Determining the position of erosion surface in the deposit of Bidester area

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Abstract

Erosion surface and depth of probable gold anomaly in Bidester exploration area that is located in west of Taftan Volcano (65km northwest of Khash) have been investigated by using especial method of calculating the background and threshold limits in current article. Therefore, the standardization and zonality (to some extent) of supraore and subore elements are significant. Calculation of the ratios of mineralization is on the basis of the productivity coefficient of elements. For determining the productivity coefficient, threshold limit of each element is considered. Before the previous stage, anomalous areas as probable gold mineralizations should be calculated by univariate and multivariate processing and paragenesis and type of mineralization should be distinguished. By studying the results of soil sampling with 50 × 100m density, maps and statistical calculations, three parts are introduced in Bidester area. After identifying anomalous areas and their confirmation by previous studies, threshold limit is computed. In addition to the local background of anomalous elements, their number, mean, standard deviation and threshold limits are calculated. Productivity coefficients, which are on the basis of zonality coefficients, can be obtained by mean of samples above threshold limit and their ratio with anomaly samples. The calculations clearly show the effect of number of high grade samples in relation to total samples that is known as Coefficient of Anomaly. Finally, according to the possibility of gold mineralization in the region, zonality coefficients which indicate the probability of deposits are used. Calculations on gold deposits (with two zonality coefficients) are executed. By considering to the zonality coefficients, the probable depth of gold mineralization in the area can be recognizable.

Keywords: *Background limit, Threshold limit, Productivity Coefficients, Zonality Coefficients, Bidester and Taftan*

Introduction

According to differentiation and elemental separation in magmatic bodies and hydrothermal solutions, surficial and deep anomalies or the anomalies over or beneath deposit are different. The differences depend on the characteristics of the constituents of a migrant complex and the conditions of migration environment such as pressure, temperature, pH, Eh and the hosted rock. Therefore, a regular zonality is observed in supraore and subore elements. Discovering and generalizing this regularity and its application for exploration of blind deposits were executed by Soviet Union scientists for the first time (Grigorian).
Figure 1 presents sequence of elements from surface to the depth based on the studies carried out in 300 mines by (Grigorian).
The above-mentioned regularity and sequence are not present in all deposits. Some of them can be supraore and subore deposits. The intensity of secondary haloes of the elements depends on the environment of sampling, location of erosion surface and cumulative ratios.

For instance, the most common ratio of supraore to subore elements in porphyry copper deposit is Pb. Zn/ Cu .Mo. The large expansion of haloes of supraore elements (Zn and Pb in relation to copper), against of Cu & Mo, The calculation of this ratio and other ratios of the mineralizations are not on the basis of raw data. Productivity coefficient of elements is considered for calculating these ratios. The definition of ratios is regarding to threshold of each element.

-Introducing areas I, II and III as probable gold mineralizations

At first step, anomalous areas should be introduced by calculating, and univariate and multivariate processing. Paragenesis assemblage and the possibility of mineralization should be determined in each area. Totally, soil sampling was executed from B-horizon of soil in 410 sites, (+80 and -60) size and 100 × 50m density. According to the maps and statistical calculations, three areas were considered.

-Areas containing gold mineralization and considering Ag > 0.4, As > 20 and Au > 35

The characteristics of the parameter depend on the information obtained from previous stages and bases on the average of the mentioned elements in soil. Table 1 shows the average amount of silver, arsenic and gold in soil.

The amounts of parameters are considered on the basis of relative overlapping in the area. The area is presented in figure 2. According to the processing, there is a possibility of the existence of gold mineralization in western part of the area. Because the anomalies of some of elements are together with gold anomaly, Sb > 5, Bi > 5, Ag > 0.4 and Au > 25 were considered. Based on this parameter, an anomaly of gold and its accompanying elements is introduced in eastern portion of the area. The anomaly is illustrated in figure 3.

Some of the samples taken from anomalous area I have both the above-mentioned parameters and Cu > 75ppm. Only six samples have both Cu > 75ppm and Mo > 2.5ppm.

