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Extension discrepancy distribution of the hyper-thinned continental crust in the Baiyun Rift, northern margin of the South China Sea

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It has been widely reported that extension of the upper crust measured from faulting is far less than the lower crustal thinning at rifted continental margins. This phenomenon is referred to as “extension discrepancy”. However, recent studies found out not all rifted margins had experienced a crustal thinning increasing with depth. Here, we use observations from 3D seismic reflection data that cover the Baiyun Rift, to explore the extension discrepancy between the brittle extension and crustal thinning when the crust of the Northern South China Sea margin thinned from 30km to <12km. To achieve this, first, we restored the rift system of the Baiyun Rift in the absence of post-rift sediments and water loading. Subsequently, we applied alternative methods based on the fault geometries and the crustal thickness ratios to compare the deformation of the brittle crust and the whole crust. Results show (1) the upper crustal faulting was sufficient to explain the whole crust thinning in the basin center, indicating no extension discrepancy; (2) near the rift flanks, the upper crustal faulting is greater than the whole crustal thinning, indicating inverse discrepancy. In the northeast of the Baiyun Rift where detachment faulting occurred, magmas passively upwelled and thickened the crust due to isostasy. Consequently, the lower crust was exhumed locally during the detachment faulting. These results indicate the hyper-thinning process of the continental crust in the Northern South China Sea was substantially dominated by tectonic extension rather than thermal thinning.