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Research Article

Explore the Metal Elements of Chadegan Based on Geophysical Data and Remote Sensing

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ABSTRACT

The studied area is located on the one hundred thousand page of Chadegan, in the middle of Sanandaj-Sirjan zone and on the metalogenic belt of Malayer-Golpayegan, in the western part of this to Isfahan province. With regard to the anomalies of metallic minerals in the region and considering the growing demand for metals from metals-related industries, particularly lead and zinc and while most exploration and geological activities in the region are old has never lead to any comprehensive results.

In this project, first the geographical and geological location of the region is studied and then remote sensing was applied in the area and then satellite images sensors ETM+ were analyzed with ENVI 4.8 software and reflective elements and promising areas were introduced. In the next step, Lead and Zinc anomalies were studied by geochemical methods and by data obtained from 900 samples from the region, map of lead and zinc anomalies of the area was drawn by software SURFER 10, then we matched it with the report from the agency and finally we compared the results together. As a result, it became clear three areas were determined for Pb-Zn which are mostly located in the eastern half of the Chadegan 1:100 000 page, which is the area around Tiran A and Asgaran-Krone B, meaning Northeastern part of the page, and around Hoorah C (around Zayandeh Rood River) which is the Southeastern part of the Chadegan page, they were all introduced for more detailed studies.

Keywords: Techno-volcanic; Pyroclastic; Tertiary; Upper cretaceous ophiolite; ETM remote sensing; Magnetic mineralization

INTRODUCTION

Tiran is one of the oldest counties of Isfahan and city of Tiran is the second most green city of the province. City of Tiran is the county's central town which is located in western part of Isfahan province within the central mountains of Iran and the western foothills of the Zagros mountains and borders from north and east the county of NajafAbad, from west to Fereydan and Chadegan, from south to Lenjan, and Southwest to Shahr-e-Kord in Chaharmahal-Bakhtiari province and has access to Isfahan-Markazi, Isfahan-Khoozestan, Isfahan-Lorestan and Isfahan-chaharmahal Bakhtiari roads. The studied area is located in Western Isfahan and Shahr-e-Kord's quadrilateral 1:250000 and Chadegan 1:100000 page [1].

The Chadegan 1:100000 geological map is located within the Northeastern Shahr-e-Kord quadrant with Eastern longitude coordinates of 51, 00 to 50, 30 and Northern latitudes of 33, 00 to 32, 30. The studied area, in terms of administrative divisions, is located within the two provinces of Isfahan and Chaharmahal-Bakhtiari.

Geology of the region

Chadegan is a mountainous region which is surrounded by high mountains. One of them is Dellakuh Mountain. Cities of Daran and Chadegan are located on its Western slope. Most mountains of the region are naked and rocky but Southern mountains contain proper vegetation cover. Caused by the mountainous formation of the region and its high altitude above sea level, snow periods are long in the area which is very effective on the

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vegetation of the region which in turn attracts herds of cattle from Bakhtiari tribes to the area. Plants of the include Gavan, Karafs, Gaz and scattered Baloot trees. Dallan mountain range in Northwest of the area with the of height 3890 meters and Zayandeh-Rood river valley in the southern part of Cham-Khalifeh and Chamchang villages with 1900 meter above sea level, are highest and lowest points on the map [2].

Regional climate

The city's weather is mild during spring and summer and very cold during winter. A number of rivers originate from the mountains of the region which generally move East-West or from North-South and flow into Zayandeh-Rood River. Morghab and Abkhor-Sang rivers could be named in this regards. The economy is generally based on agriculture and livestock. Fertile land and water from rivers and springs have attracted the local population to agriculture and farming. Some important products include potato, grain, beans. Potato is the prime product and cattle herding is also very prosperous here [3].

Morphology of the ground

Chadegan is a mountainous region which is surrounded by high mountains. One of them is Dellakuh Mountain. Cities of Daran and Chadegan are located on its Western slope. Most mountains of the region are naked and rocky but Southern mountains contain proper vegetation cover. Caused by the mountainous formation of the region and its high altitude above sea level, snow periods are long in the area which is very effective on the vegetation of the region which in turn attracts herds of cattle from Bakhtiari tribes to the area. Plants of the include Gavan, Karafs, Gaz and scattered Baloot trees. Dallan mountain range in Northwest of the area with the of height 3890 meters and Zayandeh-Rood river valley in the southern part of Cham-Khalifeh and Chamchang villages with 1900 meter above sea level, are highest and lowest points on the map [4].

