Continent Reworking at the Northern Margin of the North China Craton: Insights from Magnetotelluric Data into Deep Processes and Carbon Cycling Mechanisms

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SUMMARY

The North China Craton (NCC), the largest and oldest craton in China, has experienced multiple significant crustal growth and evolutionary events. Its northern margin adjoins the Central Asian Orogenic Belt (CAOB), forming a complex tectonic transition zone. During the Late Permian to Triassic period, the subduction and subsequent closure of the Paleo-Asian Ocean led to the formation of the CAOB, a process widely believed to have altered the composition and properties of the lithospheric mantle at the northern margin of the NCC. This study aims to use the Magnetotelluric (MT) method to investigate the impact of the subduction and accretion of the Paleo-Asian Ocean on the northern margin of the NCC and to explore the global significance of continental reworking as a deep carbon cycling mechanism.

We utilized long-period MT data from the SinoProbe NCC MT array and two MT profiles from the CAOB, totaling 114 MT stations. After data processing and analysis, we performed 3D inversions incorporating prior constraints of topography, seawater, and marine sediments using the ModEM package. We found that the lithospheric mantle of the Yinshan-Yanshan orogenic belt in the northern NCC mainly exhibits low resistivity, which may be related to the collision-accretionary orogenesis of the CAOB. Meanwhile, an isolated large conductor was identified in the southwestern Khondalite belt, which appears to have little relation to the orogenic process of the CAOB. Additionally, a large-scale conductor exists from the lower crust to the upper mantle in the central and northern parts of the Ordos Block, indicating that the mantle may have undergone some degree of modification.

These findings indicate that the crust at the northern margin of the NCC has experienced tectonic reactivation, with the stretching and extension of the lower crust facilitating the migration and mixing of deep melts. This process likely involved crust-mantle interaction, leading to partial modification of the composition of the ancient crustal basement. The complexity of crustal composition and structure within the CAOB reflects the characteristics of the young crust of the Phanerozoic accretionary orogenic belt. We believe that these electrical characteristics are all related to the deep carbon cycling processes induced by the subduction, accretion of the Paleo-Asian Ocean, and the reworking of the NCC continent, providing important constraints on the deep physical properties for understanding the compositional evolution mechanisms and characteristics of continental crust at different stages of growth.

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Keywords: North China Craton, Central Asian Orogenic Belt, Magnetotellurics, continent reworking; deep carbon cycling