Research Paper

Determination of Geochemical Anomalies in Stream Sediments of Zaylik Region (East Azerbaijan) Based on the Element Distribution Pattern

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Abstract: The Zaylik mineralization zone includes andesitic volcanic rocks which is the basis for other rocks in the area. The base of these andesitic rocks is yet to be characterized, but pyroclastic deposits and acidic to basic lava flows have overlaid them on the top. The results of statistical evaluations and distribution patterns of As, Cu, Ag, Au, Zn, Sb, Pb, and Mo, on stream sediments showed that the most significant geochemical anomalies were related to copper, lead, zinc, and gold. These anomalies appear to be consistent with the siliceous veins and caps and alteration zones in the region. Frequency histograms of Au, Pb, Zn, Mo, and Cu were mostly abnormal and showed positive skewness. The table of correlation coefficient and cluster decomposition showed positive correlations between Mo and As and also between Pb and Zn at a confidence level of 99%. Moreover, at 95% confidence, positive correlations were observed between Pb and As and also between Zn and Cu, while an inverse correlation was observed between Zn and Mo.

Keywords: Geochemical anomalies, Stream sediments, Zaylik region, East Azerbaijan.

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INTRODUCTION

The study area in the 25 km southeast of Ahar is located in Ahar-Arasbaran zone. The lithosequence in the study area is comprised of Eocene volcanic rocks containing andesitic tuff, andesite, dacite-rhyodacite and Quaternary sediments and also intrusive masses with microdiorite and quartzmonzonite composition. Three types of mineralization were identified in the area; 1- Siliceous alteration zones (siliceous caps); 2- Vein mineralization type; 3- Altered zones with rhodocyte host rock. According to the field surveys, three types of alterations also were found in the region, which is the first and most widespread type related to advanced argillic alteration. The second type is related to siliceous argillaceous alterations around the siliceous veins and the third type is siliceous alteration in the form of silica caps with iron oxides. Some research on alteration zones and the role of hydrothermal solutions have been previously done, such as Miranvari et al. [1]. However, due to the absence or lack of statistical studies and geochemical models in the region, as well as the importance of geochemical mapping in exploration programs on the other hand, in this study we used univariate and multivariate analysis methods, then analyzed statistical parameters and finally drew local geochemical maps to understand the distribution and relationship between elements in the region.

MATERIALS AND METHODS

To achieve the objectives of the present study, Eight samples of thin sections and one polished section have been studied in terms of litholigy and mineralogy. In order to study the statistical parameters, to draw distribution maps and to determine the geochemical anomalies of the elements, 18 samples of stream sediments were analyzed by ICP-OES + AU analysis in the laboratory of the Geological Survey of Iran. Samples were collected based on lithological, alteration, and catchment basin criteria. Finally, for analyzing the statistical parameters was used Excel, SPSS and R (version 3.6.2) and for drawing geochemical distribution maps of elements was utilized Arc GIS software.

FINDINGS AND ARGUMENT

In this study, after preprocessing, the background values, threshold and anomaly of some trace elements in stream sediments were calculated. Then the frequency diagrams of the normalized values of the elements were drawn. According to that Au, Pb, Zn, Mo, and Cu were mostly abnormal and showed positive skewness. Distribution and dispersion of different elements in the rock units and the relationship between these elements is one of the most important cases in geochemical studies [2]. In order to determine the relationship between elements, the correlation coefficients were obtained by Pearson method (Figure 1). Comparison of these correlations shows that the correlation between gold and its trace elements is not very high and the closest correlation was found between gold and arsenic (0.38). On the other hand, positive correlations were found between molybdenum and arsenic (0.67) and zinc and lead (0.61) with 99% confidence level. Also were found positive correlation between lead and arsenic (0.55), zinc and copper (0.50) and there is an inverse correlation between zinc and molybdenum elements (-0.53) with a 95% confidence level.
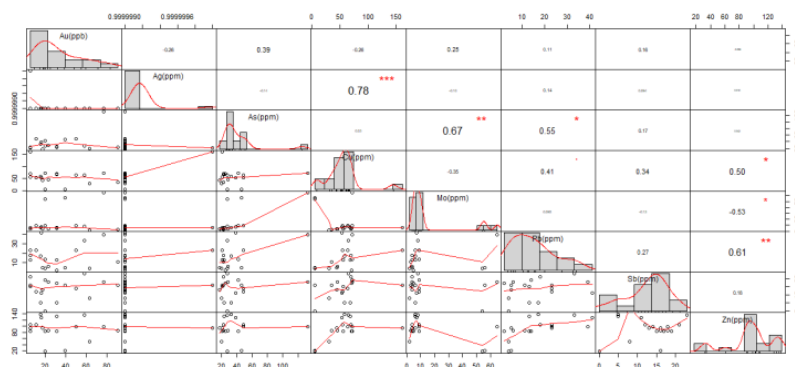

Figure 1. Correlation matrix of stream sediment elements in Zaylik area (shows the correlation coefficients that are important at the 95% confidence level)

