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Determination of Cu and Mo Potential Targets in the Khatunabad Based on Analytical Hierarchy Process, West of Mianeh, Iran

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***Abstract*—**Khatunabad area is situated geologically in Urmieh-Dokhtar magmatic belt in NW of Iran. In this research, studied area has been investigated in order to recognize the potential copper and molybdenum-bearing target areas. The survey layers include the lithologic units, alteration, geochemical result, tectonics and copper and molybdenum occurrence. As an accurate decision can have a considerable effect on exploration plans, so in this efforts have been made to make use of new combination method. For this purpose, the analytical hierarchy process was used and revealed highly potential copper and molybdenum mineralization areas. Based on achieved results, geological perspective in north of studied area is appropriate for advance stage, especially for subsurface exploration in future.

***Keywords*—**Analytical hierarchy process, Potential targets, Khatunabad, Iran

I. Introduction

THE purpose of this paper is prediction of Cu-Mo targets by using of analytical hierarchy process in Geographical Information System (GIS).

A GIS is a computer based system which integrate the data, data storage and management, data manipulation and analysis, and data output for both spatial and attribute data to support decision-making activities [1]. After over 40 years of development, GIS have been applied to serve important roles in many fields such as environment monitoring, resources management, applications in commerce and business filed and different utilities. The ultimate purpose of GIS is to make evaluations or predictions with different specific data integration models to combine spatial and attribute data from various sources to provide support for decision-makers [2]. Since mineral exploration is a multi-stage activity that begins at a small scale and progresses to large scale.

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II. Position of Studied Area

The area of Khatunabad is located at the 25 km west of the Mianeh and 125 km southeast of the Tabriz city in Iran. This area is part of Urmieh-Dokhtar magmatic belt that's hosted by major copper porphyry deposit like as Sarcheshme, Ahar and Sonchon [3]. The location of the studied area as well as its geological map [4] illustrated in Fig 1and Fig 2.

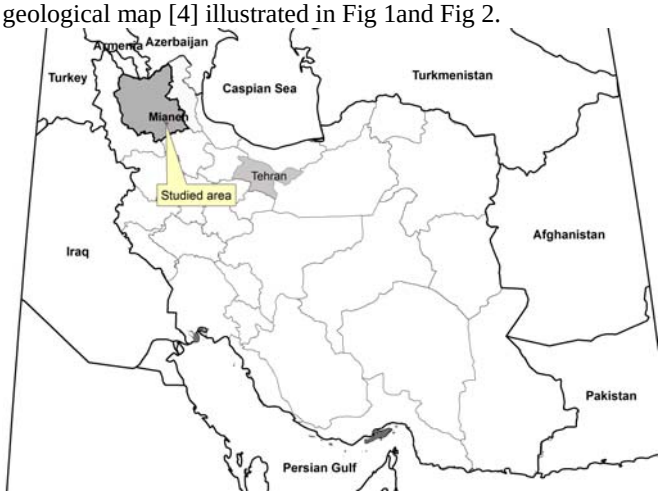

Fig1. Position of studied area

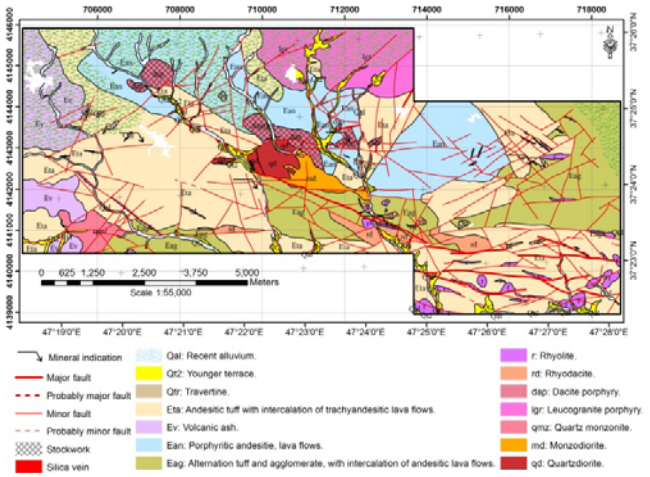

Fig2. Geological map of studied area

III. Survey Layers

In GIS the survey layers were processed, based on the

following functionalities, and the factor map was extracted.

