Studies of Remote Sensing for Exploring Copper and Associated Elements in the Khatoonabad (West of Mianeh Region)

Reza Nouri [1]*, Dr. Mohammad Reza Jafari[2] and Dr. Faranak Feizi[3]

1-Ph.D. Student of Economical Geology: Islamic Azad University, North Tehran Branch, Tehran, Iran.

2- Department of Geology: Islamic Azad University, North Tehran Branch, Tehran, Iran.

3- Department of Mining Engineering: Islamic Azad University, South Tehran Branch, Tehran, Iran.
*E-mail address: reza_noor2002@yahoo.com

Abstract
The region of Khatoonabad with 78 square kilometer located NW of Iran. It's a part of Urumieh – Dokhtar zone. Morphology is affected completely by main faults with W-E and NW-SE trends. ETM+ and Aster data used in remote sensing studies implies that general trend of the alteration is along the mentioned faults. Two types of mineralization have been recognized in this zone. The disseminated copper mineralization in volcanic units and copper and molybdenum mineralization in sub volcanic dacite porphyry stocks. There is accordance between results of satellite interpretation and aeromagnetic geophysical, structural, geochemistry and mineralization zones.

Keywords: *Remote sensing; Khatoonabad; Mianeh; Copper; Ore geology*

Introduction
Khatoonabad area is located in 1:250000 geological map (coordination: 37° 25' 37" N and 47° 18' 48" E). Access to studied area is possible by Tehran- Tabriz- Mianeh- Hashtrud road.

Remote sensing studies
A: Investigation of remote sensing data based on ETM+ images
1. Recognition and Separation of rock units
Difference rock units have been extracted from 1:100000 geological map on satellite images.

2. Extraction of tectonic structures
In the first step all geological faults and lineament were drawn on satellite images. Then, all lineaments and ring structures were revealed by using median, edge sharpening and type 1-laplacian edge detector filters (Figure 1).

3. Recognition and separation of alteration zones
In the first stage by using ratio method (RGB 7/5, 4/2, 3/1), argilic, iron oxide and vegetation have been shown pink, blue and green colors on images. [4]
Principal component analysis is the second stage. (5-7) PC2 (5,7) and PC4(1,4,5,7) were sequentially for argilic and iron oxide alterations that have been shown in yellow to yellowish colors on satellite images (Figure 2). [2]

B: Survey of remote sensing data extracted from ASTER images
2/1 ratio in VNIR band is used for distinguishing iron minerals, band 13 (TIR) for silica

containing minerals and 4/6 ratio in SWIR band for argilic alteration. (7+8) / (9+6) showed propylitic alteration (chlorite & epidote) (Figure 3). The Final satellite photomap of studied area is shown in Figure 4. [1]

Structural geology

Major faults have W-E trend. In addition, a group of main faults has NW-SE trend (West of Qareaghaj). NE-SW minor faults create proper condition for hydrothermal fluids (the trend of the faults is shown in Figure 2 based on satellite interpretation).

Rock unit description

Eocene Volcanic and pyroclastic rocks including andesitic tuff with intercalation of trachyandesitic lava flow, alternation of tuff and agglomerate, with intercalation of andesitic lava flows, porphyritic andesitic and volcanic ash and intrusive units including quartzdiorite, monzodiorite, quartzmonzonite, leucogranite porphyry, dacite porphyry, rhyodacite and rhyolite are observed. In addition, sedimentary units' including travertine, younger terraces and recent alluviums are identified. Geological map of studied area (1:25000) is shown in Figure5. [5]

Petrography

By studying of 35 thin sections, extrusive units were defined as follow: A) Andesitic tuff with intercalation of trachyandesitic lava flows. B) Alternation of tuff and agglomerate, with intercalation of andesitic lava flows, C) porphyritic andesitic intrusive and subvolcanic were also defined as follow: A) Quartzdiorite, B) monzodiorite, C) Quartzmonzonite, D) Lleucogranite porphyry, E) Dacite porphyry, F) Rhyodacite G) rhyolite.

Mineralography

Pyrite, chalcopyrite, chalcocite, malachite, gutite, magnetic and iron hydroxide were defined by studying of 8 sample polish sections.

Alteration

Based on remote sensing data, 8 samples were studied by XRD analysis. Alterations were observed as follow: strongly and weakly propylitic, sericitication, argilic, phyllic and silicified zones. In addition, silica veins were observed in limited zones in studied area.

