Distinguishing of deposits and analysis methods according to the concentrations of Co, Ni, Mn and Ti in pyrites

S. Temur
H. Kurt

University of Selçuk, Department of Geology, 42079-Konya, Turkey

The pyrite samples from Horzum (Kozan – Adana, Southern Turkey) and Bolkardaği (Ulukişla – Niğde, Central Turkey) zinc-lead deposits have been analysed using atomic absorption spectrometer (AAS) and microprobe (MP) methods, and Co, Ni, Mn and Ti abundance have been determined. Horzum deposits have low temperatures (150–200°C) and hydrothermal origin which can not be directly related to the magma (Temur, 1987), but the formation of the Bolkardaği zinc-lead deposits are in relation with hydrothermal solutions which have magmatic origin and middle temperature (200–300°C) (Temur, 1991). In this work, according to the trace element concentration of obtained pyrites, distinguish ability of deposits has been discussed whether the distinguishing of different analysis methods is important or not.

Pure and coarse pyrite crystals have been chosen using binocular microscope and these crystals have been dissolved in 1:3 HCl + NHO_3 at 100°C. The analysis of this solutions have been made using AAS. Measurement have been carried out using Varian Tectron A 75 series machine. MP analysis have been carried out using a Chambridge Instrument microscans machine. The one way analysis of variance (ANOVA) haas been applied to the data and the differences between rows and columns have been checked using Fisher (F) test.

TABLE 1. The Co, Ni, Mn and Ti concentrations in pyrites (ppm), (n – element number, Mean – arithmetical average, Str. Dev- Standard deviation, Stan Err- Standard Error)

	Param.	Microprobe		AAS	
		Bolk.	Horz.	Bolk.	Horz.
Co	n	34	34	56	32
	Mean	431	2778	118	59
	Str.Dev.	674	16008	31	55
	Str. Err.	116	2745	4	10
Ni	N	34	34	56	32
	Mean	268	609	68	44
	Str.Dev.	446	1106	31	35
	Str. Err.	77	190	4	6
Mn	n	34	34	56	32
	Mean	109	73	25	28
	Str.Dev.	228	171	5	23
	Str. Err.	39	29	1	4
Ti	n	34	34	56	32
	Mean	37	39	473	267
	Str.Dev.	87	68	68	98
	Str. Err.	15	12	9	17

Interpretation of data

The Co, Ni, Mn and Ti concentrations in pyrites from zinc-lead deposits on Horzum and Bolkardaği have been distinguished due to the analysis methods applied and results are listed in Table 1. The very high standard deviation and standard error obtained by using MP analysis indicate unreliability of average of population. Moreover, the average of samples between deposits differs by a factor of ten or higher.

Hypothesis

H_{0A} – No difference exits between deposits in X element concentration in pyrite

H_{0B} – No difference exits between analysis methods in X element concentration in pyrite

To the alternative hypothesis;

H_{1A} – The deposits are different due to the X element concentration in pyrite

H_{1B} – The analysis methods are different due to the X element concentration in pyrite

According to above given hypothesis, the result in Table 2 can be summarized as following.

According to the calculation given in Table 1, since F value is 9.3 with 0.05 error ratio, the zero hypothesis is 'rejected due to the Co, Ni, Mn and Ti concentration in pyrites'. Therefore it is understood that the pyrites from the different deposits represent same population. The zero hypothesis is also rejected due to the Co and Ni concentration of pyrites from Horzum and Bolkardaği zinc-lead deposits. Namely, whichever analysis method is used, the Co and Ni concentrations in pyrites between two type of deposits appear to be a distinctive characteristic, but this characteristic can not be determined in Mn and Ti concentrations.

Discussion and conclusions

The analysis method is very important feature in determination of trace elements of minerals. As discussed above the different analysis methods can give very different results. Thus, at the beginning, the proper analysis method must be chosen and the data should not be interpreted together by using different data obtained from different analysis methods. When this show same population or same indecision exists the variance analysis or similar statistical methods should be tested.

In this work, since AAS method resolved all of the pyrites, the composition of the minerals, which are in the form of inclusion and exsolution, show the characteristics of the pyrites. But, in the microprobe, since the compound at the probed point is taken as base, the standard deviations and standard errors of the analysis results increase due to the case of coincidence of the inclusion or exsolution. Also it has been found that Co and Ni concentrations in pyrites can be related to the formation of deposits, and based on this characteristic the distinguishing can be made. But the same characteristic has not been found for Mn and Ti concentrations.

When pyrites are formed, the metals ions in this element can be displaced and this case can be caused by the displacement of this metal ions or by the case in which the minerals remark in the form of inclusion/exsolution crystals.

TABLE 2. The distribution table of variance analysis (ANOVA) due to Co, Ni, Mn and Ti concentration (ppm) in pyrite

Source of variation	Sum of squares	Degrees of freedom	Mean square	F
Co				
Among beds	2298256	3	766085	F_C =1.59
Among method	1308736	3	436245	
Error	1447244	3	482415	F_R =3.21
General	5054201	8		
Ni				
Among beds	140345	3	46782	F_C =3.57
Among method	25123	3	8374	
Error	39267	3	13089	F_R=0.64
General	204735	5		
Mn				
Among beds	4161	3	1387	F_C=11.01
Among method	273	3	91	
Error	379	3	126	F_R =0.72
General	4813	5		
Ti				
Among beds	110224	3	36741	F_C=10.19
Among method	10404	3	3468	
Error	10816	3	3605	F_R =0.96
General	131444	5		

References

Temur, S. (1987) *Horzum (Kozan Adana) yöresi piritli çinko-kurşun yataklarnn jenetik incelemesi;* Yerbilimleri (Hacettepe Üniv. Yerbil. Uyg. ve Aras. Merk. Bült.), **13**, 31–48.

Temur, S. (1991) *Bolkardaği (Ulukişla - Niğde) yöresi çinko - kurşun yataklarnn jenetik özellikleri;* Çukurova Üniv. Müh.-Mim. Fak. Jeol. Müh. Böl. Ahmet Acar Jeoloji Semp., Bildiriler, 191–8.