

Asthenospheric flow beneath the eastern margin of the Tibetan Plateau revealed by a three-dimensional Magnetotelluric study

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SUMMARY

The Qinling Orogenic Belt, which neighbored the Tibetan Plateau, formed by the convergence of the North China Craton and the Yangtze Craton, is located in the middle part of mainland China. It is a critical window to clarify the formation and evolution of the composite collision orogenic belt and to observe the northeastward extrusion and escape of material caused by the collision of Indian and Eurasian plates. Using 872 magnetotelluric sounding stations, we obtained for the first time a high-resolution three-dimensional resistivity model of the lithosphere of the Qinling Orogenic Belt and its surrounding areas. The model shows that the near EW direction anomalies dominate the electrical structure of the middle-upper crust of the Qinling Orogenic Belt, and high-resistivity anomalies are arranged at intervals along regional faults and plate suture zones, which show obvious low resistivity. The lower crust and upper mantle show electrical structural characteristics mainly in the near SN direction. Based on these, we propose that the "overpass-structured" electrical structure indicating the crust-mantle decoupling of the Qinling Orogenic Belt was formed under the influence of the asthenospheric flow escaping from the northeast of the Tibetan Plateau. The three-dimensional lithospheric resistivity model also shows that the high-conductivity anomaly in the middle and lower crust of the northeastern margin of the Tibetan Plateau terminates in the West Qinling Orogenic Belt at about 106.5°E and continues to migrate eastward in the form of asthenospheric flow. High conductors penetrating the crust and mantle are also found in the Weihe Graben, the East Qinling Orogenic Belt, the circular rift zone around the Ordos Basin, and even the northern Ordos Block, considered a stable craton. This may represent upwelling of northeastward escaping asthenospheric flow along rift zones and areas of structural weakness. We propose that this asthenospheric flow and upwelling transformed the lithospheric mantle in the Qinling Mountains and the central and western parts of the North China Craton through thermal erosion.

Keywords: Eastern margin of the Tibetan Plateau, Qinling Orogenic Belt, 3D resistivity model, Channel flow, Asthenospheric flow

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