Telemetry

Image analysis and date processing: For studying and primary exploration of Chadegan 1:100000 sheet, photos from 2005, sensor ETM+ landsat satellite 7 have been used. In order to identify areas containing Lead and Zinc by ENVI 4.8 software, several ways such as false color combination, using filters and classification have been applied and finally areas of high potential are introduced [5].

The pre-processing stage

The first step is performing geometrical corrections, Radiometry and Topography. In geometrical corrections, we try to minimize the 80 meter difference between geological maps and geographic coordinates and we also use geographic coordinates system and UTM simultaneously. While taking an image from an area, it is possible that errors are caused by difference in altitudes in the area, dust in the area, changes and satellite vibration during the process. So first, using correction files provided by ground stations, we must reduce these errors considering the required accuracy and we also use IAR algorithm for the amount of contained data [6].

Statistical analysis on bands

For beginning of the image processing phase, one of the important pieces of information is the statistical information of different bands. In this data, a number from 0 to 255 is attributed to each of the bands regarding the reflection amount in each of the bands. As a result, 0 represents minimum amount of reflection and maximum absorption and 255 shows minimum absorption and maximum reflection. The data regarding the Table 1 is shown here:

No. band	Min reflection	Max reflection	Average reflection
1	35	180	75/6
2	24	186	79/7
3	17	227	101/6
4	9	192	94
5	1	211	91/6
6	5	189	80/86
7	1	193	82/86
8	17	239	95/62

Table 1: It shows the minimum reflection maximum reflection values and average reflections count.

As a result of orbital rotation, we can see that images from the area have a slight rotation inside them. This tilt must be removed so as to the image be in the same direction as north. As the satellite images cover a huge surface, the studied area must be cropped from the main picture since this would limit the amount of data and increase the concentration on the studied area (Figure 1).

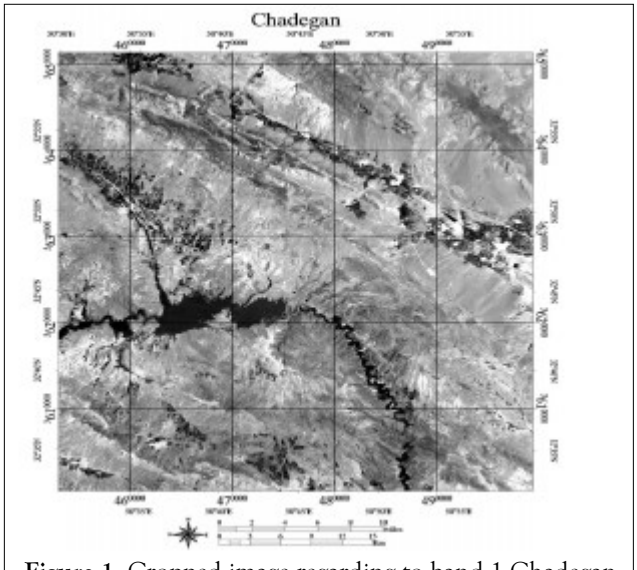

Figure 1: Cropped image regarding to band 1 Chadegan.

Fracture extraction, faults and linarites in the area

In order to identify fractures, faults and linarites in one area, one could apply different filters in different directions, the most important ones are Directional filter and Edge-illustrating filter (sobel). Directional filter is applied in 45 and 135 degrees to illustrate the linarites in the area in Northeast-Southwest and Northwest-Southeast directions, so this way there could be a clear correlation between mineralization and linarites (Figure 2).

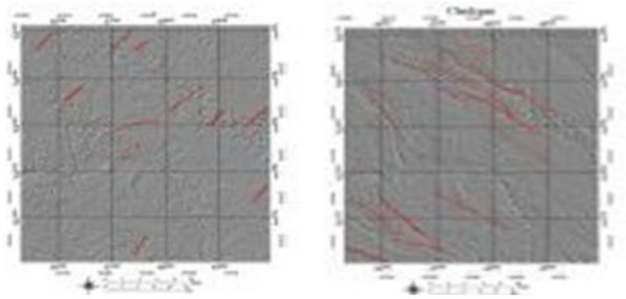

Figure 2: Applying 45 degrees directional filter to illustrate minor faults of the region and Applying 135 degrees filter to identify main faults of the region.

