Study on 3-D crustal structure in the area along Yangtze River: The significance to multi-metal mineralization

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Introduction

The complex structure characteristics of the area along the Yangtze River in Anhui Province is located in the convergent collision belt formed by two big tectonic plates, which are North China Plate and Yangtze plate. Plenty of mineral sources were generated in the duration of the frequent magmatic activities in this area. Therefore, it has a significant meaning in the exploring mineral sources to get a comprehensive view of the 3-D crustal structure. Based on the inversion and integrated interpretation of six geophysical profiles across this area, we obtain the 3-D characteristics about the crustal structure in Anhui Province along Yangtze River.

Data Processing and Results

Taking the crustal structure of Yangtze Plate as the frame, and combining with the geological strata or tectonic units, the initial model containing the different blocks was designed. Taking the exeisting partially seismic profile interpretation as the constraint condition, gravity and magnetic robust iterative inversion and the 3-D crustal structure integrated interpretation are carried out in the six geophysical profiles across the entire area. Several conclusions were obtained as follows: (1) The crustal structure has the obvious three layers overally, namely the upper crust, the mid-crust and the lower crust. (2) The upper crust, with a violent changing structure, has deposited the relative thicker cap rock. The partial area may hit 10km, with the character of the low velocity, low resistivity, low density and low magnetism (V: 5.7~5.8km/s, ρ_s: 5~10Ωm, σ: 2.6×10^3kg/m^3, J: 10^{-2}~10^{-1} A/m). (3) The mid crust has the top depth generally below 10 km and the bottom depth generally about 20km, with the characteristics of high velocity, high resistivity, high density and high magnetism (V: 6.0~7.0 km/s, ρ_s: 1000~1500Ωm, σ: 2.9~3.0×10^3kg/m^3, J: n×A/m), differently from the upper crust. (4) The lower crust, with an average of 12km depth, has the character of high velocity, high resistivity and high density (V: 6.8~7.6km/s, ρ_s: 10^3~10^4Ωm, σ: 3.0~3.2 kg/m^3). The Curie surface is in this layer. This study has siginificance to multi-metal mineralization.

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Historical variations in zinc stable isotope compositions of smelter polluted sediments

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Two case studies were carried out to investigate the use of zinc stable isotopes as tracers for industrial smelter sources and processes: 1) two organic sediment cores obtained 800 m from the former pyrometallurgical zinc smelter of Lommel (Belgium), which received exclusively atmospheric inputs, and 2) two dam lake sediment cores taken 15km upstream and 30km downstream of the former pyro/hydro-metallurgical zinc plant of Viviez (France), which received predominantly riverine dissolved Zn and particulate Zn inputs. Zinc isotopic compositions were measured on the LMTG Thermo-Finnigan Neptune MC-ICPMS in Toulouse and expressed as per mille deviations from the JMC 3-0749L standard. In case 1 atmospheric pre-industrial deposits have δ^{66}Zn = +0.31±0.09 ‰ (2sd). Deposits dated from 1900-1930 have δ^{66}Zn = +0.29 ± 0.06 ‰ (2sd), and sediments dated from 1956-1995 shift to lighter isotopic compositions of δ^{66}Zn = +0.13±0.08 ‰ (2sd) in 1968. 42 ZnS minerals from ore import dominating Australian and African mines yield, together with literture ZnS data, a grand average of δ^{66}Zn = +0.16±0.07 ‰ 2se, n=83 for ZnS. Emission control since 1955 is a likely cause for the δ^{66}Zn sediment shift. In case 2 the polluted riverine sediments dated from 1952-2002 have elevated δ^{66}Zn of +0.75 to +1.32 ‰ relative to the geochemical background δ^{66}Zn = 0.33±0.06 ‰ (2sd). Mine tailing slag samples also had elevated δ^{66}Zn ranging from +0.18 to +1.49 ‰. In summary we show that 1. Bulk ZnS ore minerals have homogeneous δ^{66}Zn. 2. Zinc refinery processes fractionate Zn isotopes: slags are enriched in heavy isotopes. 3. near-field (<1km) atmospheric deposition resembles Zns ores, far-field carries isotopically light Zn, and mine tailing drainage carries heavy Zn.