DOI: 10.29302/Pangeea 19.02

USE OF INFORMATION ENTROPIA METHOD IN THE DETERMINATION OF THE GENESIS OF THE MINERAL DEPOSITS

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ABSTRACT: *This paper presents a statistical method for determining the genesis of useful mineral deposits. It is based on the maximum degree of dispersion of some values on the definition domain of a statistical series, which can be represented graphically. By comparing graphical images of multiple fields or comparing with a standard graph, the genesis of some deposits can be determined quite accurately.*
Keywords: *information entropy; dispersion; genesis; mineral deposits;*

1. Theoretical aspects

From a statistical and mathematical point of view, information entropy is an indicator of dispersion, an indicator that highlights the maximum degree of dispersion of values of a characteristic on the definition domain of statistical series. The theoretical foundation of this statistical method assumes that any phenomenon, no matter what nature it is, is capable of issuing an undefined number of informative signals. To determine the value of the indicator, the following sizes are taken into account:

A = the set of signals being emitted;
a = a signal being emitted;
$p(a)$ = probability of emission signal a.

Between these three elements there are the following relationships:

$$a \in A; \quad 0 \le p(a) \le 1; \quad \sum p(a) = 1$$

In this situation, the value of information entropy (H), can be determined according to C.A. Shanon, namely:

$$H(A) = \Sigma p(a) \cdot lg_2 \cdot p(a)$$

The use of this statistical method in determining the genesis of the deposits takes into account the contents in different chemical elements of a mineralization, for each of these elements being established different ranges of contents, intervals built on the basis of natural numbers, for each interval to be determined the value information entropy, according to the relationship:

$$H = f_i \cdot lg_2 \cdot fi$$

where: fi represents the population frequency of the content in a given chemical element over the calculated interval.

By summing the partial informational entropy values, characteristic of each interval, the total information entropy value of the chemical element taken into account is obtained. The values thus obtained are represented graphically, obtaining the polygon of the information entropy frequencies for this chemical elements.

The use of this method in determining the genesis of the deposits involves two aspects, namely:

- comparison of the graph obtained from the processing of the data with a standard graph for mineralization of a certain genesis;
- comparing the graphs of two or more mineralizations, from which it can be appreciated whether or not these mineralizations have the same genesis.

Since very few graphical charts have been prepared and made public, the method can be successfully used for the second case, or a comparison of mineralizations, so that their genesis can be discussed.

2. Application

For example, we present the method of applying the method for several polymetallic mineralizations on the northern slope of the Făgăraş Mountains (fig. 1).

Determining the informational entropy of the elements: S, Pb, Zn, Cu and Fe for the mineralizations in the Porumbacu valley, the Arpaşu valley and the Transfăgărăşan road (Table 1) and comparing its variation graph (fig. 2), the information entropy variation for the three situations are almost identical, so their appearance is related to the same metalogenetic process.

The three areas, located at a relatively large distance from each other and all located in the complex of the retromorphic shale, concluded that the action of the mineralizing solutions that affected the old mezomamorphic complexes, turning them into the current predominantly filiform shale, could be responsible for putting these mineralizations in place.

Researchers who studied the nowadays area believe that the mineralization is of a sedimentary nature over which the

