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# Formation mechanism of the eastern Tibetan margin: implication of numerical studies

Lin Chen (1,2), Gerya Taras (2), Zhongjie Zhang (1), and Guizhi Zhu (2)

(1) Institute of Geology and Geophysics, Chinese Academy of Sciences,10029, Beijing, China (chenlin@mail.iggcas.ac.cn), (2) Department of Geosciences, Swiss Federal Institute of Technology (ETH-Zurich), CH-8092 Zurich, Switzerland

The eastern margin of the Tibetan Plateau, where the Longmen Shan (LMS) locates and the devastating Wenchuan earthquake occurred, is characterized by a steep topographic transition from the plateau in the west to the Sichuan Basin in the east (Clark et al. 2005). In contrast to other margins of the plateau, no significant shortening has been observed across the LMS from GPS measurement (Chen et al. 2000). In addition, seismic detection results reveal that there are great differences in crustal and lithospheric structure between the eastern Tibet and the Sichuan Basin (Wang et al. 2007; Zhang et al. 2009; Robert et al. 2010; Zhang et al. 2010). These observations open an important question on the nature of mountain building process. Therefore, the LMS is a key area to test different geodynamical models proposed to describe the mountain building process and the evolution of this region.

In this study, we use petrological-thermomechanical models to investigate the geodynamic mechanism of the uplift of LMS. We set up our models based on various observations in this region, including crustal and lithospheric structure data revealed by seismic detection, density inverted by gravity abnormal data, denudation rate and sedimentation rate derived from thermochronology study, and so on. The numerical investigations were conducted in two dimensions along west-east profile using the thermo-mechanical code I2VIS (Gerya and Yuen, 2003a). This code is based on conservative finite differences and non-diffusive marker-in-cell technique taking into account visco-plastic rheologies. Surface processes are implemented using a gross-scale erosion sedimentation law (Gerya and Yuen, 2003b). The numerical modeling results are mainly constrained with the observed topography and heat flow in this area.

Two distinct types of geodynamic model are investigated in detail. One is obstacle-delamination model, the other is lower crust channel flow model (take channel flow model for short). The former model exhibits that the lithosphere on the left of the interface is constantly thickening due to the obstacle of the stiff Sichuan basin to the eastward movement of the plateau. As the thickening of lithosphere accumulates big enough, lithospheric mantle delamination occurs because of gravity instability. The predicted topography drops at the place of delamination happened. On the whole, the calculated topography is totally similar to the observed one in shape, although the amount doesn't match well. The latter model (channel flow model) is conducted based on the setting of the LMS. The crust in the west block is thicker than the east, and a partial molten middle crust is intentionally set to the west block. The results indicate that the eastward movement of the plateau is inhibited by the Sichuan basin block and the partial molten middle crust is forced to move upward. Again, the calculated topography is similar to the observed one in shape, but differs in amount. We also systematically vary a series of parameters (including convergent rate, erosion rate, and sedimentation rate, etc) to check their independent effect on results.