- Map reclassification
- Producing Proximity Map
- Operation on attribute tables
- Assigning appropriate weight to each factor (digits from 1 to 9 are assigned to the statements where the higher the number is, the stronger the preference is)
- Converting factor maps format to raster
- Producing intermediate factor map

A. Lithology layer

Intrusive units like as Rhyolite, rhyodacite, quartz monzonite, quartzdiorite, monzodiorite, dacite porphyry and lucogranite porphyry are the most important part of studied area. The Other units like andesitic tuff with intercalation of trachyandesitic lava flows and volcanic ash weren't major as intrusive units. (Fig3).

B. Tectonic layer

In the studied area two major trend of faults, NW-SE and NE-SW, have been recognized. The relation of faults with copper and molybdenum mineralization can be analyzed by calculating copper and molybdenum occurrence from the faults. Therefore densities of faults were processed (Fig4).

C. Alteration layer

Based on remote sensing and field studies, argillic, phyllic and sericite alteration zones shows highest value to propylitic zone (Fig5).

D. Geochemical layer

One of the key data sets in the studied area is stream geochemistry data, samples were analyzed by ICP-Mass [5]. Copper geochemistry is the most obvious indicator of area for follow-up. Copper show distribution with a mean 83 ppm, mean of 120 ppm, and maximum of 3610. Molybdenum spread from 2 ppm to 272 ppm (Fig6 and Fig7).

E. Copper and molybdenum occurrence

Copper oxide, carbonate and sulfide and molybdenum occurrence used as exploration layer for combing the exploration data (Fig8).