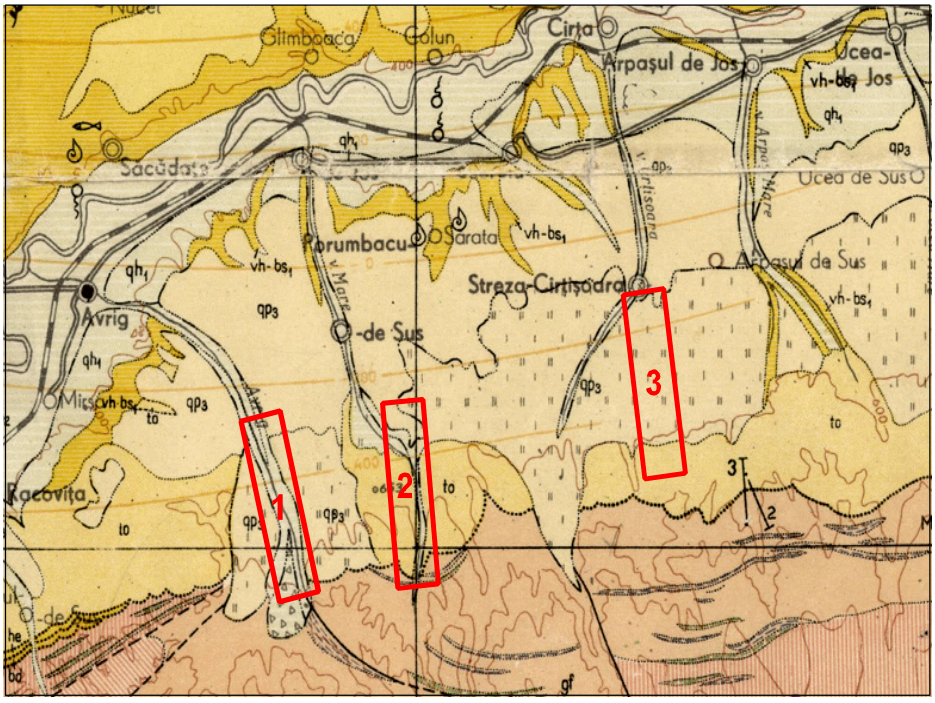

Fig. 1. Geological map of the Făgăraş Mountains with mineralized areas
1-Porumbacu valley, 2-Arpaşu valley, 3-Transfăgărăşan road
(according to the Geological map of Romania, sc. 1:200000, sheet Sibiu)

Table 1. Values of information entropy

Area / Elements	Porumbacu Valey	Arpașu Valey	Transfăgărășan road
Cu (%)	5,11	5,16	5,23
Pb (%)	5,02	5,04	5,10
Zn (%)	4,52	4,55	4,60
Fe (%)	4,37	4,42	4,48
S (%)	5,30	5,35	5,40

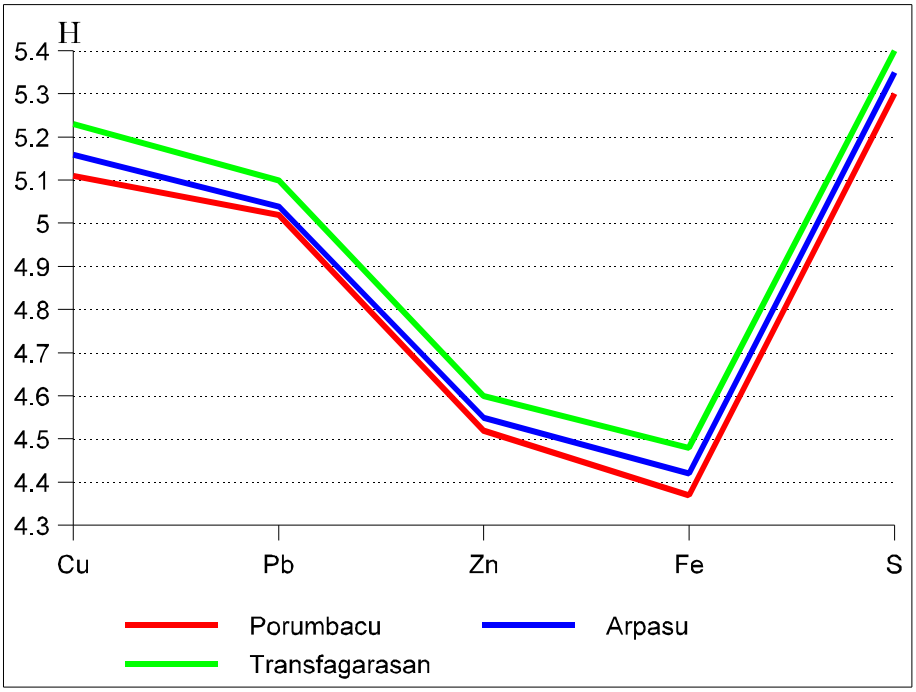

Fig. 2. Comparative graph of information entropy

metamorphism with metasomatic regeneration processes overlaps.

Corroborating the information provided by this method with the geological observation data, it can be concluded that the hypothesis of the hydrothermal genesis of the mineralization explains better some aspects regarding the genesis of the concentrations of metallic minerals occurring in the area. Hydrothermal processes triggered during regional metamorphism could have affected such a large area, given the rather large distance between the studied areas.

Besides, this genetic type of mineralization is accepted by the specialists who studied the mineralizations on the Transfăgărășan road and the mineralizations on the Valea Nișului-Turnu Roșu, both of

which are cantonated in the same complex of retromorphosed mezometamorphic shale.

3. Conclusions

The statistical method presents a greater number of chemical analysis, and the determination of the statistical indicator, the informational entropy, requires a large amount of calculations. Given the possibility of using the computer to determine information entropy, those with a large number of chemical analyzes will be able to get standard charts for different types of known genes, which could form a "catalog" covering as many genetic types, easy to use by all concerned.

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