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Multifractal filtering methods to investigate tectono-magmatic framework in the Eastern Tianshan mineral district, China

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The Eastern Tianshan district is a critical Cu-polymetallic mineralization zone in China. Influenced by the northward plate subduction, geological framework generally extends along the EW direction, dominated by which spatial distributions of volcanic activities, volcanic sediments and granitic intrusions are EW oriented as well.
Gravity data sensitive to mass variations of earth crust are often employed to detect and recognize buried geological bodies (e.g., ore bodies, buried intrusions, faults, etc.). Fault traces as products of complex and cascade geological processes possess self-similarity, anisotropy and other fractal/multifractal characters. Multifractal theories and methods are, therefore, appropriate to analyze faults and investigate their causative geological processes. In addition, mineral exploration in this area is frequently impeded by Gobi-desert coverage, since geo-information of interests will become weak, missing and/or inadequate. Many of former studies had demonstrated that fractal/multifractal approaches are efficient tools to explore complicated geological events. Especially in shallow covered areas, weak geo-information can be enhanced significantly.
This study applies a multifractal filtering method to gravity and geochemical data, which is objective to identify Fe-Cu-Au mineralization related faulted structures. The multifractal filter, spectrum-area (S-A) model is currently employed to characterize anisotropic properties of geological framework in the study area. According to the filtered anomaly and background patterns, mineralized districts can mostly be targeted along the faulted zones and around the intermediate-felsic intrusive rocks in the Aqishan-Yamansu volcanic basin. Nevertheless, the jointly used upward continuation and vertical derivation cannot achieve patterns as the S-A filter due to the scale variance of the model. The S-A model defined based on the self-similarity and scale invariance of their corresponding sections on the log-log graph of power spectrum against area is scale invariant and presents advantages in separating anomalies and/or backgrounds. The results of current study demonstrate consistency of recognized fault traces and known tectonic signatures in uncovered areas. Furthermore, underlying faults can also be identified by enhancing weak signals in desert covered areas. Revealing geological framework under coverage as the work demonstrated in this study is important, since it can be in favor of further mineral exploration for Fe-Cu-Au polymetallic deposits associated with faults.