In a cluster diagram in which the distances between clusters are arranged using Pearson correlation coefficient, the elements are divided into three groups: the first group; Including the elements Ag and Cu, which have the highest correlation coefficient. The second group; Containing Zn, Pb and Sb, which are formed as a sulfide phase in the veins of the region and show a significant correlation with each other. Finally, the third group; Includes As, Mo and Au with a strong correlation coefficient (Figure 2).
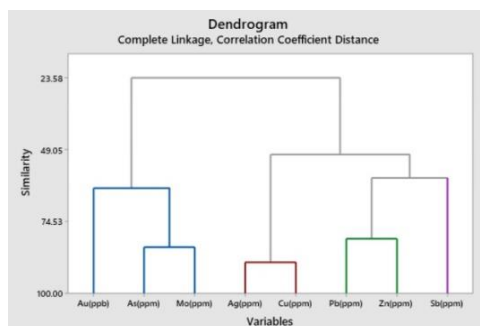

Figure 2. Cluster analysis of normalized raw data in stream sediments of the study area

In this study, geochemical maps were drawn spectrally in Arc GIS software. The most important geochemical anomalies seem to be related to the copper, lead, zinc and gold, which are consistent with veins, siliceous caps and alteration zones (Figure 3).
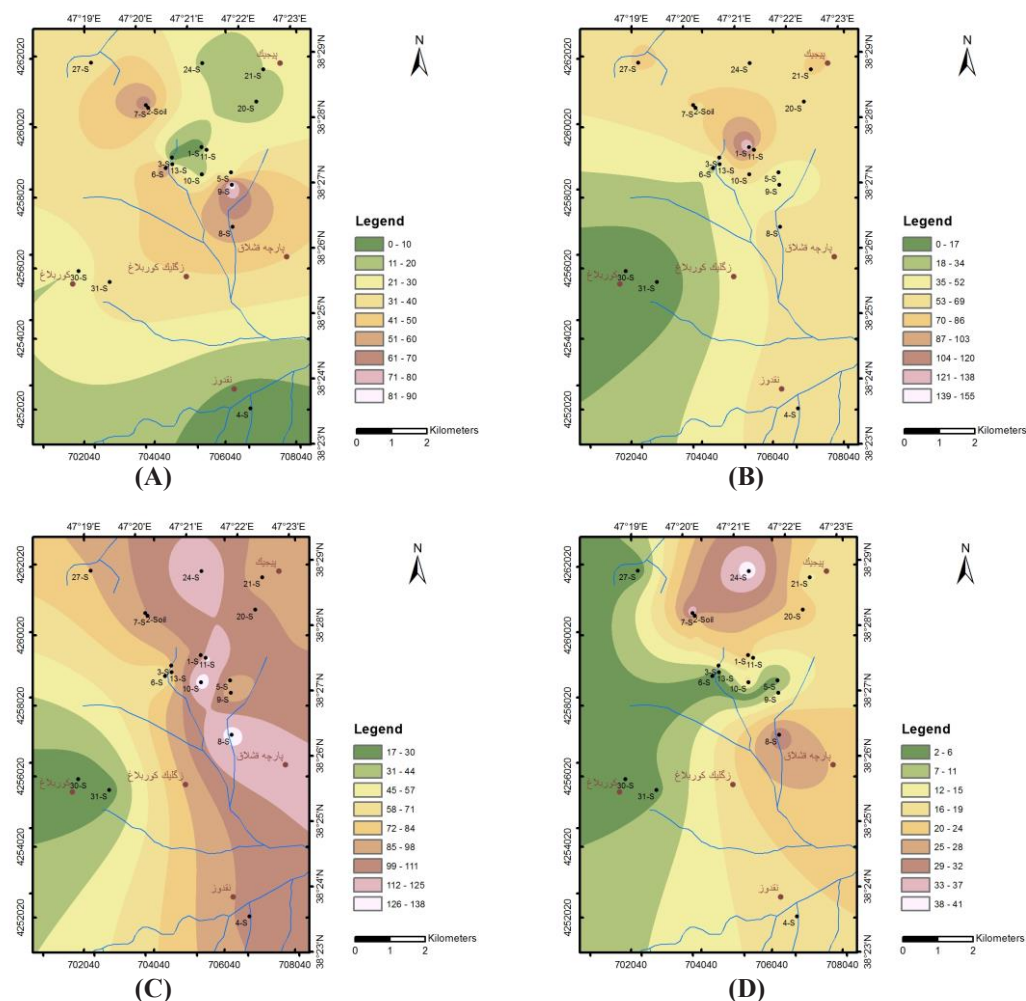

Figure 3. Geochemical map of the distribution of **A:** gold, **B:** copper, **C:** zinc and **D:** lead in the study area

CONCLUSIONS

The following conclusions were obtained by geochemical analysis as well as field observations from the region:

- The frequency diagrams of Au, Cu, Mo, Zn, Pb show positive skewness due to the more values of these elements in some of the samples.
- According to the correlation coefficient and cluster analysis of elements, a positive correlation is observed between molybdenum and arsenic as well as lead and zinc with a confidence level of 99%. There is also a positive correlation between lead and arsenic as well as zinc and copper and finally an inverse correlation between zinc and molybdenum with a 95% confidence level.
- According to field surveys, it seems that the function of the main faults in the region has been compressive and the penetration of CO_2 and SiO_2 rich fluids has caused the creation and expansion of alteration zones in the region.
- According to the diffusion and dispersion map of elements, it seems that the most important geochemical anomalies are related to copper, lead, zinc and gold, which are consistent with veins, siliceous caps and alteration zones in the region.

REFERENCES

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