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Anisotropic singularity index mapping method for characterizing nonliner geological processes

Jie Zhao (1,2), Wenlei Wang (3), Qiuming Cheng (1,2)

(1) China University of Geosciences (Beijing), China (jiezhao2014@163.com), (2) State Key Lab of Geological Processes and Mineral Resources, China University of Geosciences, (3) Institute of Geomechanics, Chinese Academy of Geological Sciences

Singularity index mapping methods which can appropriately reflect efficiency of singularity theory on investigating non-linear natures of various geological events has attracted a long term attention. In the context of singularity estimation methods, more than 20 published journal papers discussed development of estimation algorithms and their application. Among these case studies, anisotropic natures of geological features are mostly focused. From previously proposed square, directional, and elliptical window based mapping techniques to recently introduced anisotropic singularity method, accumulation and depletion caused by non-linear mineralization processes within a narrow spatial-temporal interval had been characterized, by which spatial variations of related physicochemical quantities were depicted and interpreted. During the application of the squared window-based method, the estimation is isotropic and may not characterize heterogeneity of physicochemical signatures, appropriately, since it assumes that the signatures within the small areas A(i×i) or in their vicinity are homogeneous without consideration of directional variations in a local scope (i.e. anisotropy). In 2017, we proposed an anisotropic singularity method to rectify this issue. After that, we further noticed that the step number i still cannot be determined, appropriately, although the high and small numbers of i are corresponding to regional and local variations, respectively. As a successor of former study, we further developed and proposed an improved anisotropic singularity mapping method. In this study, we used an elliptical window-based method to estimate singularity index, during which U-statistics was utilized to determine that the vicinity (or step number i) is anomalous or background space. According to this elliptical window and U-statistics based singularity index mapping method, not only anisotropic natures of mineralization related anomalies are characterized, but also the step number i can be determined for better understanding and/or interpreting mineralization processes.