Mejdar Deposit Petrogenesis
A Case Study of Copper Mineralization Belt in North West of Iran

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Abstract
Mejdar is an area located in southeast of Ardabil and west of Talesh mountains. This area is part of west Alborz-Azarbaijan structural zone in Iran. The area contains sequences of Eocene volcanic rocks from andesite to basalt and Plio-Quaternary sedimentary rocks. The presence of great amounts of copper indexes especially malachite and azurite in porphyritic andesite rocks of this area as well as ancient tunnels, wells and copper melting kilns as old extraction traces in different points suggests the existence of remarkable copper deposits in this area. The widespread influence of hydrothermal alteration, vast spread of copper deposit, low karat of copper in most parts of the area, the presence of high amounts of molybdenum, bismuth and arsenic along with copper, porphyritic and megaporphyritic andesite host rock and its formation in Eocene, abundance of Oligocene subvolcanic intrusions in Azarbaijan all indicate that the copper deposit of Mejdar area is likely to be porphyry. Furthermore similar old extractions in Songhon porphyry mine in Ahar, widespread influence of hydrothermal fluids of Mesdaragh deposits in Meshkin Shahr, preliminary reports from copper deposits of Khotbesara area in east of Talesh mountains, and alignment of these areas with Iran copper mineralization belt all suggest that copper deposit of Mejdar area is porphyry type.

Keywords: *Mejdar; Copper Deposit; Hydrothermal; Eocene; Mineralization Belt; Iran*

1. Introduction
Mejdar area is situated 55 kilometers southeast of Ardabil, between 48°, 26′, 27″ - 48°, 33′, 19″ eastern longitude and 37°, 52′, 48″ - 37°, 55′, 3″ northern latitude. This area is located in west of Talesh mountains and is part of west Alborz – Azarbaijan structural zone. It is an active structural area because of having abundant joints and faults. The rocks building the area are igneous and sedimentary. Igneous rocks are sequence of Eocene volcanic and pyroclastic rocks. Sedimentary rocks comprise Plio-Quaternary rocks. Hydrothermal alteration influenced several points in the area and caused secondary minerals. Study of area indicated abundant copper and molybdenum.

2. Discussion
Study of Mejdar copper deposit shows that this deposit is probably of porphyry type and is one of the copper mineralization belt points in northwest of Iran. There are some evidences for this as follow:

1. Ancient tunnels, wells and copper melting kilns are extraction traces. This extraction is about two thousand years old indicating the abundance of copper in this area. This case is similar to old extractions in Songhon porphyry mine. This is the first clue of copper exploration in Mejdar area.

2. Great amounts of copper indexes especially malachite and azurite and their dispersion in different points explain abundance of copper in this area.
3. Porphyritic and megaporphyritic andesites are copper host rocks. This is a suitable case for copper concentration [4] and is similar to other host rocks of Iran porphyry copper deposits.
4. Porphyritic and megaporphyritic andesites as host rocks of copper are formed at the Eocene. This epoch is the age of other porphyry copper deposits' host rock in Iran [3] and shows suitable time of copper formation in the Mejdar area.
5. Low karat of copper in the most points and even in the trenches and wells samples increases Mejdar copper deposit of being porphyry type. Meanwhile, local enrichment points, as ancient extraction points, are in the joints and faults indicating exceptional spots in the area scale.
6. Wide alteration that shows intense influence in andesite rocks can be evidence of the area copper deposit being porphyry type. This factor has given rise to the rarity of fresh samples.
7. Molybdenum quantity as a copper paragenesis in the most points is proportional with copper quantity and the abundance of bismuth and arsenic can display porphyry source of copper in the area .
8. One of the Oligocene subvolcanic masses created by Pyrenean orogeny phase between Eocene and Oligocene in Azarbaijan [1] might be formed in Mejdar area. Insufficient erosion and lack of outcrop in this mass at the surface can be contributed to different factors such as high thickness and low age of andesite at the top, high resistance of this rock and the limited duration of time after erosion.
9. Hydrothermal solutions activity of Mesdaragh area in Meshkin shahr with high karat of copper and its location on the line connecting Mejdar to Songhon porphyry mine in Ahar, as well as primary reports from copper indexes of Khotbesara area in east of Talesh mountains and east of Mejdar area can show the spread of porphyry copper deposits from Songhon toward east – southeast.
10. Iran's being located on the copper mineralization belt with two bands in east – west and northwest – southeast direction and the passage of the first band from Mejdar area can confirm copper deposit in Mejdar area being porphyry type.

