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Thermo-rheological structure of the northern margin of the South China Sea: structural and geodynamic implications

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Rheological properties of continental lithosphere are key controls on the behavior of continental deformation. Using thermal structure, constrained by surface heat flow data and measured thermal properties of rocks, the present study calculates different thermo-rheological structure scenarios for the ocean–continent transition (OCT) at the northern margin of the South China Sea, using two different models: a conventional model, taking into account frictional sliding and power-law creep, and a model that additionally includes a high-pressure brittle-fracture mechanism. Two compositions of the lower part of the lithosphere are considered: a soft case with felsic granulite lower crust and wet peridotite lithospheric mantle, and a hard case with mafic granulite lower crust and dry peridotite lithospheric mantle. The former scenario shows a major rheological change from a “jelly sandwich” to a “Christmas tree” type of rheology from north to south along the margin. This complex rheological structure explains lateral changes in earthquake distribution and geometries of extensional faults of the OCT at the northern margin of the South China Sea. Further, our analyses indicate that the initial lithospheric rheology profile probably has only one ductile layer in the lower part of upper crust. Such an initial lithospheric rheology model predicts focused extension to form asymmetric margins, which is the case for the SCS.

Keywords: Ocean-continent transition; Crustal strength; Thermo-rheology; South China Sea; Pearl River Mouth basin