Gravity and Magnetic Evidence for the Geological Setting of Major Mineral Systems of the Main Metallogenic Belts in South China: A Qualitative Analysis

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South China is characterized by large-area multistage magmatism. It boasts a huge number of polymetallic deposits such as W-Sn, Cu-Au, rare earth deposits, thus serving as a “giant granary” of metal mineral resources in China (Lü et al., 2021). There are five large-scale metallogenic belts only in the east of South China, namely the Middle-Lower Yangtze River metallogenic belt (MLYMB), Qingzhou-Hangzhou metallogenic belt (QHMB), Nanling metallogenic belt (NLMB), Wuyishan metallogenic belt (WYSMB), and Xiangxi-E’xi metallogenic belt (XEMB). Furthermore, multiple world-class deposits have been discovered in this area, showing excellent prospecting potential. Several concerns have been raised about the apparent features of the deposits, i.e., temporarily different stages, and spatially distinct belts. What led to the difference in the type and metal association of the deposits? What controls the distribution of the different types of metallogenic belts? Where can we find new deposits and ore concentration areas? To address these concerns, it is necessary to consider the metallogenic factors of the deposits systematically. The metallogenic processes were divided into three significant parts according to the latest theory of mineral system, namely metallogenic source zones, ore-depositing pathways, and ore-accumulating sites (Lü et al., 2020). Accordingly, the metallogenic start in the deep lithosphere and terminations where shallow crust deposits accumulate were studied as a whole object. The regional gravity and magnetic field contain abundant underground information. Therefore, the processing and inversion of such information make it practicable to discuss the critical metallogenic factors of a mineral system from three aspects: vertical layers, horizontal intrusions, and 3D morphology of key geological bodies.

The gravity data obtained based on ground Bouguer gravity anomalies are usually corrected under the Cartesian coordinate system, without considering the influence of the curvature of the Earth. However, in the case of Bouguer gravity calculation of a large area, the spherical gravity correction was found by Jiang (2014) through experimental comparison as an influential factor that helps to improve the terrain correction accuracy of the areas with a length greater than 30 km. South China is more than 1,600 km long from east to west and more than 1,300 km wide from north to south. Therefore, gravity anomalies in such a large area should also be calculated based on spherical coordinates. Luo et al. (2019) improved the Tesseroid model proposed by Uieda et al. (2015) and further developed a spherical coordinate-based method. In this paper, this method was applied to calculate the Bouguer gravity anomalies in the east of South China.

To reduce the influence of the change in magnetic parameters on RTP, the sliding window method of RTP was adopted in this paper. The research area was divided into the windows of 300 km × 300 km according to the experimental comparison. After RTP was conducted for all windows using different geomagnetic parameters, the windows were integrated together again. In this way, the EMAG 2 of RTP magnetic anomalies of South China was obtained.

Vertical structures such as the Moho and magnetic basement in South China were obtained by processing and inversion of satellite gravity and magnetic data, the tectonic framework of South China was determined by multiscale edge detection of gravity and magnetic anomalies (Yan et al., 2019), and 3D density and magnetic structures were obtained through 3D gravity and magnetic inversion (Yan et al., 2020), thus providing deep information for research into the structure and mineralization of South China.

The boundaries of JNO were determined. Its southern boundary is considered to be Ningbo–Jinhua–south Shangrao–north Ganzhou–Chenzhou–Linwu–Wuzhou–east Yulin–east Beihai while its northern boundary is considered to be Xuanzhou–Huangshan Mountain–Jiujiang–Xiaming–Yiyang–Changde–Jishou–Tongren–Kaili.

The source zones of the mineral systems in major...
metallogenic belts in South China are reflected by the vertical structures of the lithosphere in this area (Fig. 1). In MLYMB, the mineral systems of the Fe and Cu deposits have multi-level source zones. The initial-level source zone is the enriched mantle, which is formed owing to the thinning of the lithosphere and deformation caused by the fluids in the asthenosphere. In QHMB, the source zone of Cu deposits such as the Dexing deposit is the mantle, while the source zone of W deposits on the margin of the Moho uplift such as Zhuxi and Dahutang deposits is the remelted crust. As for QHMB, the W and Sn mineral systems originate from the crustal magma. In WYSMB, the diagenism and mineralization are mainly related to the interactions between materials in the crust and the mantle. The crust-derived materials form the deposits mainly containing W and rare earths, and mantle-derived materials form polymetallic deposits such as Cu and Au. As for XEMB, it consists mostly of metal deposits of the type of strata-bound sedimentation with the crust as the source zone, such as Sb, Pb, Zn, and Mn deposits.

The pathways of the mineral systems of the major metallogenic belts in South China are deep faults and block or terrane boundaries determined by edge detection of gravity anomalies, as well as density contrast boundaries obtained with the 3D density model. The metallogenic pathways of Fe and Cu deposits in MLYMB mainly include the Yangtze River deep fault in NE trending and Tongling-Taizhou fault in SE trending and its secondary faults. The eastern segment of QHMB is mainly controlled by the faults in northeast Jiangxi, the southern segment of QHMB and the NLMB are mainly under the control of the boundary faults of F1, and WYSMB is related to Zhenghe-Dapu fault and Heyuan-Shaowu fault.

A 3D density and susceptibility model was obtained by 3D gravity and magnetic inversion. The distribution of different types of deposits was qualitatively reflected by different combination of density and susceptibility model, revealing the distribution of termination sites of different mineral systems in this area, providing indications for future ore-prospecting exploration in South China.
Key words: Bouguer gravity anomalies, mineral system, metallogenic belt, South China

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