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Multifractal analysis of the strength of Fe-Cu paragenetic relationships in eastern Tianshan, China

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Paragenetic association of elements is a natural and important geological phenomenon reflecting the geochemical behavior of elements during various geo-processes. Because of intrinsic characteristics, different elements of paragenetic association may also be generated. As a result, the respective material sources could be shifted from the original locations, and the strength of paragenetic association of elements could be declined. Therefore, study of paragenetic association of elements can help in locating material source, characterizing migration form, and indicating precipitation conditions. Resulted from complicated and cascade geo-processes, the strength of paragenetic relationship between elements presents variations in space. To examine influences of the strength of paragenetic association of elements on polymetallic mineralization, the current research proposes a data processing procedure that includes non-linear regression and multifractal analysis of the resulting regression coefficients. This procedure is currently tested in the eastern Tianshan mineral district, China, and encouraging results are being derived. In this research, geographically weighted regression (GWR), which is a non-linear statistical method, is used to examine the relationship between Fe and Cu concentrations in eastern Tianshan mineral district, China. This local regression method allows calculation of coefficients for Fe and Cu concentrations at every individual location. Therefore, the variation of the strength of Fe-Cu paragenetic association across the study area can be derived. Furthermore, a multifractal method, spectrum-area (S-A) analysis is applied to the regression coefficient map in order to delineate locations strong associated with Fe-Cu mineralization. Anomalies indicating very strong paragenetic association are separated from background. In addition, noise indicating locations with strong paragenetic relationships but that are not suitable for Fe-Cu mineralization are removed; whereas, information indicating locations which possess medium paragenetic relationships but are suitable for Fe-Cu mineralization are enhanced. On the other hand, the background map is also informative. It can be used to identify strong or weak background of Fe-Cu paragenetic relationships in the study area. Based on the proposed data processing procedure, analytical results could be useful in mineral exploration for polymetallic deposits in the future.