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Crustal scale deformation history of the Longmen Shan inferred from thermal, thermo-barometric and structural data

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High mountains with a steep topographic gradient subsists in the Longmen Shan (Sichuan, China) at the eastern boundary of the Tibetan plateau. However, there is almost no significant present day horizontal shortening (< 3mm/yr) across this range as shown by GPS measurements (Chen et al., 2000 ; Gan et al., 2007 ; Shen et al., 2009).
Two main crustal models for the uplift and the evolution of the Tertiary of the Longmen Shan are commonly proposed. The first one explains the uplift by faulting and crustal shortening (Tapponnier et al., 2001) whereas in the other one, the uplift is a consequence of the inflation of a ductile lower crust (Burchfiel et al., 2008).
A recent seismological study using the receiver functions technique images a very steep 20km Moho step between the Tibetan crust (63km thick) and the Yangtze craton (44km thick) (Robert et al., in press) which brings new constraints on the crustal structures and confirm that we have to consider the entire lithosphere into evolution models of this mountain belt.
We present a structural, thermal and thermo-barometric study on two East-West cross-sections across the Longmen Shan which brings new constraints on the thermal structure of the belt. These new data allow the identification of the major zones of exhumation which can be assigned to different tectonic phases.
The jump in crustal thickness is located at the apex of the Wenchuan shear zone. It marks the western boundary of the metamorphosed units of Songpan Garze characterized by temperatures varying from 590°C down to 300°C as commonly observed in mature accretionary wedges. The major front is the Beichuan Fault Zone which brought the internal zones onto Triassic and Jurassic series with lower temperatures (less than 400°C).
Results emphasize on the construction of the range during at least two main tectonic events with different styles. The first tectonic stage (Indosinian orogen) corresponds to an accretionary wedge of sediments thrusted over the margin of the continental crust of the Yangtze craton. However, the Neogene reactivation is a consequence of the formation of the Tibetan plateau and the associated crustal thickenning which began during the Tertiary. We propose a new crustal scale scheme where the entire thick Tibetan crust is considered as a soft thick material abutting the cold and resistant Yangtze crust.