IDENTIFICATION OF TARGETS FOR COPPER MINERALIZATION USING MULTI-SPECTRAL ANALYSIS OF ASTER SATELLITE IMAGES IN HASHTIJAN 1:100000 SHEET, NW IRAN

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ABSTRACT

Urumieh-Dokhtar is the well-known vast metallogenic belt extended from NW to SE of Iran and basically is referenced in copper mineralization studies in Iran. Hashtjin 1:100000 sheet (NW Iran) is located on this belt and rock units are consisted of Oligocene intrusive, volcanic rocks and Eocene Sedimentary rocks. Concerning the significance of identifying the alterations and faults zones in copper exploration, the aim of this study is identifying the copper mineralization by multi-spectral analysis of ASTER (Advanced Space borne, Thermal Emission and Reflection Radiometer) satellite images in the limitation SD-SWIR (Spectral Domain of Short Wave Infrared). Several analytical methods are implemented in this study such as SAM (Spectral Angle Mapper), MF (Matched Filtering) and PCA (Principal Components Analysis). These methods have been utilized for recognizing the Argillic, Propylitic and Sericitic alteration zones and all of them are relying on the remote sensing methods as well as geological studies of new targets for copper mineralization identification in the area.

KEYWORDS

ASTER, SWIR, SAM, MF, PCA, Hashtjin, Urumieh-Dokhtar

INTRODUCTION

Iran is a located on one of the huge metallogenic belts which is called Urumieh-Dokhtar and has high potential for copper and gold. This belt is expanded from NW to SE of Iran. Hashtjin sheet were located in Alborz-Azerbaijan structural and Tarrom-Hashtjin metallogenic zones (Karimzadeh Somarin, 2006). There are Oligocene volcano-plutonic rocks such as Tonality, Diorite, Trachy-Andesite, Granodiorite and Granite which are correlated to a Cenozoic magmatism. Furthermore, there are Eocene sedimentary rocks consisting of Marl, Siltstone, Limestone and Sandstone as well. Main rock types of the area are Eocene volcanic and volcano-sedimentary rocks such as ignimbrite and Tuff (Ghasemi, 1988).There are several metallic deposits and occurrences such as Cu, Au, Pb and Zn in this area.

In this research, a spectral analysis was performed on the ASTER satellite imagery data of the Hashtjin sheet to map out the spectral signature associated with the hydrothermal alteration. Due to the extreme variations of spectral reflectance curves of minerals in the short-range infrared (SWIR) and high spectral resolution of ASTER sensor, the sensor identifies different rocks and minerals on the surface of the studied area effectively.

Geological setting of Hashtjin 1:100000 sheet

The area is situated 120 km south of Ardebil city, NW Iran (Figure 1).