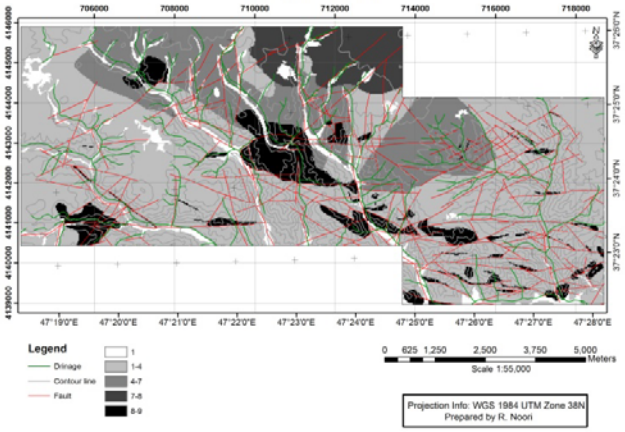

Fig. 3 Lithology of studied area

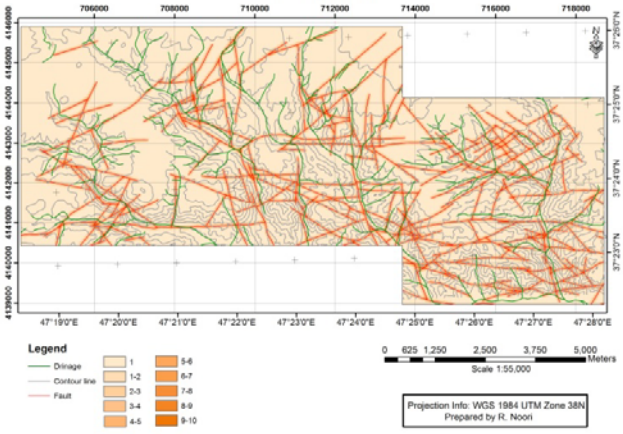

Fig. 4 Faults of studied area

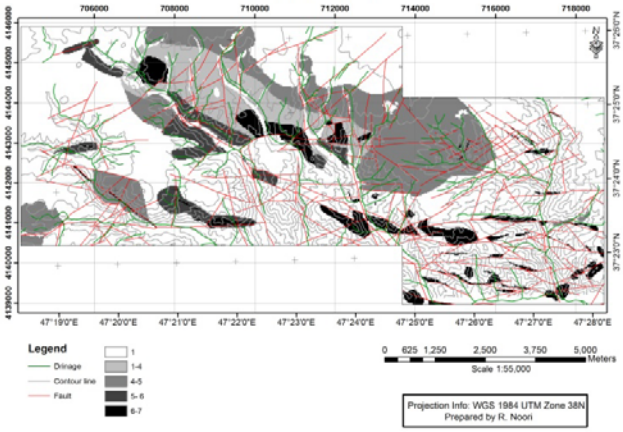

Fig. 5 Alteration of studied area

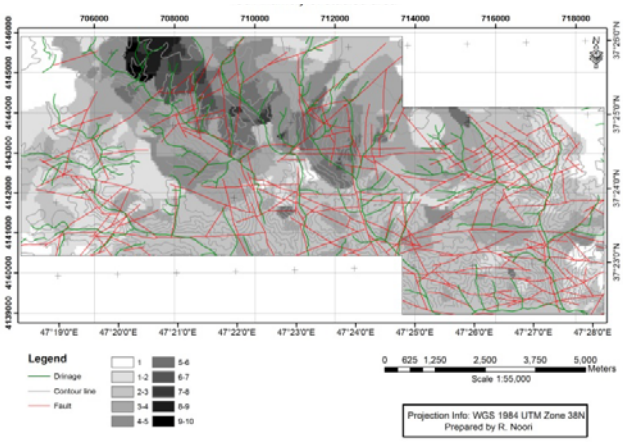

Fig. 6 Cu anomaly of studied area

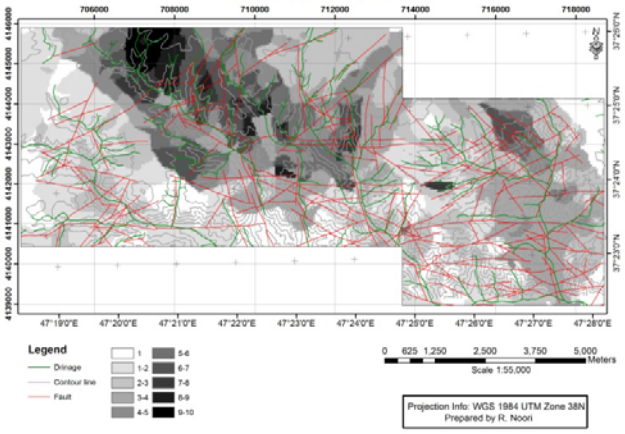

Fig. 7 Mo anomaly of studied area

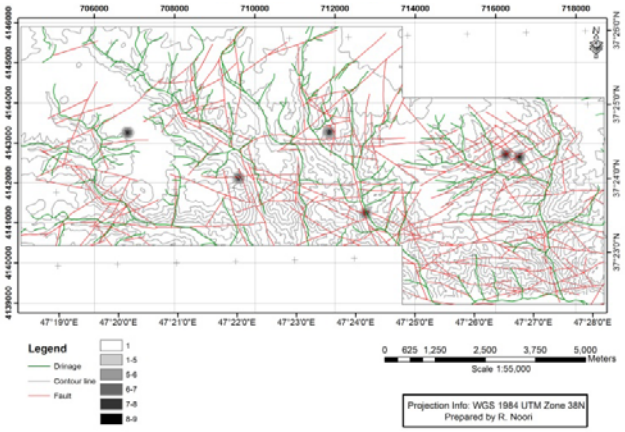

Fig. 8 Copper mineralization of studied area

IV. Prediction of Cu-Mo Targets

The factor map of this area is produced using analytical hierarchy process by aid of ArcMap GIS software.

The AHP is based on different evaluation scales to determine the importance of alternatives regarding each criterion and criteria weights. All the weights are calculated through pair-wise comparison based on a one to nine scale for quantifying verbal expressions. These expressions describe the strength of importance among alternatives or criterion. Much criticism has been towards the ranking of weights which reflects the relative importance of alternatives in a multi-attribute judgment problem [6].

Inconsistency for the judgment matrix is computed as a function of its maximum eigen value kmax [7]. GIS software generated a consistency index, CI = 0.05 for the pairwise comparison of the criteria, which is considered reasonable (table I). AHP allows for inconsistency in decision-making, and at the same time provides a measure of this inconsistency in each set of judgments, which is deemed unacceptable if it is > 0.10% – a larger value of which will disrupt consistent measurement, and lower value of which would make an insignificant change in measurement [6]. By using expert opinion and survey from technical literature, and then the findings aggregated to get the final results has been shown on Table I. The overall CI is 0.05 for the synthesized priorities with respect to the defined objective (Fig9 and Fig10).