-Calculating threshold limit of elements

After determining anomalous zones and their confirmation by previous studies, threshold limit is calculated. Calculation of this limit that can be useful for commencing anomalies is very significant.

The best way is referring to local background. Therefore, local background is computed on the basis of I, II and III anomalies for the elements introduced, their number, average and standard deviation. Then, threshold limit is calculated. Table 2 shows the calculations.

-Calculating productivity coefficient for introducing zonality coefficient

Productivity coefficients that are basis for computing zonality coefficients are calculated according to the average of the samples over threshold limit for each element and ratio of the samples to the samples of anomalous area. The calculations indicate the effect of the samples with high grade in relation to the all samples that is known as "Coefficient of Anomaly". Table 3 presents the mentioned calculations for the elements. For optimizing the areas that do not have any sample over threshold limit, lower threshold limit are considered and the lowest anomaly coefficient is calculated. Three examples of this type of areas are in I and II anomalous zones.

Because of inappropriate coverage of copper and molybdenum anomalous zones, the calculations of zonality coefficients related to porphyry copper mineralization are omitted. Mineralization is considered on the basis of I, II and III anomalies that show probable gold mineralization.
Table 3 indicates the calculations of mean, anomaly coefficient and productivity coefficient in I, II and III anomalies.

-Calculating zonality coefficients

For investigating the possibility of the presence of gold deposits, zonality coefficients regarding to productivity coefficients are calculated. Calculations in gold deposits are executed with two zonality coefficients (table 4).
According to table 4, the possibility of the existence of gold mineralization is at depths. Based on zonality coefficients, their large amounts and figure 4, the probability of the presence of gold mineralization is at depths.

List of tables and figures

Table 1: The average amount of silver, arsenic and gold in soil.

Element	Average in Soil	Parameter in Bidester Area
As	50-1PPm	30
Ag	0.1PPm	0.4
Au	2PPb	25,35

Table 2: Calculation of threshold limit of elements regarding to recent studies.

Element	Count	Mean	Max	Min	SD	x+2s	Comments	The desired parameter
Cu	362	34.4	68.9	3.7	11.06	56.5	Only twenty-five samples have (6% of data) have the grade over 100ppm	Cu<70
Zn	350	56.88	74.7	7.3	13.62	84.12		Zn<75
Pb	264	45.67	99.9	10.9	24.02	93.71		Pb<100
As	275	18.44	29.8	0.8	5.33	29.1	Concentration of As > 30 in west of the area	As<30
Sb	275	2.31	4.9	0.4	0.99	4.29	Concentration of Sb > 5 in east of the area	Sb<5
Mo	331	1.28	2.9	0.5	0.53	2.34	Concentration of Mo > 3 in southwest and west of the area	Mo<3
Au	221	23.3	54 54	0.5	14.04	51.38	30% of the samples have the grade over 100ppb	Au<55
Ag	233	0.18	0.39	0.01	0.12	0.42		Ag<0.4
Bi	243	2.12	4.8	0.05	1.26	4.64	All parts of northern part of the area have Bi < 5	Bi <5
Co	207	9.69	12.9	0.1	2.99	15.67	Most parts of northern portion of the area have Co > 13	Co<13
Be	255	1.18	1.3	0.1	0.18	1.54	parts of northern portion of the area have Be > 1.4	Be<1.4
Sn	288	2.37	3.9	1.3	0.59	3.55		Sn<4
W	260	4.09	94.4	1.4	8.27	20.63		W<2.2
Ba	239	378	449	85.4	56.2	490.4	The trend of Ba > 450 samples is northwest-southeast.	Ba<450
Ni	235	46.5	64	1 1	15.1	76.7		Ni<65

Table 3: Calculation of productivity coefficients for introducing zonality coefficient.