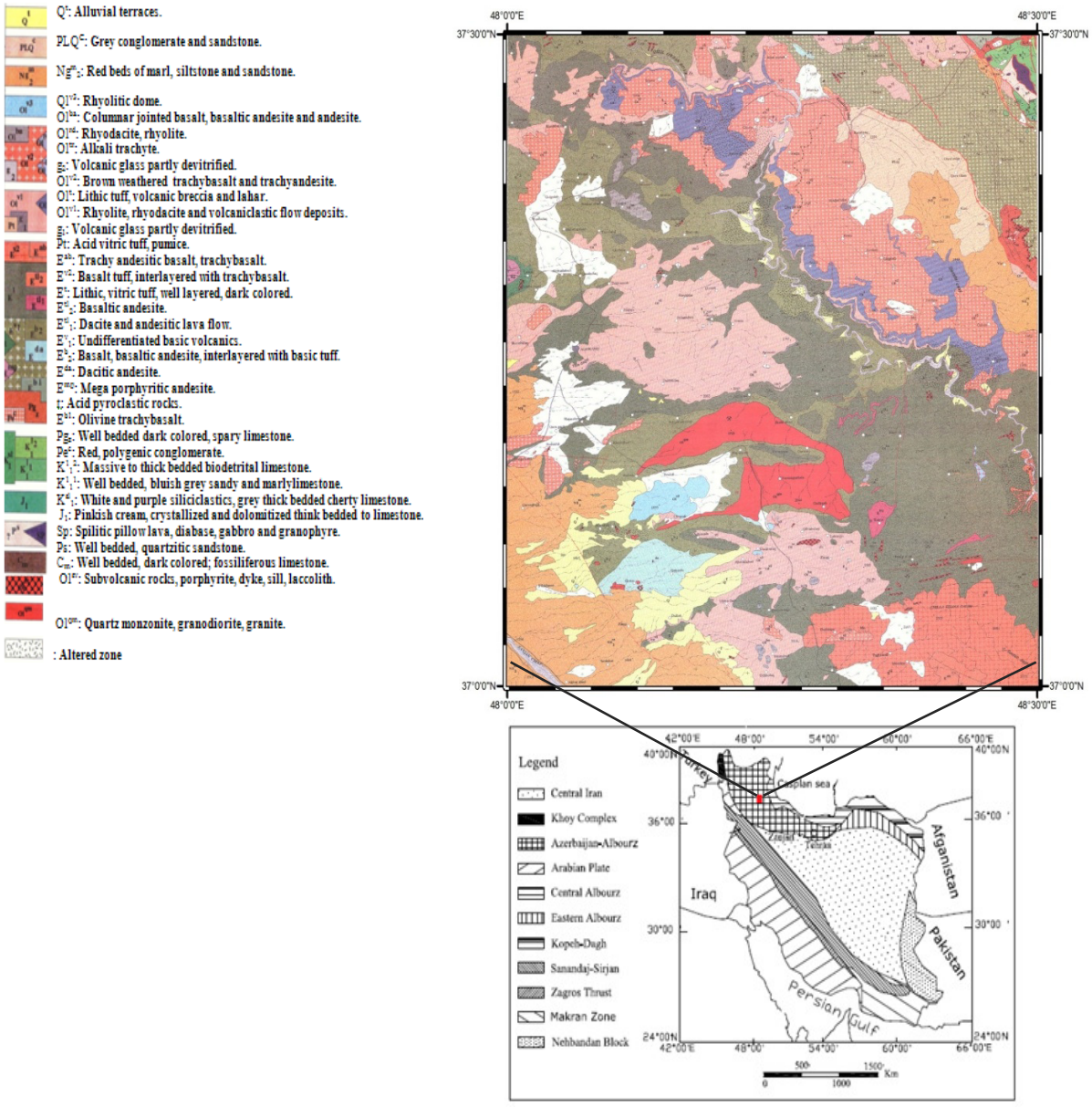


Figure 1 – Geological map of Hashtjin 1:100000 sheet, Azerbaijan-Albourz structural zone (Karimzadeh Somarin, 2006)

In this area, large intrusive Eocene volcanic rocks are cut and volcanic rocks have crossed Karaj Formation. Igneous rocks of Qom Formation with asymmetric foundation, is placed on top of them. These igneous rocks are intrusive Alkaline Granite, Granite, Granodiorite, Monzonite, Quartz Monzodiorite, Syenite, and Quartz Syenite. Studies by various researchers have shown that these masses are I-type Granitoids. The intrusive magma series, and Calc Alkaline and Shoshonitic with type I and has high potassium. There are many metallic deposits and occurrences consisting of Cu, Au, Pb and Zn.

METHODS

Various methods were implemented and the results of different methods compared. The regional geological map was used to support the remote sensing studies. Matched filtering (MF) is a partial spectral un-mixing technique to detect the known spectral class of interest, while suppressing the background (Bendini, 2011; Figure 2). Spectral Angle Mapper, one of the most effective methods for the classification of satellite data, is a mapping method that uses the spectral angle between the vectors of the reference spectral data (prepared in the laboratory, ground or satellite data) and the vector satellite data (Kruse et al., 1993; Figure 3). PCA is a common method to analyze correlated multi-variable datasets. The technique is widely used for multi-spectral image interpretation based on linear algebraic matrix operations (Liu & Mason, 2009; Figure 4).