As it stands in the pictures, we see on the Northwest to Southeast direction that many major faults and fractures which have acted as mineralizer and space creator faults. The minor faults have a Northeast-Southwest trend that act as space maker and destructor faults.

Satellite image processing

First method: Using false color composite. It is one off the most common methods in deposit analysis and searching for minerals. We build mathematical equations in the false color combination according to minerals features in reflection of waves in different frequencies. Since Landsat satellite bands cover large waves' groups, we have to reduce this interval so that we make a new range by using mathematical equations and we use the new band built in bands formation. This color change from black to red is due to different levels of humidity by the type of product in the farms [7]. Lands with highest humidity have darker colors and using vegetation indexes like NDVI, product type, humidity and density of the plant could be studied. In the image below, Band ratio has been chosen so farmlands are removed of this image. River is green due to passing through the mineral area while dam is yellow because it contains water and the orange area is lead-zinc zone (Figure 3).

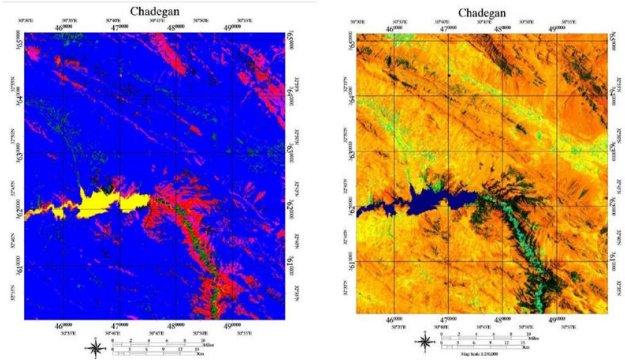

Figure 3: The image explains the different types of rivers and the colour codes and It shows the dark green and black this shows stone wavelength region look like lead-Zinc wavelength.

The second method is using classification algorithms.

The basic principle is to put the phenomena that have similar reflection into one group. The classification is done in two ways:

A. Unsupervised classification: In this method, the user has no intervention and is done without tips.

B. Supervised classification: In this type, some areas are the for introduced as guidance and reference and based on the similarity of an area's reflection with the reference areas, the classification is done.

Unsupervised classification was used due to absence of reference points. In the ISO Data classification, the groups are fewer and it is based on simplicity but classification K-mean is more complex and has more groups and the result is unorderly and complicated. However, in both methods areas with similar reflections fall into the same groups [8].

k-mean-image

This image has red colour which shows it has similarities with lead-zinc ore waves (Figures 4,5 and 6).

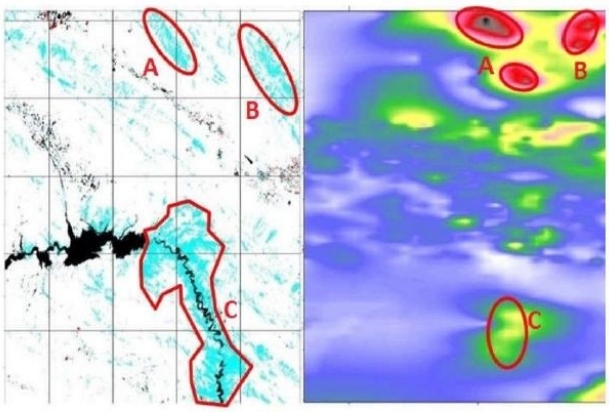

Figure 4: Comparison between geochemical map and remote sensing of lead anomaly in Chadegan 1:100 000 sheet.

