Multi-scale imaging of the lithospheric electrical structure beneath the Xiangshan volcanogenic uranium deposit, SE China

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SUMMARY

Xiangshan (XS) uranium ore field is the largest and highest-grade volcanic-related uranium (U) ore resource in China. The sources of ore-forming elements, fluids, and tectonic settings remain controversial despite productive studies in this area. The Uranium Mineral System (UMS), composed of multiple geological components and multi-scale deep processes that generate U deposits, is crucial in understanding the genesis of U deposits. A multi-scale dataset was formed based on 120 broadband MT and 32 long-period MT data collected from the XS volcanic basin and its adjacent areas. Based on the multi-stage gradual inversion strategy, a regional one-dimensional conductivity model of the study area was first constructed. Subsequently, the three-dimensional (3-D) inversion process was carried out using the L-BFGS inversion algorithm. The preferred 3-D electrical structure model images a resistive upper crustal column, which corresponds to the metamorphic basement. A “wedge-shaped” high resistivity within the crust of the XS and Yuhuashan (YHS) volcanic basins and their northwest side is interpreted as the crustal roots resulting from the collision-induced crustal thickening. Two low resistivity anomalies dip southwest at the scales of the mid-to-lower crust and upper mantle, respectively. The latter is the main “source” of the UMS, while the former represents the “path” of the UMS, which regulates the upward migration of deep magmatic-hydrothermal fluids. Overall, the UMS in the study area exhibits a multi-level network framework of vertically extensive and trans-lithospheric scale. Combined with the regional geological data, a genetic model of the deep process and dynamic background of the U mineralization in the XS area was further proposed, which reveals that the generation of mafic magma is driven by the partial melting of the upper mantle, which results from the uplift of the asthenosphere due to the detachment of the lithosphere under post-collision conditions.

Keywords: Xiangshan uranium ore field; Uranium Mineral System; Magnetotellurics; Multi-scale Electrical Structure; Uranium mineralization

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