Geophysics

A) According to magnetic anomalies, the general trend is SE-NW that overlays the trend of tectonic structures. B) South and central zone of studied area covered by volcanic units such as basalt- andesite and other volcanic units. C) Northern part is covered by felsic and alluvial.

Geochemistry

According to drainage geochemistry studies in 1:25000 scale, anomalies; such as Cu, Mo, W, Bi, Zn, Te and Pb that all have complete accordance to each other and porphyry stocks and intrusive. For example, detection limit of these anomalies for copper is 120 gram per tone to 3.6% and for Mo, W and Zn elements the anomalies are 5.8, 7.7 and 136 ppm. [3]

Mineralization and ore geology

Mineralization in volcanic units

Copper mineralization in volcanic units is related to trachyandesitic and trachybasalt in andesitic tuff intercalation of trachyandesitic lava flows and alternation of tuff and agglomerate, with intercalation of andesitic lava flows.

Mineralization in subvolcanic stocks

Copper mineralization and enrichment of Au, Mo, Pb, W, Bi have been reported in dacite porphyry and rhyodacite in the studied area divided to 3 zones. zone1: mineralization in dacite porphyry stock in north of Qopakhtape village. Zone2: Mineralization in rhyodacite stocks. Zone3: Mineralization in dacite porphyry stock in south of Qulocheqami village.

Mineralization in silica veins

Most of mineralized silica veins are allocated along the dacite porphyry stocks.

Conclusion

According to the interpretation of satellite images (ETM+ & ASTER) and field studies, the major trend of the faults is almost WSW-ENE. The trends of the main faults are W-E and NW-SE and stocks have penetrated in both. The alteration zones are directly along the faults. The aeromagnetic geophysical result implicates conformity between mineralization and tectonic structure. Anomalies which derived from drainage geochemistry studies all have correspondence to porphyry stocks and intrusive. Two types of mineralization have been recognized in this zone. The disseminated copper mineralization in volcanic units and molybdenum and copper mineralization in sub volcanic dacite porphyry stocks have been defined.

References

1- Karimpour, M.H, Malekzadeh,A., and Haidarian, M.R. 2008, Ore deposite exploration, geology, geochemistry, satellite and geophysics models: Ferdowsi University of Mashhad.

2- Kalinowski, A., and Oliver, S. 2001, Aster Mineral Index Processing manual complied: Geosciences Australia.

3- Kavoshgaran Exploration Consultant Engineers. 2009, Drainage geochemical exploration in Khatoonabad: National Iranian Copper Industries Company.

4- Koreie, M.T., and Refahi, D. 2004, Systematic regional exploration report studies and identify promising area in the Mianeh zone, processing, integration and modeling of Geology, Aeromagnetic geophysical and Satellite in GIS environment: GSI

5- Zarnab Exploration consultant Engineers. 2009, Geological and alteration studies in Khatoonabad: National Iranian Copper Industries Company.