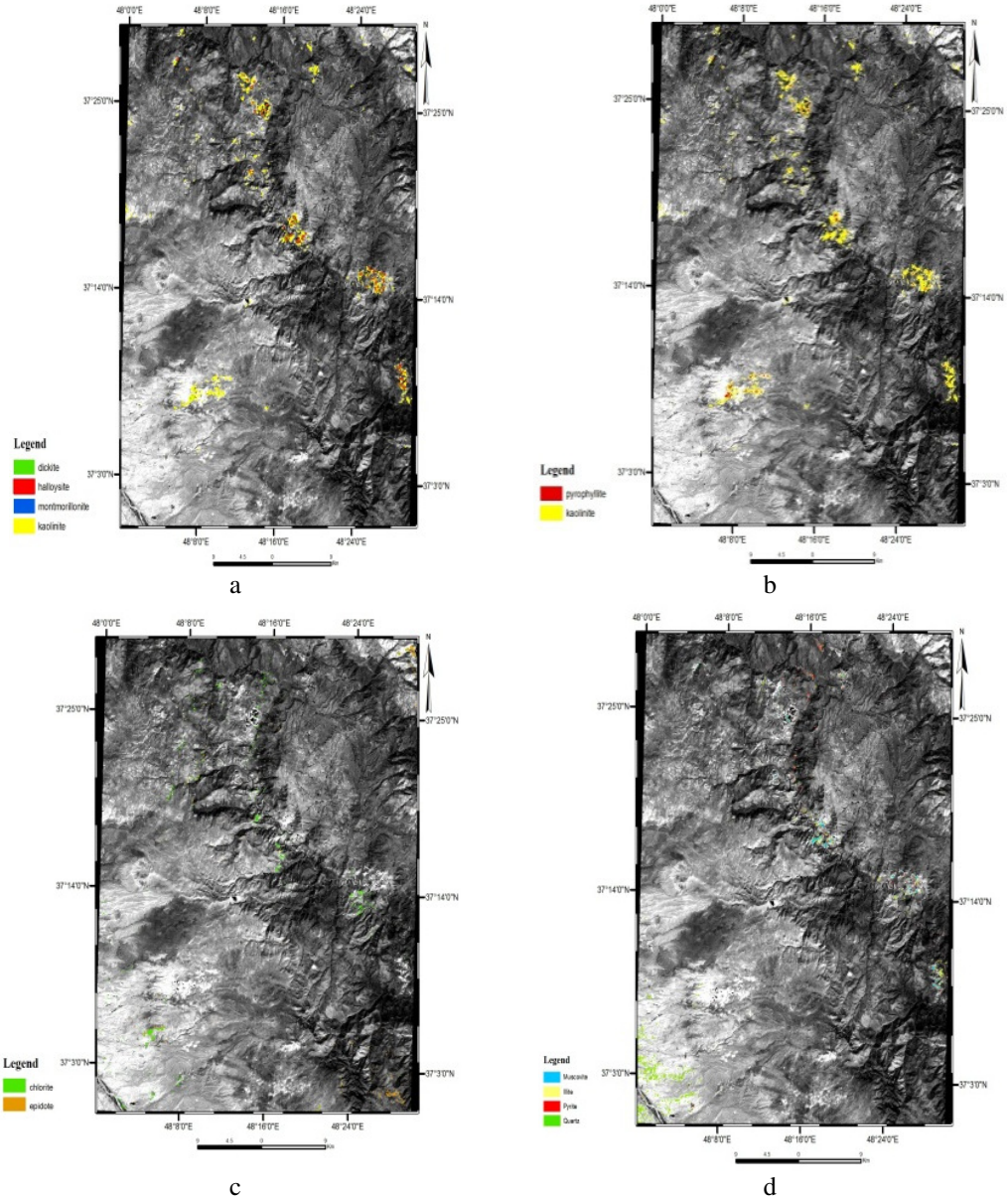


Figure 2 – Result of MF method on Hashtjin sheet (a) middle argillic alteration minerals (b) intensive argillic alteration minerals (c) propylitic alteration minerals (d) phylic alteration minerals

