Paper Number: 3117

"Split personality" behaviors of the Longmenshan Fold Belt: suggest a NE growth toward Tibet since 40 Ma

Jiang, X.D.[1], Li, Z.X.[2]

[1]Ocean University of China, Qingdao, China
[2] Curtin University, Perth, Australia

The mechanisms responsible for both the topographic uplift and crustal thickening of the Tibetan Plateau remain controversial. Two groups of end-number models have been proposed to explain the uplifting and deformation of this eastern margin of the plateau: crustal shortening by faulting and extrusion, or inflation by the lower crust's viscous flow. However, the lower GPS shortening rates and underdeveloped Cenozoic foreland could not provide explanation for upper crustal thrusting model. And the lower crustal flow model not fit the Wenchuan M7.9 earthquake. In this study, high-quality gravity data combined with earthquake data along the transects across the Longmenshan Fold Belt (LFB) are used to re-examine the lithospheric deformation and plateau expansion models for the eastern margin of the Tibetan Plateau.

A new gravity survey was conducted at 231 stations along two transects that start from the Sichuan Basin and cross the LFB into eastern Tibetan Plateau. The flexural models of the Airy isostasy, a continuous plate model, and a two-plates model with laterally varying rigidities were tested along the two transects. For the central-northern LFB transect, no elastic strength across the LFB is required to fit the gravity data with the flexural modeling, which suggests that the LFB cut through the entire lithosphere beneath it and the crust is nearly isostatically compensated here. In contrast, the preferred model for the lithospheric structure beneath the southern LFB includes a moderately stiff Sichuan plate under thrusting the eastern plateau.

In order to quantify the contribution of the flexural-isostatic deformation uplifting in response to mass-movement and denudation along the eastern margin of the Tibetan Plateau, an isostatic uplifting calculation was performed by following the methodology of Gilchrist. Modeling suggests that mountain building should be produced by the combined uplifting of the active tectonic and approximately isostatic orogenic at the central-northern LFB. The flexural-isostatic deformation uplifting is estimated quantitatively. The high topography is predominately a consequence of tectonic strike-slip uplifting with thick-skinned thrusting and ~30% contribution from the flexural-isostatic uplifting assuming local isostatic compensation.

The modeling reveals two different tectonic models for the eastern margin of Tibet ：one is a strike-slip accompanied by a small amount of thrust of thick-skinned and crust local isostatic at the central-northern LFB ; and the other is a thin-skinned thrust at the southern LFB. The weight of the plateau is not transferred eastward into Sichuan because of the low strength lithosphere along the central-northern LFB, where the effective elastic thickness Te is approximately zero and the crust has isostatic compensation. This statement provides a plausible explanation for the absence of a typical coeval foreland flexural basin at the range front because of mechanical coupling of the lithosphere and strike-slip mainly with a steeply dipping fault plane of the northern LFB. This result suggests that some of the excess mass from the elevation of the Tibetan Plateau would be compensated through flexure of a continuous lithospheric plate with an elastic thickness of 30-50km when the southwestern Sichuan underthrusts along the southern LFB. Large magnitude low angle thrust faults are present along the southern LFB with dips in the moderate fault plane. The thin-skinned thrust-fold deformation in the southern LFB causes crust shortening and elevation uplifting. This behavior result in the folding at the mountain front that generates the foreland basin in the corner of the southwestern Sichuan basin.