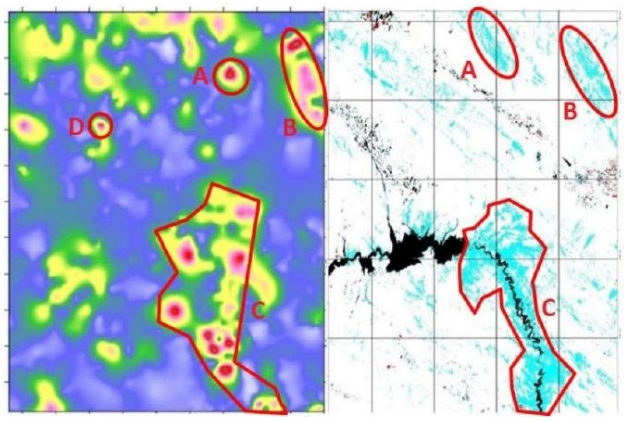

Figure 5: Comparison between geochemical map and remote sensing of zinc anomaly in Chadegan 1: 100 000 sheet.

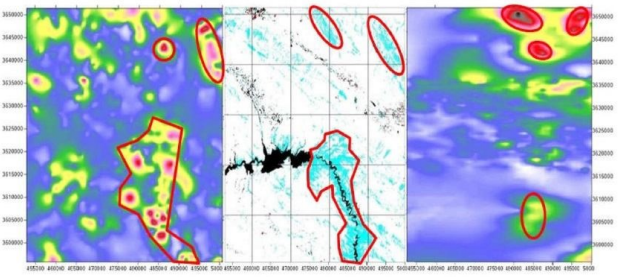

Figure 6: Comparison between geochemical map and remote sensing of zinc anomaly in Chadegan 1: 100 000 sheet.

RESULTS AND DISCUSSION

Comparison between geochemical and remote sensing studies

The right image is taken from geochemical data by Surfer 10 software and the left image is taken from remote sensing data from ETM [9]. As it could be seen in the maps, most promising areas for lead and zinc are in 1:50000 map of Asgaran-Koroon and less in the 1:50000 map of Hureh. As both lead and zinc are underground elements and come together in ores and have similar wavelengths, the most notable disadvantage of remote sensing is revealed here and as a result, geochemistry finds a significant advantage over remote sensing and its result have much more reliability and gives more accurate results. By the way, according to the Homogeneous results from the maps above, geochemistry acts as a supplement to the remote sensing method and together they determine the promising areas for detailed exploration [10].

CONCLUSION

The main problem in applying telemetry method for lead and zinc is a lack of separation between the two elements due to similar wavelengths and their underground nature; as a result it's often used as a supplementary method to complete geochemical or geophysical methods. According to processing Landsat satellite image ETM+ and regional geochemical information and Lead and Zinc anomalies were studied by geochemical methods and by data obtained from 900 samples from the region, map of lead and zinc anomalies of the area was drawn by software SURFER 10, then we matched it with the report from the agency and finally we compared the results together. As a result, it became clear three areas were determined for Pb-Zn which are mostly located in the eastern half of the Chadegan 1:100 000 page, which is the area around Tiran A and Asgaran-Krone B, meaning Northeastern part of the page, and around Hoorah C (around Zayandeh Rood River) which is the Southeastern part of the Chadegan page, they were all introduced for more detailed studies. These areas are generally within sedimentary, Cretaceous and Jurassic structural units in veins formations. The existence of a few small lead and zinc active or abandoned mines like Dare-Beed which is located 97 km West of Isfahan and 35 km Northwest of Tiran with geographical coordinates of 50,44'21 to 50,47'23 east and 32,57'68 to 32,58'32 north, located at the underlying Cretaceous limestones and lead-zinc mines of Ghayur, Kuh-Sormeh, Anjireh and Chah Famil of Tiran and etc. and also Tiran lead and zinc mineral processing factory in the area are all evidence of this result. As the objective of this paper is to introduce promising areas for lead and zinc, it is suggested that the next phase of the exploration process takes places in A, B and C locations with higher density of sampling and digging trench lines, and if possible pits and Drillholes. However due to the veins nature of the deposit, it would be probably be economically unjustified. As geochemical methods and remote sensing take place independently and have confirmed each other's results so far in this research and due to their proper level of accuracy, the next part of exploratory process is suggested as below:

For lead, based on remote sensing and geochemical methods' results from right to left: the A, B and C sections have the highest chances of mineralization. For zinc, based on remote sensing and geochemical methods' results, from right to left C, B, A and D have the highest chance of mineralization. These areas have shown probable mineraliztion in false color composite and classification methods and are more or less confirmed by geochemical methods.

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