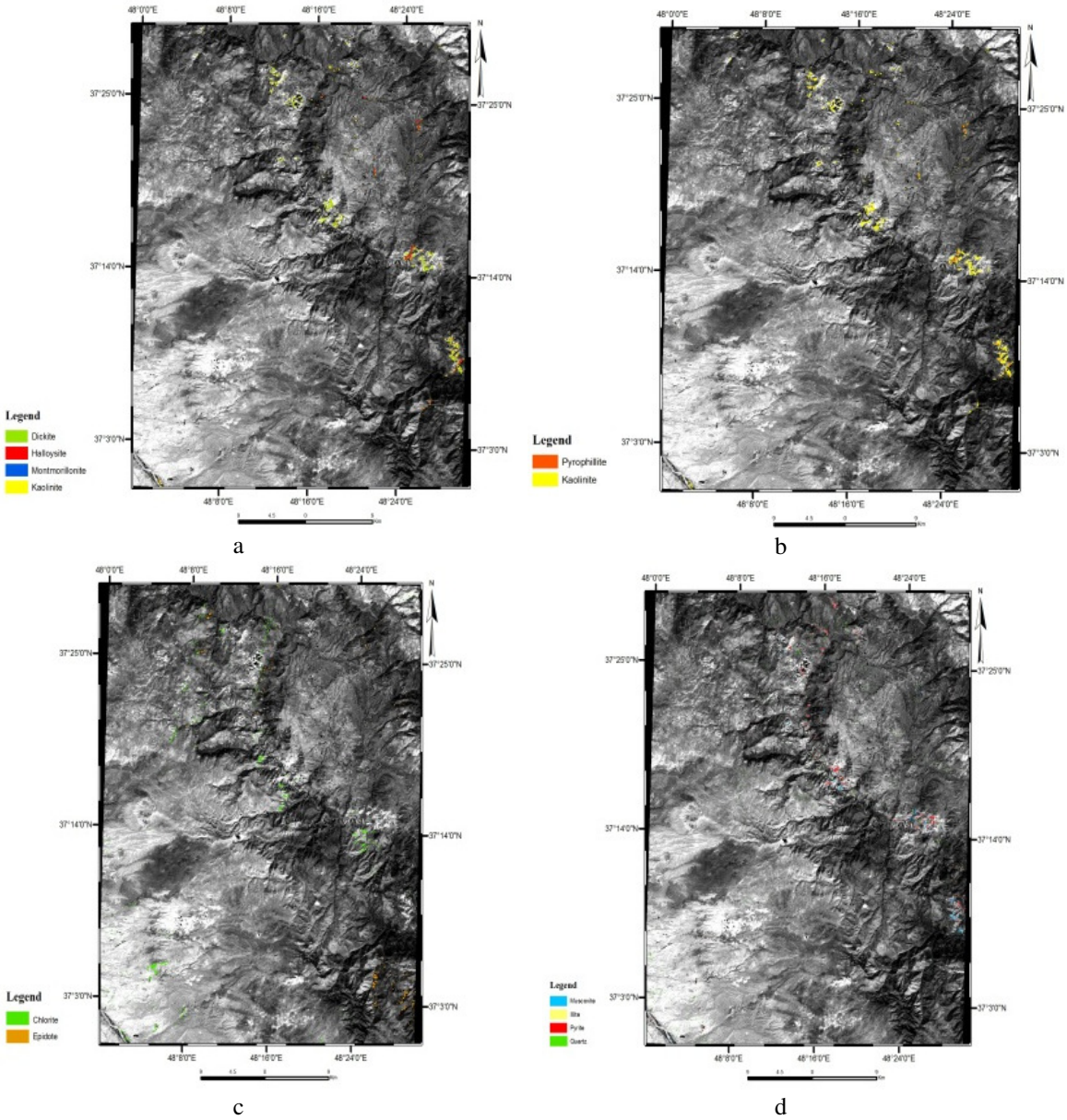
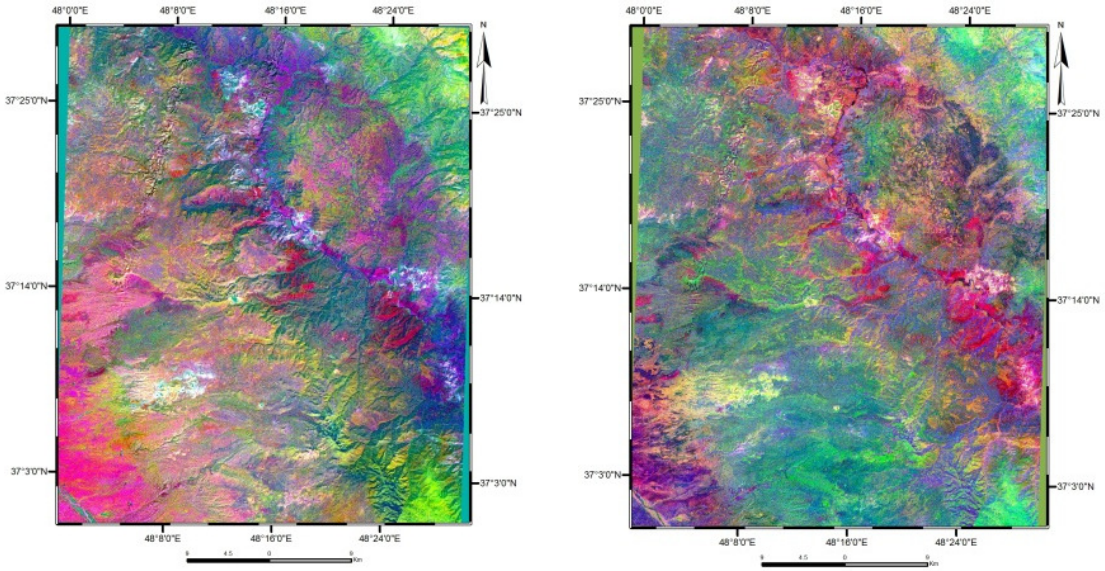


