REGRESSION ANALYSIS OF CHEMICAL CONTENTS OF ERVA PB-ZN DEPOSIT KAYSERI (YAHYALI)

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Abstract. The demand for lead-zinc ore in the industrial field has increased considerably in recent years. In response to increasing demands, geochemical research of lead-zinc deposits has also gained importance. Different methods are being developed to facilitate and accelerate these researches. One of the methods used is geostatistics. Averages, regression, correlation, kriging, etc. analyzes are among the geostatistical methods preferred by researchers. In this study, the Erva Pb-Zn deposit, located in the Zamantı lead-zinc province in Türkiye, was studied. The relationships between Erva Pb-Zn deposit geochemical analysis data will be interpreted by regression analysis, one of the geostatistical methods. There are few studies in the literature on examining geochemical data obtained from mines using geostatistical methods. For the purpose of this study, the statistical explainability of the elements whose geochemical associations were determined using linear regression analysis will be determined by regression analysis.

2020 Mathematics Subject Classification. 62H10, 62H05

Keywords and phrases. zinc–lead deposit, trace element geochemistry, geostatistics, regression analysis, Kayseri

1. Introduction

Lead-zinc, which is among the most widely used metals after aluminum and copper, are metals with a wide range of industrial uses [1]. Features such as having a low melting temperature and being easily shaped increase the use of these two elements in industry. Similar chemical (coexistence with related minerals, etc.) and physical behaviors (precipitation conditions, etc.) of lead-zinc elements enable them to coexist in nature [1]. In response to the increasing demand for lead-zinc, the discovery of new deposits and detailed research of existing deposits are also of great importance. In this context, one of the methods used in detailed investigation of lead-zinc deposits is geostatistics. Geostatistical methods are a type of applied statistics used in the geochemical evaluation, interpretation and modeling of mineral deposits such as lead-zinc [2], [3]. Some mineral deposit research that uses geostatistical analysis as a method is summarized as follows: Simulation and Kriging methods were applied in the geological modeling of the Balikesir-Balya Hastanetepe locality mineral deposit containing Pb, Zn and Ag. By using the

The financial support for this research was provided by the Scientific Research Projects Coordination Unit (BAP, FDK-2023-6411) of Akdeniz University, Antalya/Turkey. The authors would like to thank the Scientific Research Projects Coordination Unit of Akdeniz University. This paper is a part of the PhD thesis of ATAKOGLU OZER O., the first author.

simulation method, side rock and ore relationships were tried to be determined at certain elevations of the underground. However, it has been determined that the method used is insufficient for the purpose of determining underground melt cavities (lenses, karst cavities, alteration zones, etc.) [4]. In the study conducted on the Bindiba mining region in Eastern Cameroon, locations that could not be sampled were tried to be estimated with some statistical analyses. For this purpose, forecast maps, variographic analysis and normal Kriging (OK) geostatistical methods were used. From the geostatistical approaches used, the spatial variability of the metal concentration of the region could be effectively interpreted [5]. The Erva lead-zinc deposit, located in the Yahyali (Kayseri) district in the Southeast of Türkiye's Central Anatolia Region, was determined as the study area. This study has showed the application of regression analysis, one of the geostatistical methods, with the geochemical analysis data of the lead-zinc deposit determined in this study. There are not many examples in the literature about the use of geostatistical methods in the geochemical evaluation of mines. In this context, this study has touched upon the importance of regression analysis that can be used in the evaluation of mineral deposits. It has served as an example for future studies.

2. Materials and Methods

Using the Rigaku (NEX-CG Applied Rigaku Technologies, Inc. Austin, TX, USA) X-Ray Fluorescence Spectrometry (XRF) device geochemical analysis was applied to 32 samples collected from the study area. In preparation for XRF analysis, the samples were kept until they lost their moisture. The grain size of the moisture-lost samples was ground to $\prec$75 microns. The samples, which became homogeneous, were pressed-lozenge with a smooth surface under 30 MPs pressure.

3. Main results

3.1. **Regression Analysis.** Using linear regression analysis, the statistical explainability of geochemically associated elements was determined [6], [7], [8], [9], [10], [11], [12], [13]. The R^2 value in the model summary table shows the percentage explainability of the dependent variable by the independent variables [14]. The adjusted R^2 value shows the effect of each independent variable added to the model on the dependent variable [14]. The Durbin-Watson value in the model summary table indicates whether there is autocorrelation in the model [14]. Durbin-Watson value is generally between 1.5-2.5 [14]. Variance analysis is concerned with whether the model is statistically significant [14].

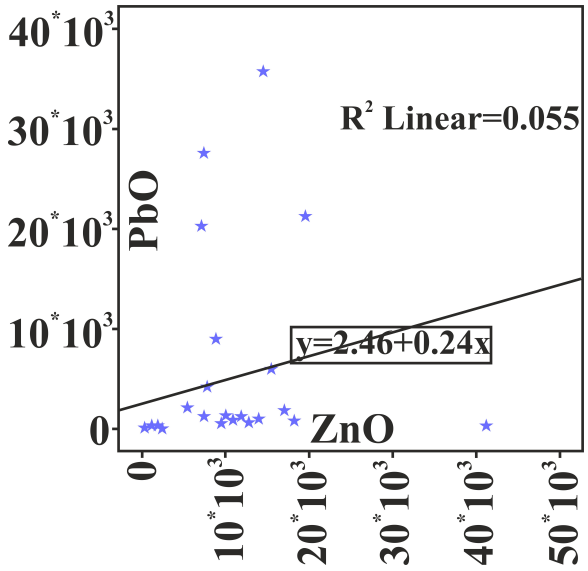


FIGURE 1. Scatter point plot PbO-ZnO of the Erva Pb-Zn deposit

Model Summary[b]							
		Change Statistics					
Model	R Square	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	1.000[a]	.999	756.822	18	13	.000	2.008
a. Dependent Variable: PbO							
b. Predictors: (Constant), Sr, Bi, Cl, Yb, Ir, Fe_2O_3, TiO_2, Zr, Tb, Na, SiO_2, ZnO, Co, P_2O_5, Al_2O_3, Hg, CaO, Pt							

TABLE 1. Model summary table of the Erva lead-zinc geochemical analysis results

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	P-value
1	Regression	2452.592	18	136.255	756.822	.000[b]
	Residual	2.340	13	.180		
	Total	2454.932	31			
a. Dependent Variable: PbO						
b. Predictors: (Constant), Sr, Bi, Cl, Yb, Ir, Fe_2O_3, TiO_2, Zr, Tb, Na, SiO_2, ZnO, Co, P_2O_5, Al_2O_3, Hg, CaO, Pt						

TABLE 2. Variance analysis table of the Erva lead-zinc deposit geochemical analysis results

4. CONCLUSION

The linear positive equation established is as follows; PbO (%) = 2.46+0.24 *ZnO (%) and the R^2 value of the established equation was found to be 0.055. Established linear positive equation R^2 value PbO-ZnO association was not

found to be significant. The value extracted from Table 1 is 99.9% independent of the dependent variable PbO and Sr, Bi, Cl, Yb, Ir, Fe_2O_3, TiO_2, Zr, Tb, Na, SiO_2, ZnO, Co, P_2O_5, Al_2O_3, Hg, CaO, Pt. It is explained by the variables. The remaining 0.01% is explained by error variables that are not included in the model. According to the table, the corrected R^2 value was found to be close to the R^2 value and was found to be 99.8%. In the model, the Durbin-Watson value is 2.008 and there is no mention of autocorrelation. It was determined that the model was significant at all levels with the values of F = 756.822 and P-value = 0.00 in the ANOVA table.

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