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PII: S0375-6742(17)30549-6
DOI: doi: 10.1016/j.gexplo.2017.07.019
Reference: GEXPLO 5968

To appear in: *Journal of Geochemical Exploration*

Received date: 2 April 2017
Revised date: 27 July 2017
Accepted date: 29 July 2017

Please cite this article as: Wenlei Wang, Qiuming Cheng, Shengyuan Zhang, Jie Zhao , Anisotropic singularity: A novel way to characterize controlling effects of geological processes on mineralization, *Journal of Geochemical Exploration* (2017), doi: 10.1016/j.gexplo.2017.07.019

# Anisotropic singularity: a novel way to characterize controlling effects of geological processes on mineralization

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# Abstract

The anisotropy of geochemical signatures of ore elements caused by various geo-processes needs to be delicately analyzed. Within a fractal/multifractal context, irregular ore material accumulation caused by hydrothermal mineralization in a short spatial-temporal interval can be described by singularity theory, quantitatively and qualitatively. However, due to limits of broadly utilized singularity estimation methods, the anisotropy of geochemical anomalies has not been maturely handled, although spatial variations of geochemical anomalies can be depicted and well exposed. In this paper, a new anisotropic singularity index estimation method is proposed and further applied to characterize geochemical anomalies of ore elements in the Malipo mineral district, China. This new method takes anisotropic nature of geochemical signatures into consideration according to inspecting and comparing changing behaviors of geochemical signatures for various directions rather than conventional isotropic estimation methods. Using the direction with the most intense variations to estimate anisotropic singularity index $\alpha_{max}$, improved patterns of geochemical behaviors with anisotropy can be achieved. Compared with other singularity estimation methods, especially the isotropic singularity by the square window-based method, the currently proposed technique objectively identifies the anisotropic geochemical features and investigates the non-linear geochemical behaviors. Moreover, the direction determined at each (sampling) location is more informative or indicative with respect to the migration paths and concentration of ore