Identification of Ore-Finding Targets Using Anomaly Components of the Ore-Forming Element Group Extracted by SVD and PCA in the Giant Gejiu Sn-Cu Ore Field, Southwestern China

Yongqing Chen, Aoyue Zheng
School of Earth Sciences and Resources, China University of Geosciences, Beijing, United Kingdom

The giant Gejiu Sn-Cu polymetallic ore deposit, located at the jointing site between the Yangtze and the Cathaysia Blocks, is one of the largest tin polymetallic ore deposits in the world. It is associated with a magmatic-hydrothermal ore-forming system triggered by the deeply buried geological structures and concealed granites. Multi-stage geological and ore-forming processes produce generally regional and local element concentration anomalies of ore-forming elements such as Sn and Cu. The principal component analysis (PCA) can be applied to establish various types of ore-forming element associations, which can be further divided into two different anomalous components with the help of the singular value decomposition (SVD). One can be defined as a regional geochemical anomaly generated by geological processes (i.e., magmatism); and the other can be regarded as a local geochemical anomaly created by ore-forming events. Three aspects are illustrated in this paper. (a) The ore-forming element combinations, including Pb-Ag-Sn-As-Mn-Cu and Be-W-F-Bi-Cu-B, are established by PCA. The ore-forming element group like Pb-Ag-Sn-As-Mn-Cu characterizes mesothermal-epithermal Sn-Cu-Pb-Ag polymetallic mineralization with alteration such as arsenopyrite and carbonate minerals; the Be-W-F-Bi-Cu-B ore-forming element group characterizes hypothermal-mesothermal W-Be-Cu polymetallic mineralization with fluorite and tourmaline alteration. (b) The regional geochemical anomaly established by magmatism and the local geochemical anomaly components created by hydrothermal ore-forming processes are respectively identified by the SVD from the ore-forming element groups. (c) The regional and local geochemical anomalies are delineated using the geochemical anomaly components corresponding to different eigenspaces. The PCA and SVD methods were applied to Sn-Cu polymetallic ore-prospecting target areas in the Gejiu ore field, southwestern China, by delineating their local geochemical anomalies. The results show that the SVD can extract not only the regional anomalies associated with magmatism, but also the local anomalies related to the hydrothermal ore-forming processes from multi-element groups established by PCA.