Area	Parameters of geochemical anomalies Parameters of geochemical anomalies	Indicator-elements(Gold Mineralization)							
		Cu*	Mo	Pb	Ag	Zn*	Ni	Co	Ba
Anomally I Au,As,Ag	Mean	131	13	379	1.2	95	87	16	626
	Coefficient of Anomaly	0.4	0.6	0.7	0.7	0.1	0.2	0.1	0.3
	Productivity	56	7.6	250	0.9	9.5	15	1.1	207
Anomally II Au,As,Ag	Mean	55	3.1	224	6.3	68	91	32	874
	Coefficient of Anomaly	0.1	0.1	0.5	0.9	0.1	0.1	0.2	0.8
	Productivity	5	0.3	101	5.4	9.6	13	5.8	717
Anomally III Au-Ag-Sb-Bi	Mean	67	2.9	205	4.1	72	100	25	748
	Coefficient of Anomaly	0	0.1	0.4	0.7	0.1	0.1	0.2	0.6
	Productivity	2.7	0.2	82	2.8	5.8	6	4.2	479

- Sample Zn > 84.12 is in anomaly I. Therefore, Zn > 75 is the basis of calculation. Zn > 66 and Zn > 69 are the basis for calculation in II and III anomalies.
- A sample with over 56.5 copper is in anomaly II. Therefore, Cu > 50 is considered. Only two samples are remained in the calculations.
- A sample with over 76.7 nickel is present in anomaly II. Therefore, Ni > 72 is considered. Only two samples are remained in the calculations.

Table 4: Calculation of zonality coefficients.

Area	gold mineralization	
	Au	
	$\frac{\text{Ba.Ba}}{\text{Co.Cu}}$	$\frac{\text{Pb.Zn.Ag.Cu}}{\text{Co.Co.Ni.Mo}}$
Anomaly I: Au,As,Ag	$\frac{42683.60}{64.07} = 666.2$	$\frac{119245.00}{146.18} = 815.74$
Anomaly II: Au,As,Ag	$\frac{513659.00}{28.70} = 17898$	$\frac{25943.00}{118.35} = 219.0$
AnomalyIII: Au,Ag,Sb,Bi	$\frac{229441.00}{11.16} = 20559$	$\frac{3586.70}{17.88} = 200.6$

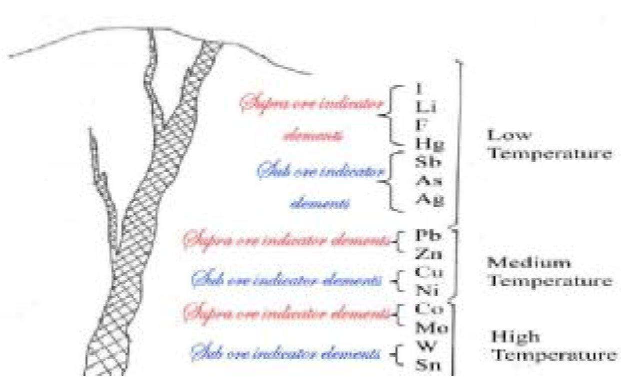


Figure 1: Sequence of elements from surface to the depth.

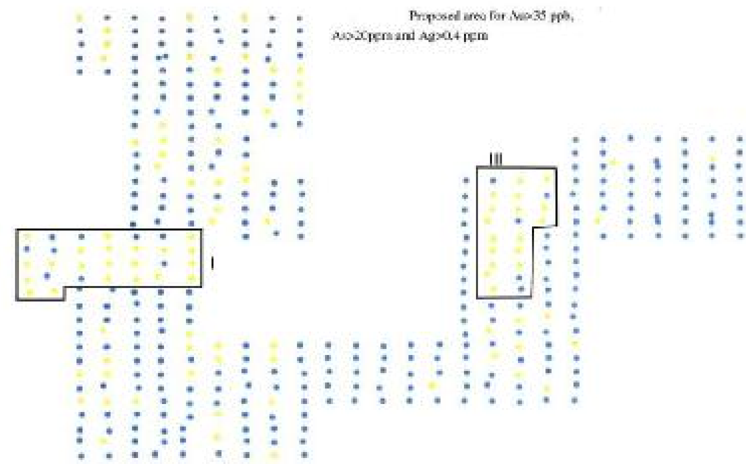


Figure 2: Areas with gold mineralization and considering Ag > 0.4, As > 20 and Au > 35 parameter.