Figure 3 – Result of SAM method on Hashtjin sheet (a) middle alteration minerals (b) intensive argillic alteration alternation minerals (c) propylitic alteration minerals (d) phylic alteration minerals



a b

Figure 4 – Result of PCA method of Hashtjin sheet (a) propylitic alteration are bright green and argillic alteration are pink and Iron oxide are blue (b)argillic alteration are blue

RESULTS

According to the information obtained from all applied 3 methods (SAM, MF and PCA) and the conducted geological studies, 3 areas (a, b and c are proposed for exploratory studies as shown in Figure 5.

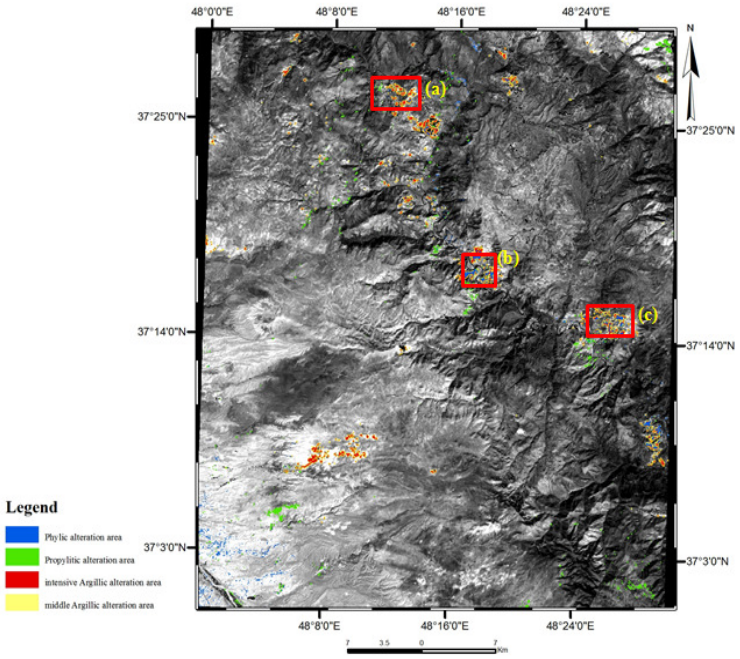


Figure 5 – New exploration targets in the Hashtjin area

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