Finally copper and molybdenum potential map by AHP method were prepared (Fig11) and show on geological map of studied area (Fig12).

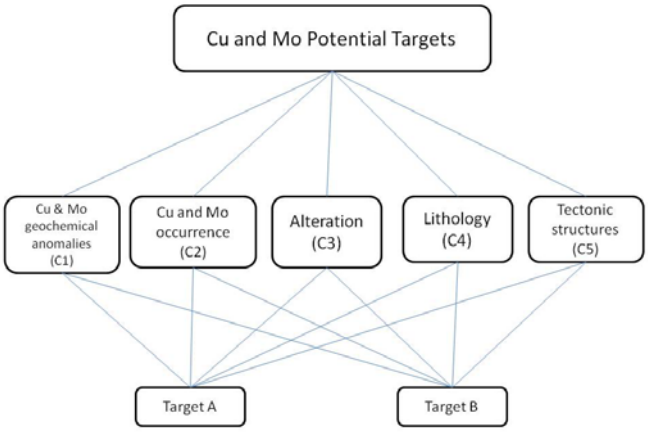

Fig. 9 Decision hierarchy for determination of Cu and Mo potential targets

TABLE I
Pairwise Comparisons of Criteria with Respect to the Goal

	C1	C2	C3	C4	C5
C1	1	2	3	4	6
C2	0.5	1	3	4	2
C3	0.33	0.3	1	3	2
C4	0.16	0.16	0.5	1	2
C5	0.16	0.5	0.33	0.5	1
Consistency ratio	**0.0553**				

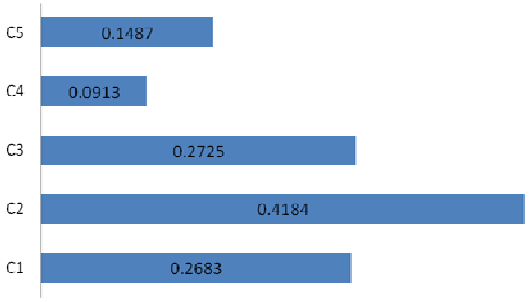

Fig. 10 Priorities for criteria with respect to goal

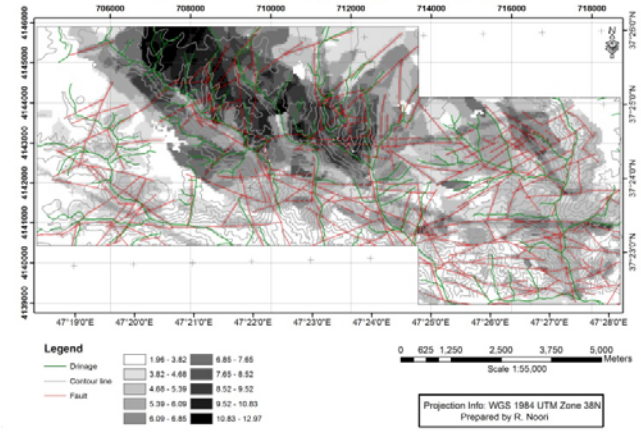

Fig. 11 Khatunabad Cu & Mo potential map by GIS & AHP method

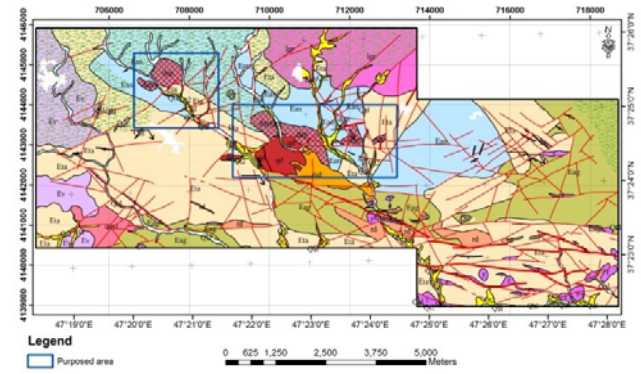

Fig. 12 Cu and Mo Potential Targets in the Khatunabad

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