3. Results

Mejdar copper deposit probably is porphyry type. Abundance of indexes and low karat of copper in different points, andesitic composition and porphyritic texture of host rock and formation in Eocene, also high intensity of hydrothermal alteration in surface and abundance of Oligocene subvolcanic mass in neighboring areas of Mejdar are some of the reasons strengthening our claim. Location of Mejdar area in relationship with other porphyry copper deposits in Iran copper mineralization belt and conditions similar to those deposits verify this evidence. Geophysical and geochemical study and structural data are useful about this subject. Study of fluid inclusions can help to confirm copper deposit in Mejdar area to be porphyry type.

4. Refrences

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Table 1. Major and trace element composition for the rocks from Mejdar area

Sample	M6	M7	M8	M12	M15	M16	M17	M18	M19	M20	M21	M22	M23
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
SiO_2	52.91	53.60	56.48	59.10	54.88	55.83	51.81	54.35	55.15	54.02	61.84	59.71	65.54
Al_2O_3	14.05	14.46	17.72	19.28	13.95	17.89	13.43	15.52	16.56	13.42	18.79	11.84	13.50
Fe_2O_3	6.79	7.91	5.88	7.41	8.50	5.60	9.96	7.76	9.61	9.46	2.03	5.51	6.84
CaO	7.88	9.59	4.91	2.59	6.73	7.34	8.05	7.39	4.13	7.42	0.35	0.74	2.49
Na_2O	2.44	2.41	2.04	0.07	1.66	1.31	0.65	2.54	0.75	0.61	0.01	0.01	0.74
MgO	4.04	3.11	0.80	0.27	3.59	1.21	5.33	2.84	3.95	4.40	0.01	0.11	3.46
K_2O	2.05	2.13	3.32	0.32	2.40	2.83	1.54	1.78	3.22	2.19	0.03	0.07	1.77
TiO_2	0.925	0.794	0.534	0.813	0.760	0.646	0.763	0.870	0.787	0.722	0.777	0.576	1.010
MnO	3.760	0.157	0.073	0.075	0.140	0.104	0.190	0.214	0.243	0.157	0.018	0.028	0.053
$P2O_5$	0.369	0.410	0.238	0.225	0.265	0.312	0.234	0.448	0.268	0.221	0.281	0.201	0.175
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Cl	14	5	23	109	15	17	18	31	13	17	50	45	112
S	328	12	10	15	13	14	12	11	16	9	5444	5546	248
Rb	26	41	109	19	82	83	41	41	75	58	10	13	69
Sr	701	664	361	458	635	390	566	691	347	518	686	515	422
V	146	139	72	144	140	80	148	145	124	137	124	157	105
W	0	0	0	0	0	0	0	0	0	0	0	0	3
Y	14	18	22	16	19	20	15	18	19	17	14	11	23
Zr	107	110	187	154	111	196	105	115	110	103	192	110	208
Zn	112	108	79	99	70	71	79	106	59	73	431	1249	103
Mo	7	5	3	4	5	3	4	11	6	3	755	1235	2
As	158	34	43	51	6	20	9	30	1	1	2250	8587	1
Ba	3041	588	734	701	356	621	365	633	869	376	3015	2855	351
Co	16	21	6	19	22	8	29	22	20	25	34	37	13
Cr	66	84	3	87	73	5	59	56	43	58	79	106	51
Cu	216	136	86	51	64	258	77	62	85	47	60298	99242	50
Nb	3	4	22	14	5	12	9	13	7	7	17	10	19
Ni	24	26	17	41	25	6	28	67	31	24	7	38	29
Pb	25	21	35	17	22	25	21	23	23	22	385	173	20
U	1	4	4	3	1	3	1	3	1	4	5	11	1
Th	4	1	7	2	7	9	4	5	4	1	10	1	12

