



## Integration of remote sensing and ground magnetic data for delineating copper mineralization zones: A case study from Rah-Chaman area, Khorasan-e-Razavi Province, Iran

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### Extended Abstract

#### Summary

In this study, remote sensing and ground magnetic data were integrated to assess the porphyry copper mineralization potential in Rah-Chaman area, located in Razavi Khorasan Province, northeastern Iran. The study area is situated in the northern part of the Central Iranian magmatic belt, where geological evidence indicates the presence of hydrothermal alteration zones associated with mineralization processes. ASTER satellite imagery was utilized to map surface alteration zones, including argillic, phyllic, propylitic, and gossan types, whereas ground magnetic data were employed to delineate

the potassic zone as an indicator of subsurface alteration. The results of data processing demonstrate that these two methods are highly complementary and can provide an integrated understanding of both the spatial distribution and vertical extent of alteration zones.

### Introduction

Mineralization processes in porphyry copper systems are typically governed by the composition of the host rocks, structural settings, and hydrothermal alterations. Among the various alteration zones, the potassic zone holds particular significance in early-stage exploration due to the abundance of magnetite and the presence of copper-bearing minerals. Since surface alterations represent only a limited aspect of the overall mineralization system, the integration of remote sensing and magnetic data provides an effective tool to detect both surface and subsurface components of these zones. The Rah-Chaman area was selected as a prospective target for copper exploration owing to its suitable tectonic setting and the presence of igneous and metamorphic rocks with high potential of copper mineralization.

### Methodology and Approaches

In the first stage, ASTER remote sensing data were processed following geometric and atmospheric corrections using the FLAASH algorithm. Subsequently, two principal image processing techniques - band ratios and matched filtering - were applied to detect the key minerals of each alteration zone. Band ratios of 4/8, 4/2, and 8/9 were used to distinguish between mineralized and non-mineralized altered rocks, and the resulting color composite revealed phyllic and argillic zones in the southern part of the study area. Matched filtering results, based on USGS spectral library data, indicated that muscovite, illite, and jarosite were dominant in the phyllic zone, whereas kaolinite, alunite, and pyrophyllite characterized the argillic zone. In the second stage of this research, ground magnetic data were collected at 13145 measurement points. After making diurnal correction, removal of the IGRF component, some filtering techniques including reduction to the pole (RTP), upward continuation, and analytic signal were applied on the ground magnetic data. The total magnetic intensity map revealed dipolar anomalies with higher intensity in the southern part of the area. A comparison between the magnetic results and the remote sensing results showed a strong correlation between zones of high magnetic intensity and potassic alteration zones enriched in magnetite. Upward continuation maps further indicated a decrease in alteration intensity with increasing depth in the southwestern part of the study area, whereas in

the southeastern part of the area, the extent of alteration increased with increasing depth.

### **Results and Conclusions**

The results of this study demonstrate that ASTER remote sensing data are highly effective for identifying and delineating surface alteration zones associated with hydrothermal systems and can be successfully integrated with ground magnetic data to obtain a comprehensive three-dimensional extent of mineralized zones. Correlation between surface alteration maps and magnetic anomalies confirmed the presence of a magnetite-rich potassic zone in the southern part of the study area. Moreover, the depth analyses indicate that the southeastern part of the area, particularly in proximity to metamorphic schist units, has the highest potential for copper mineralization. Overall, the integration of remote sensing and ground magnetic data in the Rah-Chaman area proved an efficient tool for delineating both surface and subsurface alteration zones. These findings highlight the region high potential for further detailed studies and future exploratory drilling.

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