A Method for Mineral Exploration in Areas Covered by Transported Overburden of Arid Desert Landscape: Thermomagnetic Component Measurement

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Abstract: Soil constitution includes noncrystalline iron-manganese oxides which are closely related to various types of ore-forming elements. The noncrystalline iron-manganese oxides under the condition of high temperature and anaerobic enviroment can transform into magnetic crystalline iron-manganese oxides defined as thermomagnetic component which can be separated by magnetic effect. Hence, it is described soil thermomagnetic component measurement (TCM) which analyzes the indicator elements concentration of this thermomagnetic component and instructs mineral exploration. This manuscript describes the study of TCM at the Yemaquan polymetallic mine exploration area, northwestern China. This area consists of the Yemaquan typical skarn type Fe-Cu-Mo deposit related to acidic magmatic, the No.Ⅰ Pb-Zn-Ag exploration area and the No.Ⅱ polymetallic mineralization area. The Fe-Cu-Mo mineralization in the Yemaquan ore district forms vein bodies or lenses hosted by skarn that developed near an unconformity between limestone and acidic granite. The depth of concealed ore bodies is nearly 40-200m and the thickness of surface transported regolith is about 20-100m. No.Ⅰ prospect site is located 5 km north west of the Yemaquan mine and limited drilling has outlined Pb-Zn-Ag mineralization. The thickness of surface transported regolith is 30-70m and the depth of mineralization is nearly 90-100 meters. In No.Ⅱ exploration area, a thin layer of transported regolith covers the earth's surface and the depth of polymetallic mineralization is approximately ten meters. The results are as follow: (1) The concentration of all elements reach the highest value in thermomagnetic component than soil and non-magnetic component, and it means from the magnetic components to the soil to thermomagnetic component, the concentrations of ore-forming elements tend to increase. (2) The anomalies of Pb-Zn-Ag are clearly delineated at the location of No.Ⅰ exploration area. The anomalies of Cu-Pb-Mo occur at the Yemaquan ore district. And Pb-Zn-Ag-Cu-Mo anomalies develop over No.Ⅱ polymetallic mineralization area, for likely in No.Ⅱ exploration area, the layer of transported regolith is very thin and the depth of polymetallic mineralization is only ten meters. The origin of above the anomalies is related to the known mineralization. In addition, Cu-Pb-Mo anomalies delineated at the north-east of Yemaquan ore district are possibly associated with unknown Cu-dominated mineralization because this site has similar metallogenic geological conditions with Yemaquan ore district. Consequently, the north-east of Yemaquan ore district can be considered as the key area for detailed investigation in the next step. It is shown in Figure 1 that the spatial distribution and suits of elements are consistent with the mineralization types and buried depth. (3) The observation using by SEM shows that thermomagnetic component forms particles aggregation, black or dark gray, earthy luster, and the size of single particle ranges from 0.02 mm to 0.6 mm. Enlarged images of single particles illustrate that particle edge has much aperture gap, with thick-walled macrovoid structure . Mineral surface morphology shows that microporous slice loose structure and micro particles swelled. In addition, metal particles such as Ag, Zn, and W in the micropore space of thermomagnetic component are visible by SEM. These metal particles size range from nano to micron scale. Although no direct evidence shows that those fine metals particles observed by SEM derived from deep orebodies, there were no obvious pathfinder metal particles in thermomagnetic component samples collected from the background areas. Hence, it is believed that fine metals particles are carried by some uncertain active geological agents to earth surface and trapped by soil amorphous iron manganese oxide.

