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3D targeting based on geoscience datasets and metallogenic model in the east of Gejiu Tin Polymetallic District, China

Wang, G.W. [1], Han, Q.D. [1], Chen, S.Y. [2], Zhao, P.D. [1,2], Li R.X. [1], Chen, Y.Q.[1]

[1]China University of Geosciences, Beijing, 100083, China
[2]China University of Geosciences, Wuhan, 130087, China

Geoscience datasets provide key exploration information for identification of concealed orebodies. However, the ability to derive and integrate multiple geoscience datasets is important for generating information needed by geologists for decision-making for effective exploration of orebodies. In this paper, knowledge of magma-skarn-vein type deposits as a metallogenic system was used to guide construction of 3D exploration model for potential exploration targets in the east of Gejiu tin polymetallic district, China.

The world-class main deposits of Gejiu district are skarn-type tin polymetallic. A 3D granite model is key exploration criterion for magma-skarn deposits, as granite bodies are typically the main ore-forming and ore-controlling geological objects in the study area. The 3D granite model was constructed using a dataset with 58,123 location (x, y, z) points, a 1:10,000 scale geological map that includes outcrops of granites, electrical geophysical dataset (the depth is less than 1500m.), borehole dataset, and field survey dataset (surface and three mining tunnels (1800 m, 1630 m, 1360 m)). 3D ordinary kriging in GoCAD software was used to construct the 3D granite model measuring 15 km ×30 km×2.8 km, pertaining to a vertical level range from -500 m to 2300 m, and the 3D grid cell (or voxel) used is 200 m×200 m×200 m.

In this study, 4,745 lithogeochemical samples (from mining tunnels) were used for the analysis of ore-forming zones. Each sample was analyzed for 13 elements (Sn, Cu, Pb, Zn, Ag, Mn, as, Sb, W, Mo, Hg, Cd, Bi). The lithogeochemical data were subjected to factor analysis to obtain and element association depicting the mineral deposit type of interest, and results yielded four factors, namely: Factor1 – Sn-Ag-Pb-Zn-Mn; Factor2 – As-Sb-Cu; Factor 3 – W-Mo; Factor 4 – Hg-Cd. Of these four factors, Factor1 was used as geochemical exploration criterion of potential exploration targets. Discrete smooth interpolation (DSI) and concentration-volume (C-V) fractal modelling [1] using mesh of voxet and SGrid, respectively, in GOCAD software were applied to obtain a 3D geochemical model.

Faults at the surface were mapped by field survey or extracted from the 1:10,000 scale geological map, whereas subsurface faults were derived from mining tunnels surveys at different levels (1800 m, 1630 m, 1360 m) and from exploration cross-sections and the borehole dataset. The initial exploration criterion of 3D fault model was constructed by 3D buffering analysis of faults at different levels, the improved exploration criteria of 3D fault model using 3D stratum and intrusion models. The intrusion model obtained using DSI analysis was used to constrain the fault fractal model of exploration criterion using mesh of voxet and SGrid in GOCAD software.

3D targeting of tin polymetallic deposits was achieved by integration of the exploration criteria of fault and lithogeochemical models using entropy method and C-V fractal modeling in the GeoCube software [1]. The results show that (a) the metallogenic system of magma-skran-vein type deposits can be used to

construct 3D models depicting exploration criteria, (b) the DSI analysis is flexible for constructing complex geometry model for exploration targeting at depth, and (c) the C-V fractal modeling is important for target classification and interpretation.

References:

[1] Wang et al. (2015) J Geochem Explor, 10.1016/j.gexplo.2016.01.003