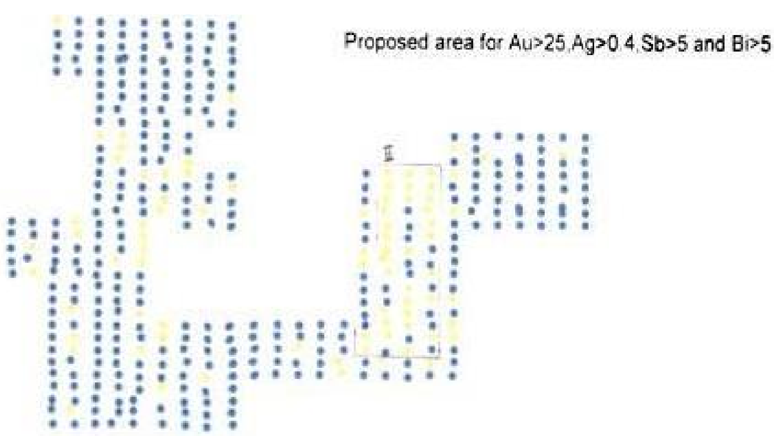
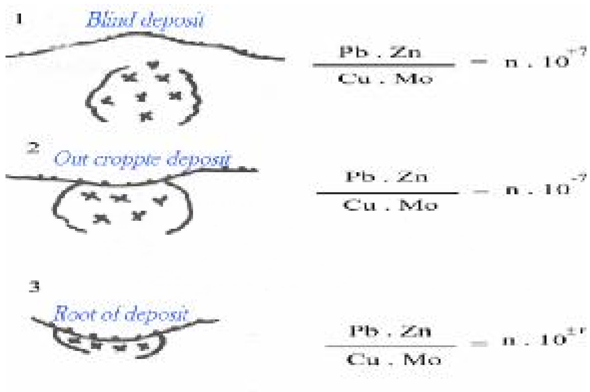
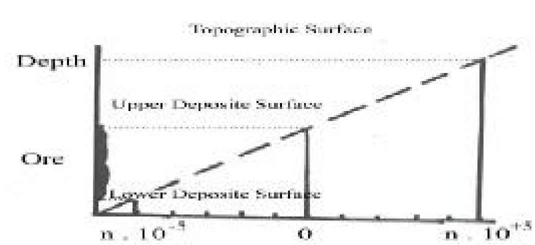


Figure 3: Areas with gold mineralization and considering Sb > 5, Bi > 5, Ag > 0.4 and Au > 25 parameter.





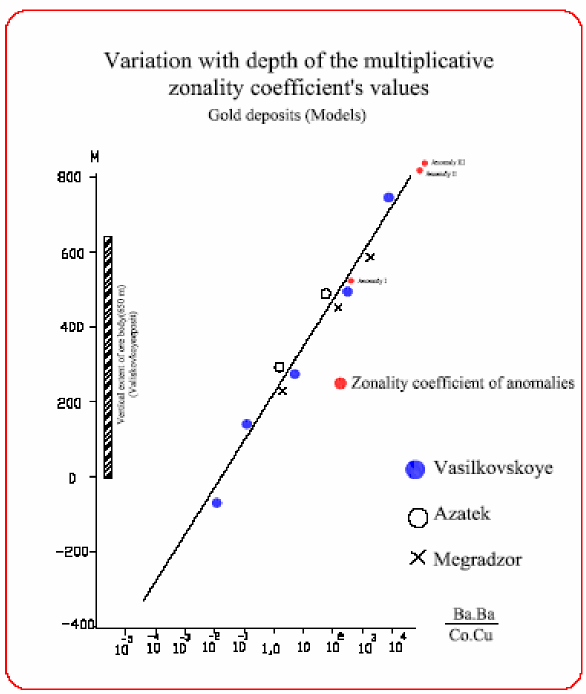


Figure 4: Relationship of digital values of zonality coefficients with erosion surface and the depth of emplacement of ore deposit in Bidester area.