Key words: mineral exploration method, arid desert landscape, thermomagnetic component measurement, Yemaquan area

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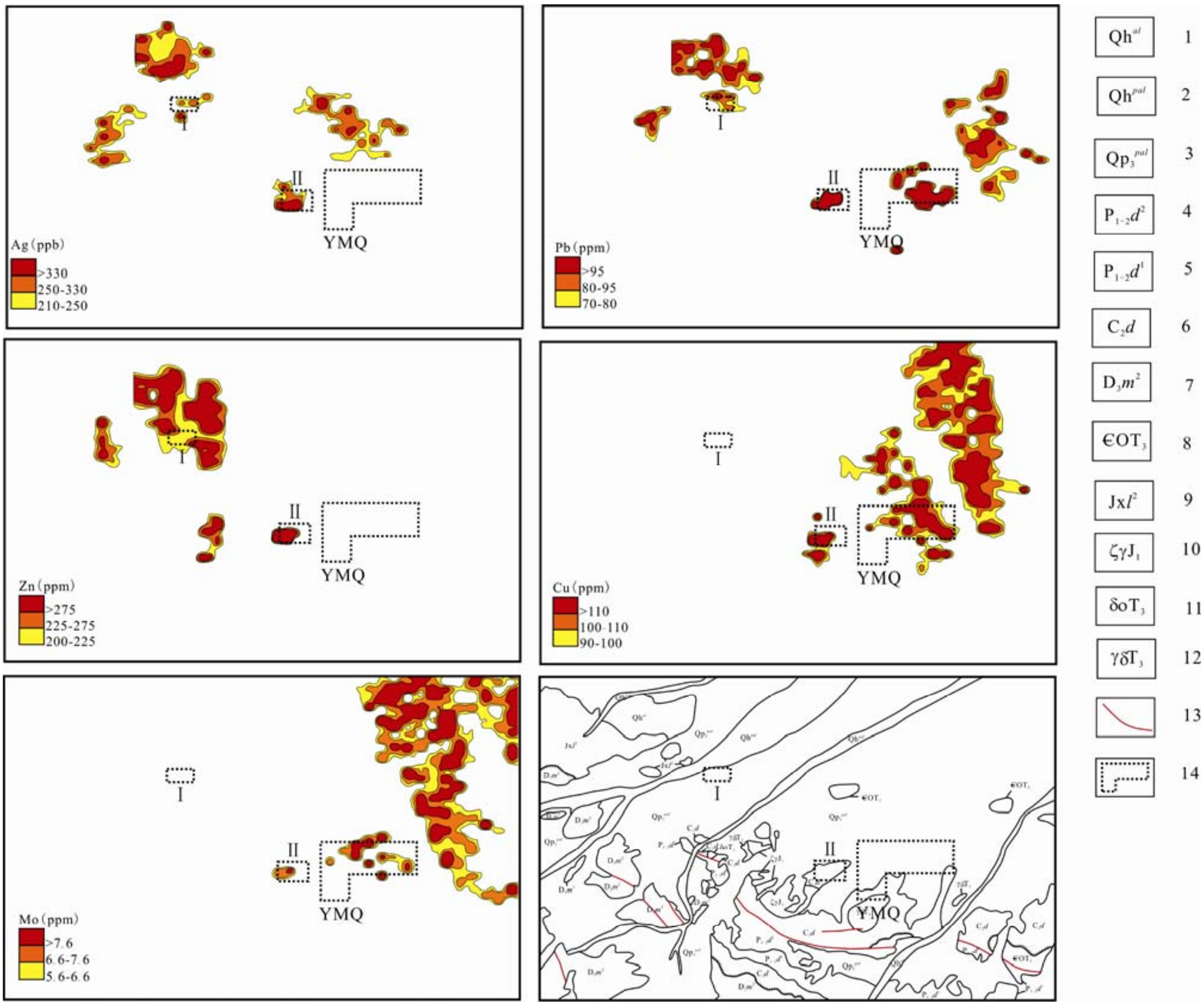

Fig. 1. Geochemical anomalies map of Yemaquan ore district and periphery

1-Impact gravel,sandy clay, clayey sand; 2-Gravel layer,partial silty sand layer; 3-Impact gravel,sand,sandy clay, clayey sand;4-Silty limestone,dolomitic limestone,dolostone,calcareous siltstone;5-Dolomitic limestone,limestone; 6-Diocalcarenite,sand limestone;7-Dacitic,rhyolite,tuff, volcanic breccia;8-Diopside marble,actinolite schist;9-Calcareous sandstone,phyllite; 10-Syenite-granite;11-Quartz diorite; 12-Granodiorite; 13-Fault; 14-Mineral deposit

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