Magnetotelluric evidence for asymmetric simple shear extension and lithospheric thinning in South China

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Extension and rifting of the lithosphere is fundamental to the evolution of the continents, but the mechanism by which the lithosphere thins remains enigmatic. Using new dense magnetotelluric array data collected within the rifted margin and adjacent areas of Southeast China (Figure 1), we resolve the three-dimensional electrical structure of the lithosphere to constrain the process of rifting and thinning. Our measurements discover a brittle-ductile transition zone featuring low electrical resistivity and low seismic velocity in the Cathaysia Block. A southeast-directed dip is resolved for the Jiangshan-Shaoxing Fault that documents the Neoproterozoic suturing of the Yangtze and Cathaysia Blocks, and has been reactivated by the Early Paleozoic and Early Mesozoic intracontinental orogenies. It acted as a low-angle detachment fault during the Mesozoic extension and rifting. Given the asymmetries of topography, electrical resistivity, Bouguer gravity anomaly and Mesozoic volcanism across the Gan-Hang Rift, an asymmetric simple shear extension model is proposed for the South China Mesozoic rift system. Water content of up to 0.1 wt% and melt fraction of up to 1% are estimated at 70 km depth beneath the central Wuyi Mountains, suggesting hydration of the mantle lithosphere. The hydration weakening of the mantle lithosphere promoted both the gravitational instability and convective removal of the lowermost lithosphere in South China.

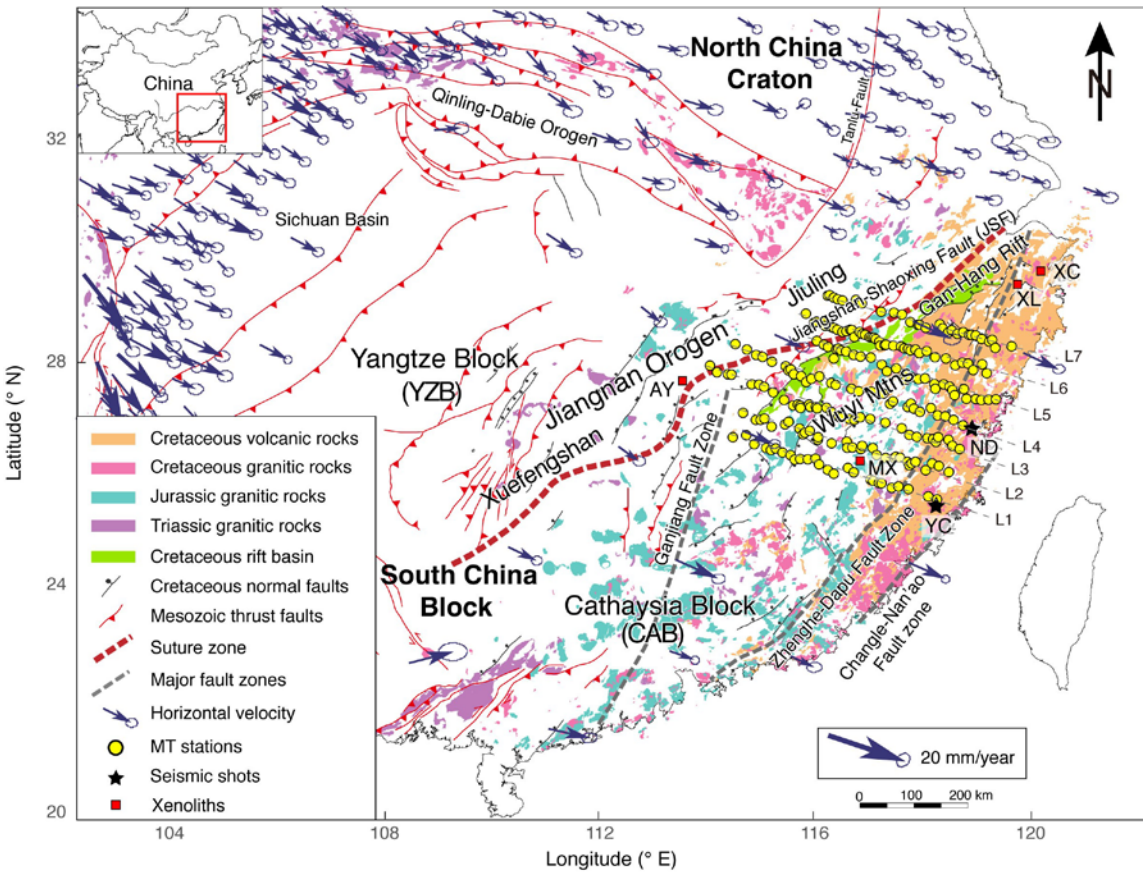

Figure 1. Simplified tectonic map of the South China.