Deep velocity structure of the northwestern South China Sea continental margin

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Seismic reflection and refraction data acquired from both onshore and offshore in the South China area and on the continental shelf of the northern South China Sea passive margin provide new constraints on the P-wave velocity structure beneath the continental shelf and contribute to constructing a continental rift evolution model. Multichannel seismic data on the continental shelf have been used to image the rift-related shallow structural units of the Pearl River Mouth Basin across the northwestern margin of the South China Sea. The Hainan Uplift, Zhu 3 Depression and Shenhu-Ansha Uplift zones are bounded by normal faults or listric-normal faults, which suggest lithospheric extension on the continental shelf. Based on the crustal thicknesses and P-wave velocities derived from the velocity structure of the seismic profile OBS2010‐2 across the continental shelf, two distinct domains are identified: (a) the thinned/extended continental crust and (b) the transitional crust. The thinned continental crust has a thickness of 25–27 km across the Hainan Rise, decreasing to 21–23 km further south in the rift and faulted depression zone. The transitional crust is characterized by a thickness of 20‐21 km. High‐velocity values (>7.0 km/s) in the lower crust of the transitional domain may indicate possible magmatic underplating during rifting. Our results show that the Cathaysia Block extends from onshore South China to offshore into the South China Sea and is bounded by the transitional crust of the continental shelf. Crustal thinning on the continental shelf of the South China Sea can be produced by lateral mantle flow within the hotter regional lithospheric background. The initial rifting of the continental margin occurred in the rift and faulted depression zone and might be explained by the upwelling of the lithosphere based on a depth-dependent extension mechanism during the late Cretaceous or Paleocene rifting.