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A fractal measure of the spatial relationships between geological features and mineral deposits

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Quantifying the spatial relationships between geological features (e.g. controlling factors for mineralization) and mineral deposits is significant in mapping mineral prospectivity. A fractal relation was proposed to measure the spatial relationships between geological features and mineralization in this study. A power relation between the density of mineral deposits (ρ) and the buffer width (ε) of geological features (e.g. faults and intrusions) which control the spatial distribution of mineral deposits was observed. This relation gives $\rho=C\varepsilon^{\alpha-2}$, here, α is the singularity index[1], and C is a constant. $\alpha < 2$ indicates a significant spatial correlation between geological features and mineral deposits, meaning that the more mineral deposits occurred near geological features. The lower α value suggests a much more significant spatial correlation between a specific geological feature and mineral deposits. Taking the Fujian Province in China as an example, NNE–NE-trending faults, Yanshanian intrusions, and Late Paleozoic marine sedimentary rocks and the carbonate formations (C-P Formation) are three key factors controlling the formation of skarn Fe mineralization. The relations between the buffer width of geological features and the density (= the cumulative number of Fe deposits /the buffer width) exhibited a perfect fractal statistic. The obtained singularity index suggested that the significance of Yanshanian intrusions and C–P Formation are greater than that of NNE–NE-trending faults in controlling the formation of Fe mineralization[2]. In addition, the fractal relation was also observed between Jurassic to Cretaceous intermediate–felsic volcanic rocks (Fig.1a), intrusions (Fig.1b), and Cu polymetallic mineralization in southwest Fujian in China. The singularity index provided an alternative approach to measure the spatial association between geological features and mineral deposits.

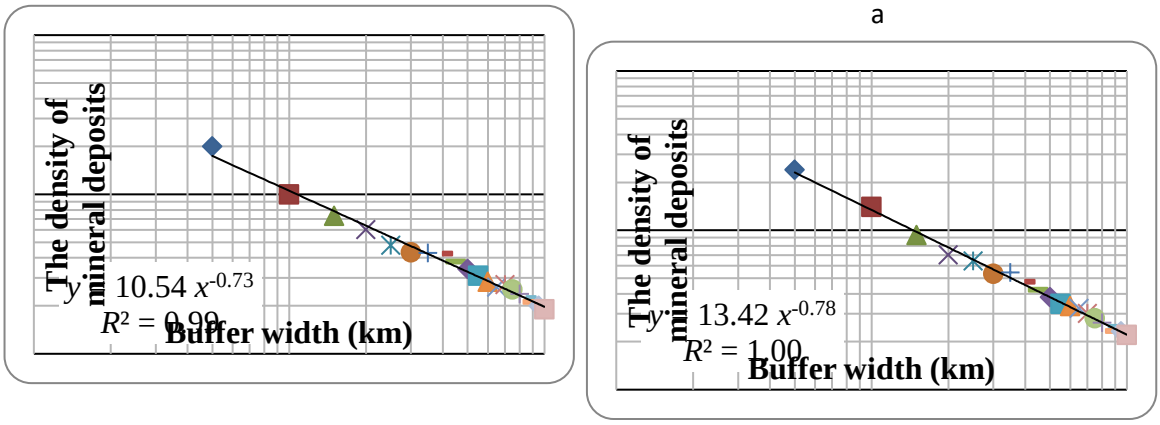

Fig.1. Log-log plots of buffer width of Jurassic to Cretaceous intermediate–felsic volcanic rocks (a) and intrusions (b) versus the density of mineral deposits.

References:

[1] Cheng Q (2007) Ore Geol. Rev. 32: 314–324.

[2] Wang Z (2015) Journal of Earth Science 26(6): 813-820.