sedimentary of Bathonian Stage. The fold structure is gentle-symmetric with a rock dip on limbs at an angle 10-15° (Guseynov, Valiyev, Mammadov, Bayramov, 2014: 24).

There are 3 groups of fault zones on the basis of strike direction and morphological characteristics: 1) faults-dislocations in north-west direction (Gedabek-Bittibulag deeper fault, Misdag ore-controlling fault). 2) faults in north-east, submeridional direction and reverse faults (Gedabek-Ertepe, Gerger-Arykhdam, Gadir ore-controlling faults); 3) transverse faults (local fault);

Gedabek-Bittibulag deep faulthas a thickness approximately 2 km for Yogundag Area. This deeper fault is divided in two parallel parts: 1. Gedabek-Bittibulag East fault (old data) and 2. Gedabek-Bittibulag West fault (by GEG, 2014 year). Gedabek-Bittibulag East fault has dips to the northeast at an angle 70-85°. It testifies to Gedabek-Bittibulag fault is one of ancient and macrobian structures within the bounds of the investigated region. It bounds Gedabek deposit from the east.

The later concerning the described systems of the faults within the deposit bounds are the sub-latitudinal faults having a northwest strike (270-310°) and a steep dip to the north (80-85°). The thickness of these faults doesn't exceed 50m. The rocks along these faults are brecciated, slightly schistose and kaolinized (Pierre, 2013: 27).

Conclusion

Epithermal gold deposits occur largely in volcano-plutonic arcs (island arcs as well as continental arcs), with ages similar to those volcanisms. Gadir deposits are located on the arc which possible to see by geomorphological situation. The deposits form at shallow depth, around 1.5 km, and are hosted mainly by volcanic rocks. The two deposit styles form by fluids of distinctly different chemical composition in contrasting volcanic environment.

The Yogundag (Gedabek and Gadir areas) epithermal system was introduced by GEG with more lithological factors such us silica sinter, lacustrine siliceous deposit, eruption breccia pipe. The latest international geological models show that the potential ore located around of eruption breccia. These factors clarify the model of ore forming in epithermal processes and will be guideline for future exploration drilling on silica sinter and around of eruption breccia pipe zones. During the detailed geological mapping was corrected the contact zones between the rock which composed the volcanic of Bajocian and Bathonian ages. Also was corrected the texture of rock consisting of the volcanic sediments of above-mentioned ages.

Summarize all the key points of the above, it can assumed that in the Gadir LSED area are main three fault types: 1. Gadir pre-mineralization faults; 2. Gadir mineralization bearing faults; 3. Gadir post-mineralization faults.

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