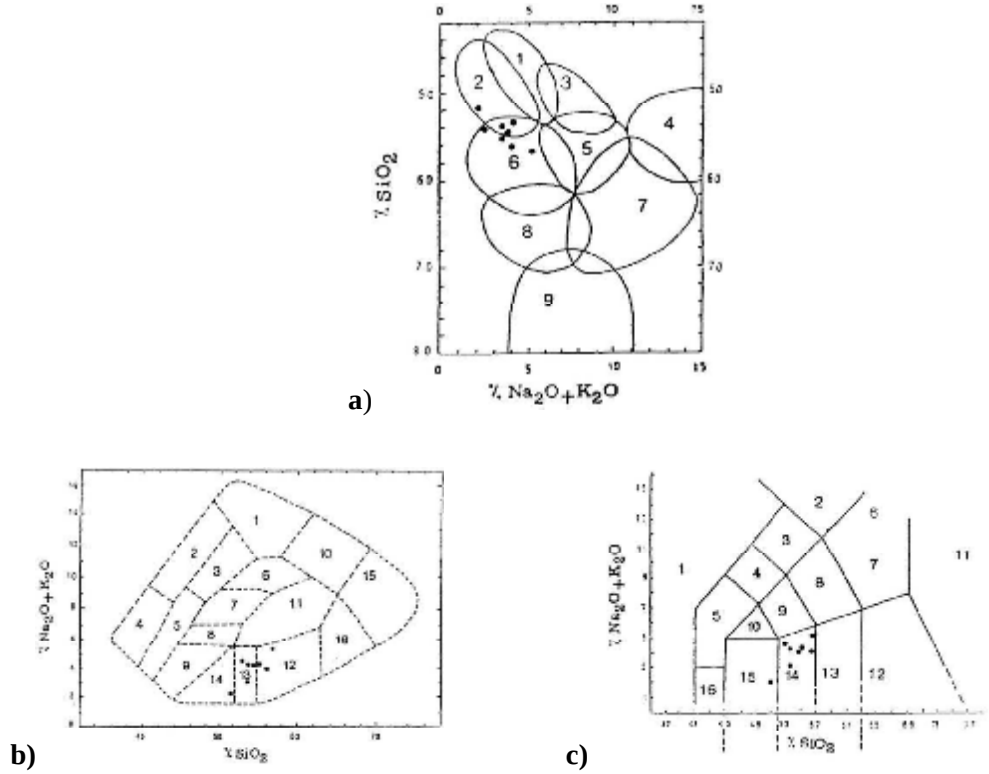

Fig. 1. Chemical classification of Mejdar area volcanic rocks: a) The area samples are located in subalkalin basalt, andesite and andesibasalt parts (Middlemost 1980); b) The area samples are located in andesibasalt and andesite parts (Le Bas and et al. 1986); c) The area samples are located in andesite, andesibasalt and subalkalin basalt parts (Cox et al. 1979)

Fig. 2. The location of Songhon deposit in Ahar (1), Mesdaragh in Meshkin Shahr (2), Mejdar in Ardabil (3) and Khotbehsara in Talesh (4) all in Iran copper mineralization belt

