Deep electrical structure and its geodynamic significance beneath the Middle and Lower Reaches of the Yangtze River metallogenic belt

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The Middle and Lower Reaches of the Yangtze River (MLRYR) metallogenic belt is one of the most important metallogenic belts in eastern China. Past studies show that the Yanshanian tectonic-magmatic activity was the main cause of the large-scale mineralization in the MLRYR metallogenic belt. To realize key scientific problems of mineralization and the deep geological structure and to reveal the relationship between the regional geological framework and deep tectonics and mineralization dynamics, magnetotelluric (MT) soundings have been carried out across the geological corridors of the northern and middle sections of the MLRYR metallogenic belt as well as the Lujiang-Zongyang faulted depression area and the Tongling faulted uplift area. Based on Robust tensor estimation of time-domain data and comprehensive and detailed analysis of the dimensionality and geoelectrical strike of magnetotelluric data by using the tools of phase tensor analysis and G-B impedance tensor decomposition, the 2-D-dominated MT data are rotated to the regional strike direction and inverted by a 2-D continuous medium inversion program combined TE and TM modes. The 3-D-dominated MT data were inverted by the 3-D NLCG inversion method. The electrical structure of the geological corridors in the northern and middle sections of MLRYR metallogenic belt delineates the electrical characteristics of different tectonic units and the location and occurrence of boundary faults. It was found that the Tan-Lu fault and the Jiangnan fault cross the crust-mantle boundary, and the crust-mantle boundary beneath these faults is decoupled and dislocated to varying degrees. The mantle with different conductive properties along the Yangtze River metallogenic belt may be related to the different parts of the lithosphere which have been alternated by different types of geological activities during intracontinental subduction and magma intrusion.

The thickness of the volcanic layer, and the position and nature of the boundary fault were identified by magnetotelluric profiles in the Lujiang-Zongyang faulted depression area. The Lujiang-Huanguzha-Tongling buried fault is defined as the northern boundary fault of the Lujiang-Zongyang volcanic basin. The high resistivity body extends beneath the volcanic basin and is far beyond the volcanic outcrop area. The long axis direction of the magmatic activity in the Lujiang-Zongyang volcanic basin is NE-SW striking, and the northeast-southwest structure is the rock-controlling and ore-controlling structure in the study area.

It was found that the high resistivity body is closely related to the Mesozoic intrusion in the Tongling faulted uplift area, and the emplacement center of magma is located in the south of the Shizishan ore-field and the area of Fanchang volcanic basin in the northeast of the Tongling faulted uplift area. The location and occurrence of major fault zones and the sedimentary cover and basement formations in the Nanling basin were determined by electrical gradient zones.

The deep structural features of the MLRYR metallogenic belt obtained from the electrical model show that the electrical structural differences between the faulted uplift zones, faulted depression zones, and transition zones of the MLRYR metallogenic belt are related to the tectonic stress state during metallogenesis, which show the weak coupling between the crust and mantle and an ambiguous crust/mantle boundary beneath boundary faults and at a large-scale magmatic emplacement center. The existence of high-conductivity mantle and a change in the conductivity from the north to the south mantle show that different mantle sections in different tectonic locations were subjected to different types of alterations during intracontinental subduction and magma intrusion. In this paper, the relationship between magmatic system, fault system and crust-mantle boundary is established. The large-scale diagenesis and mineralization of the MLRYR metallogenic belt is related to the unified regional tectonic stress field. The underplating magma utilized the crust-mantle decoupling caused by the difference of stress in different parts and the Moho fault and the existing fault System, and then formed volcanic-intrusive systems of different sizes and types in the crust and eventually led to the Yanshanian mineralization in the MLRYR metallogenic belt.