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The Rheological Structure of the East Tibetan Plateau

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The rheological structure of the lithosphere can be calibrated with seismic activities. We intensively use the seismic focal depths from 2072 events occurring in Longmenshan Fold Belt (LFB) area to identify the transition from brittle failure to ductile with depth in the lithosphere. The earthquakes were monitored by China Earthquake Network Center (CENC) from 01/07/1970 through 31/08/2010 with magnitude larger than 3.5 at 88 earthquake stations with a depth error bar of $\pm$2km. Among the 2072 seismic events, 82 of them have a magnitude larger than 5 and were recorded simultaneously by the NEIC and CENC since January 1, 1990. The parameters of the 82 events recorded by both institutions are in close agreement.
Most of the earthquakes in LFB and its vicinity occurred at depths from 2 to 36 km. However, there are 3 extras with focal depth at 39, 44 and 60 km respectively. All these three events occurred in Sichuan Basin where the lithosphere is not decouple between the crust and the upper mantle so that the brittle failure is able to propagate all the way from the crust to the upper mantle lithosphere.
Because all of the seismic events in the eastern Tibetan plateau occurred at the depths less than or equal to 36$\pm$2 km deep, the 36$\pm$2 km should be a good statistical number to define the lower boundary of the elastically strong, brittle upper/middle crust. The Moho depth across LFB calculated by the 3D flexural modeling in space domain constrained by the gridded gravity database and merged our new measurement data varies considerably from about 38 km in Sichuan Basin to about 58 km beneath the eastern plateau. The Moho depths in the eastern plateau are in lower to mid 50 km deep. In the other words, the thermally depending ductile, weak lower crust is rheologically defined the depths from 36$\pm$2 km to over 55 km. The lower crustal mobility varies according to the increase of the Moho depth.
Our gravity modeling indicates that the eastern Tibetan lithosphere has some degree of mechanical strength, which a continuous elastic plate below LFB with effective elastic thicknesses (Te) gradually changing from 50 km in Sichuan Basin to 30 km beneath the eastern Tibetan plateau. The rheological structure of the east Tibetan plate based on the lithospheric strength and geo-statistics from earthquake focal depths discussed suggest that the eastern Tibetan lithosphere including the upper crust, the lower crust and the upper mantle lithosphere is not deformed on the same pace but has a decoupled. And the mobility of the lower crustal flow is correlated with the variation of the crustal thickness defined by the Moho depth even under a temperature structure of normal geothermal gradient because the strength of the ductile flow depends on the crustal temperature variation.