Fig. 3. One of ancient tunnels' entrance in northeast of Mejdar village

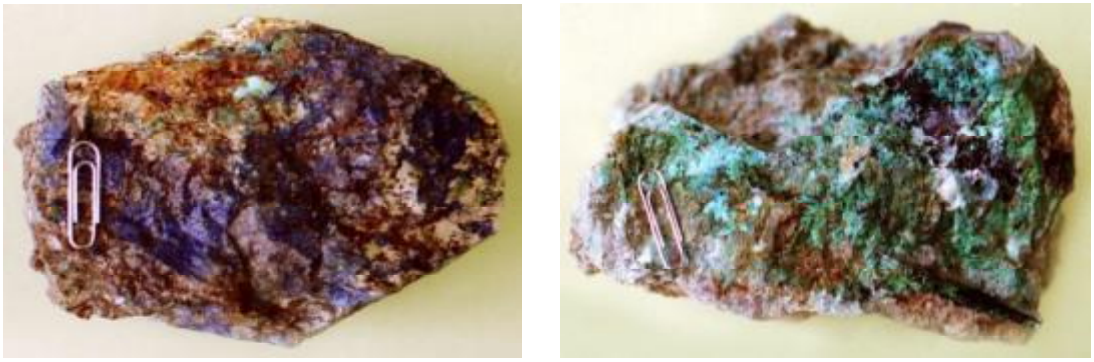

Fig. 4. The area samples with copper carbonates: malachite (green), azurite (blue); and hydrous ferric oxide: limonite (brown)

Fig. 5. An alteration spot with green color influenced by copper carbonates in northeast of Mejdar village

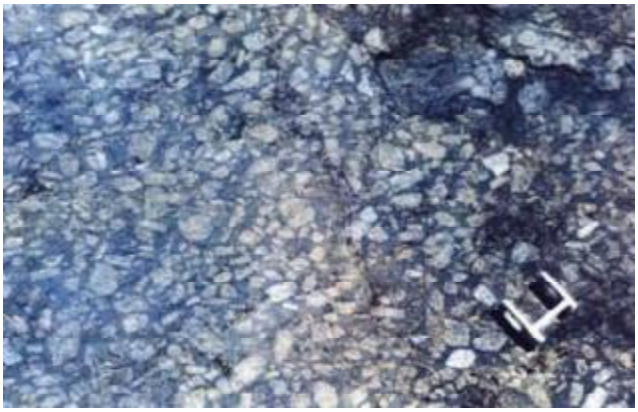

Fig. 6. Megaporphyritic andesite with mega - crystals of plagioclase in fine - crystals groundmass

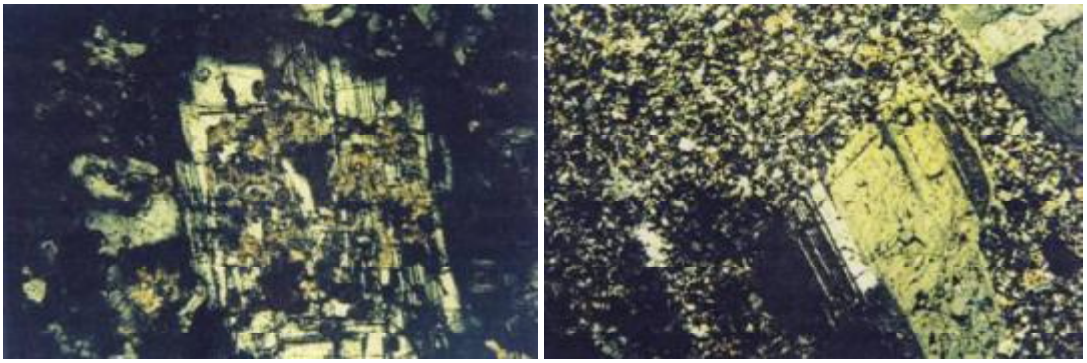

Fig. 7. Porphyritic texture of Eocene andesite containing plagioclase phenocrysts in fine - crystals groundmass (right) and Saussuritization in plagioclase phenocryst as a result of hydrothermal alteration (left) (XPL. X40)