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Linking contrasting along-strike lithospheric structure of the Tibetan Plateau to the multi-terrane structure

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The Tibetan plateau is manifested by contrasting along-strike lithospheric structure, but the formation mechanisms and its relationship with the heterogeneous multi-terrane structure of the Tibetan plate is a challenging problem. We conducted 2D thermomechanical numerical models to explore the role of geometric shape of the multi-terranes in forming the along-strike contrasting lithospheric structure beneath the Tibetan plateau. As a simplification, the Tibetan terranes are incorporated into two adjacent terrane proxies bordered by the Jinsha River suture in models, according to their thermo-mechanical properties and pre-Cenozoic tectonic evolutions. Specifically, the Lhasa and Qiangtang terranes are regarded as a strong terrane; all the terranes south of the Jinsha River suture are integrated into a weak terrane. The model results reveal two distinct collision modes. In the first one, the lithospheric mantles of both the strong and weak terranes in the Tibetan plate are completely detached, followed by the underthrusting of Indian lithosphere beneath the whole plateau. In contrast, the other mode is characterized by partial or full preservation of the strong terrane between the subducting India and North China Plate with an asthenospheric window beneath the collision zone. These two collision modes are broadly consistent with the deep structures of western and central–eastern Tibet, respectively, which are strongly dependent on the width of the strong Lhasa–Qiangtang terrane, whereas the total width of the weak terranes south of the Jinsha River suture has only minor influences.