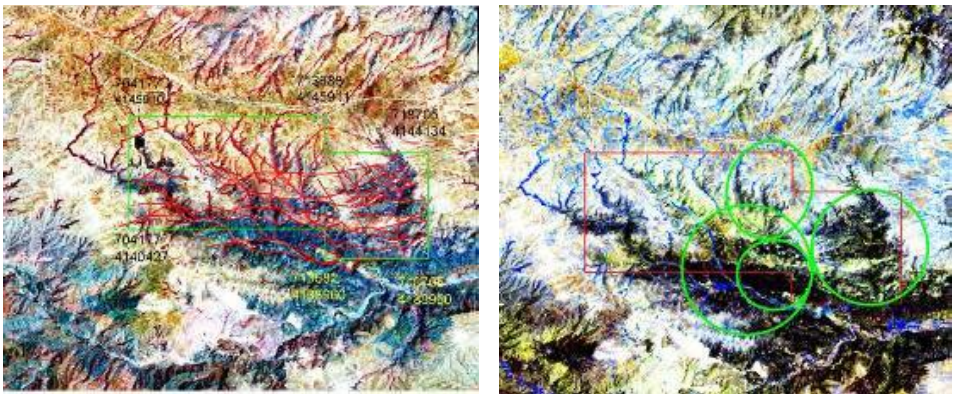

Figure1. Structural maps of studied area

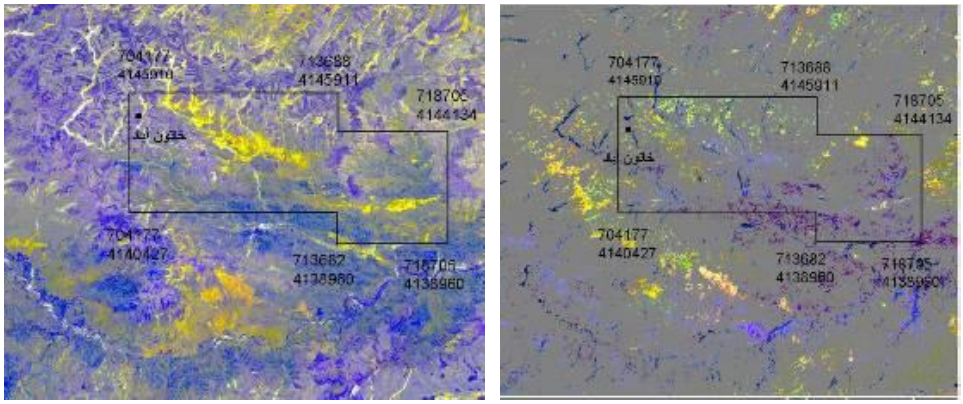

Figure2. Argilic (left) and iron oxide (right) alteration maps derived from PCA method