References

Shahabpur, J., 1384, "economic geology",Kerman University press.

Shokouh Zangeneh, Golnaz, Momenzadeh, M., Rasa, Iraj, 1384, "Estimation of geochemical exploration projects,Bidester region, south of Zahedan (soil sampling regular network), the ninth Conference of Geology Association

.Zarnab Exploration Consultants, 1382, report "Soil Sampling in Bidester south of Zahedan".

Zarnab Exploration Consultants, 1381, reported "regional geochemical exploration in Kharstan ,."(South of Zahedan (stream sediment) ".

Gilbert, John. Alirezaei, S., 1378, "Geology of deposits", Institute of Amirkabir Publications.

Hassanipak, AA, 1377, "Principles of Geochemical Exploration", Publishing and Printing Institute of Tehran University.

Hassanipak, AA, 1377, " (Geo Estatistic)",Publishing and Printing Institute of Tehran University.

Darvishzadeh, A., 1370, "Geology of Iran", Institute of Amirkabir Publications

Hassanipak, Ali Asghar and Shojaat, Behnaz, "Modeling of metal and non-metallic deposits - and application".

Grigorian. S, 2004, "Report on Kharestan prospect ,"Moscow-Tehran. Grigorian. S, 2004, "Report on Kharestan prospect", Moscow-Tehran.

Ore Mineralization at Qamsar Cobalt Deposit: Skarn and Metasomatism Evidences

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Abstract

Qamsar cobalt deposit is located 7 km northwest of Qamsar, in Urmieh-Dokhtar magmatic arc and in contact with a microdioritic subvolcanic body and limestone rocks of Qom Formation. Intrusive bodies in the area have middle to felsic composition and include diorite, tonalite, granodiorite and granite. Analytical data and studies on bodies in the area indicate that they are in calc-alkaline and per-alumina series. Ore mineralization in the deposit occurs as magnetite veins. Cobaltite as disseminated, diffusion, massive and veinlet textures accompanies magnetite. Cobaltite as euhedral and also with clastic texture is visible within magnetite and is sometimes hurtled by magnetite crystals. This shows that cobaltite crystallization occurred before magnetite crystallization in a sulfidic phase. Magnetite was crystallized in a subsequent oxidic phase.

Keywords: *Skarn, hydrothermal, alteration, cobaltite, erythrite, Urmieh-Dokhtar, Qamsar.*

Geology

The oldest outcropped units found in the area surrounding Qamsar cobalt deposit are Upper Eocene volcanics which are quite extended in the region. The Eocene eruptions have been of calc-alkaline type and submarine. These eruptions have been strongly sodic around the city of Kashan and appear as submarine lava and sometimes as continental dacite and andesite (Ghorbani 2002). In this area, deposits of Qom Formation begin with large thickness of Middle Oligocene gray coral limestones that gradually turn into Upper Oligocene micritic limestones (Radfar et al., 1993). In the northeast of Qamsar, deposits of Upper Oligocene are outcropped as gray to yellow limestone, green marl and gray sulfidiferous shale. An alternation of Lower Miocene pyroclastics and andesitic breccias, with calcareous sublayers, has been overlying these units (Fig. 1).

Intrusive bodies

Most intrusive bodies in the area have a monzogranite to granodiorite composition. The masses intruded the older rocks and caused contact metamorphism. Meinert et al. (2005) suggest that there is a parallel relationship between the sequence of emplacement, crystallization, alteration, and cooling of a pluton and the corresponding metamorphism, metasomatism, and retrograde alteration in the surrounding rocks. The youngest rocks affected by contact metamorphism of these masses are limestons of Qom Formation (Radfar et al., 1993). Therefore, time of magma intrusion should be younger than Lower or Middle Miocene.

Another igneous unit is the hypabyssal microdiorite to quartz-diorite body which intruded the volcanic rocks, Eocene pyroclastics, and Qom Formation limestones. Cobalt mineralization