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Mineralization associated geo-processes recognition by multifractal/fractal filtering theory

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Geo-processes dominating the formation of mineral deposits are often various and cascaded. Recent progresses in the global geochemical mapping project and spatial analysis techniques enhance utilization of geochemical exploratory datasets to investigate mineralization and its associated geo-processes. Techniques including principal component analysis (PCA) and extended PCA have been considered as suitable treatments to characterize geo-processes. In our former studies, PCA has been successfully employed to investigate ore-controlling geo-processes. The resulting characterized geo-variables were further integrated to indicate mineralization-favorable spaces. However, there remains at least one more unsolved problem, that is whether the underlying cascaded geo-processes are characterized appropriately and completely. Theoretically, controlling effects of cascaded ore-forming processes cannot be exactly the same, but individual geo-processes have their own signatures. From the viewpoint of fractal/multifractal theory, results caused by a particular ore-controlling geo-process may have properties of self-similarity. Geochemical distribution patterns as final products of mineralization can be considered as mixtures of patterns possessing self-similarities of these geo-processes. Based on this consideration and choosing the Malipo mineral district in southeastern Yunnan Province, China as study area, fractal/multifractal filtering techniques were used to separate between mixed signals. Geo-information concealed in different sections of power spectrum could be extracted and more detailed geo-processes defined, consequently. In addition to recognition of hydrothermal mineralization associated magmatic, tectonic and sedimentary processes, clues to infer geo-processes dividing the study area into diverse geochemical background and geological units help to enhance geological understanding of the study area.