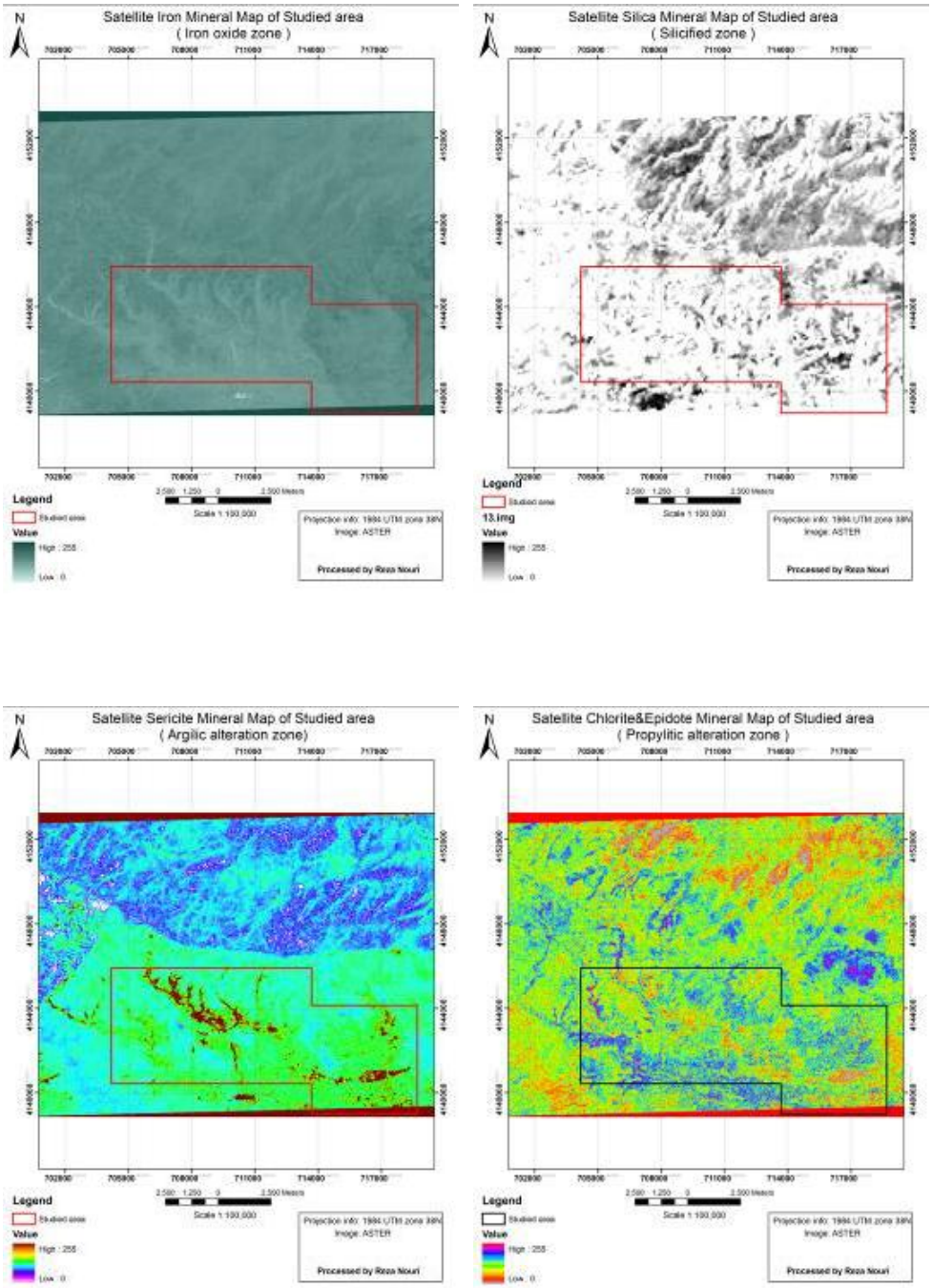

Figure3. Alteration maps derived from ASTER satellite images

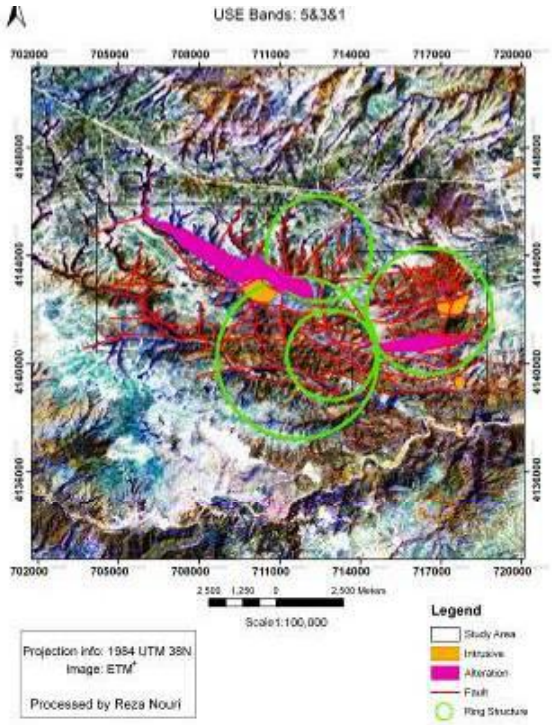

Figure4. Final satellite photomap of studied area

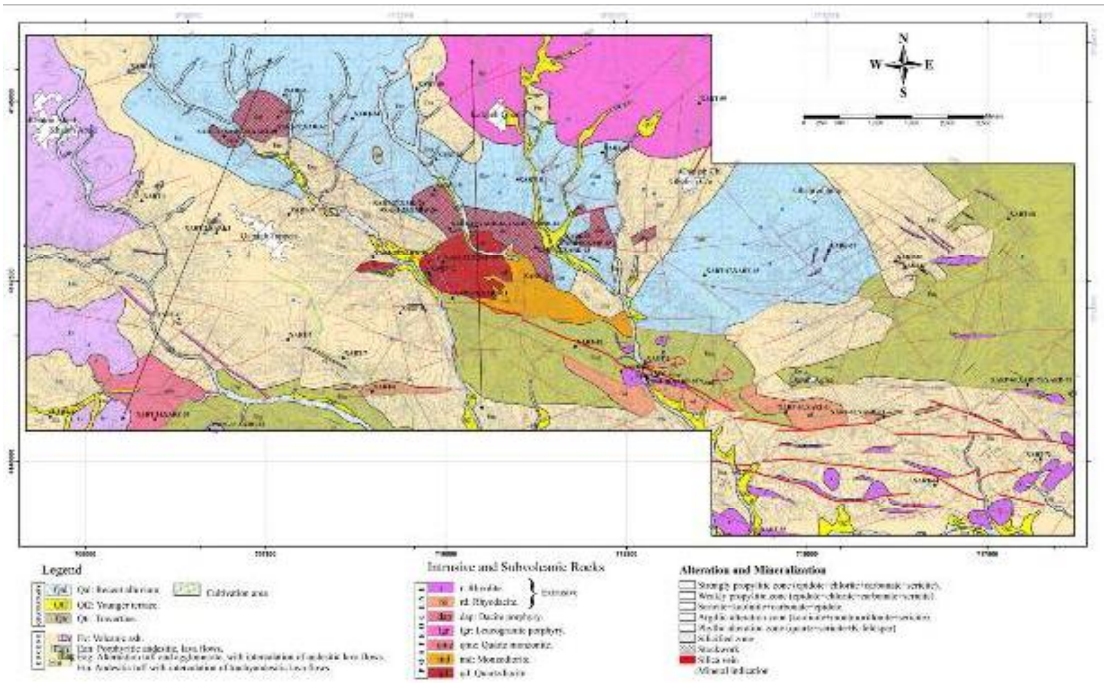

Figure5. Geological map of studied area (scale 1:25000)