Tracking basement cross-strike discontinuities in the Indian crust beneath the Himalayan orogen using gravity data – relationship to upper crustal faults

Laurent Godin[1], Lyal B. Harris[2]

[1] Department of Geological Sciences & Geological Engineering, Queen's University, Kingston, ON K7L 3N6, Canada, godinl@queensu.ca
[2] Institut national de la recherche scientifique, Centre – Eau Terre Environnement, 490 de la Couronne, Quebec City, QC G1K 9A9, Canada

The Himalaya is the result of the on-going convergence and collision of India and Asia, two plates with complex and protracted geological evolutions. The internal configuration and processes that govern the rise of the Himalaya and Tibetan Plateau are crucial to understand continental collision zones. However, knowledge of the prior configuration of the colliding plates is equally important, since inherited (pre-orogenic/basement) structures can undeniably influence the development of the orogenic architecture throughout the orogen's cycle of collision and eventual collapse. Three northeast-trending palaeotopographic ridges of faulted Precambrian Indian basement underlie the Ganga Basin south of the Himalaya (Oil and Natural Gas Commission 1968; Valdiya 1976; Gahalaut & Kundu, 2012). Our study (Godin & Harris, 2014) illustrates a crustal-scale fault origin for these ridges and succeeds in determining how far north beneath the Himalayan system they extend and how they ultimately govern the location of upper crustal faults in southern Tibet.

Spectrally filtered EGM2008 Bouguer gravity data and edges in its horizontal gradient at different source depths ('gravity worms') over northern Peninsular India, the Himalaya, and southern Tibet reveal several continuous Himalayan cross-strike discontinuities interpreted to represent crustal faults (Fig. 1). Gravity lineaments in Peninsular India coincide with edges of the Precambrian basement ridges and megakinks up to 100 km wide develop in foreland cover sequences between the interpreted basement faults. The interpreted basement faults project northward beneath the Himalayan system and southern Tibet. Our results suggest that several active Himalayan cross-strike faults, such as the ones related to many graben in southern Tibet, are rooted in the underplated Indian lower crust or step *en échelon* along interpreted basement faults. Our interpretation thus suggests that south Tibet graben are spatially related to deep-seated crustal-scale faults rooted in the underplated Indian crust. These major discontinuities partition the Himalayan range into distinct zones, and could ultimately contribute to lateral variability in tectonic evolution along the orogen's strike.

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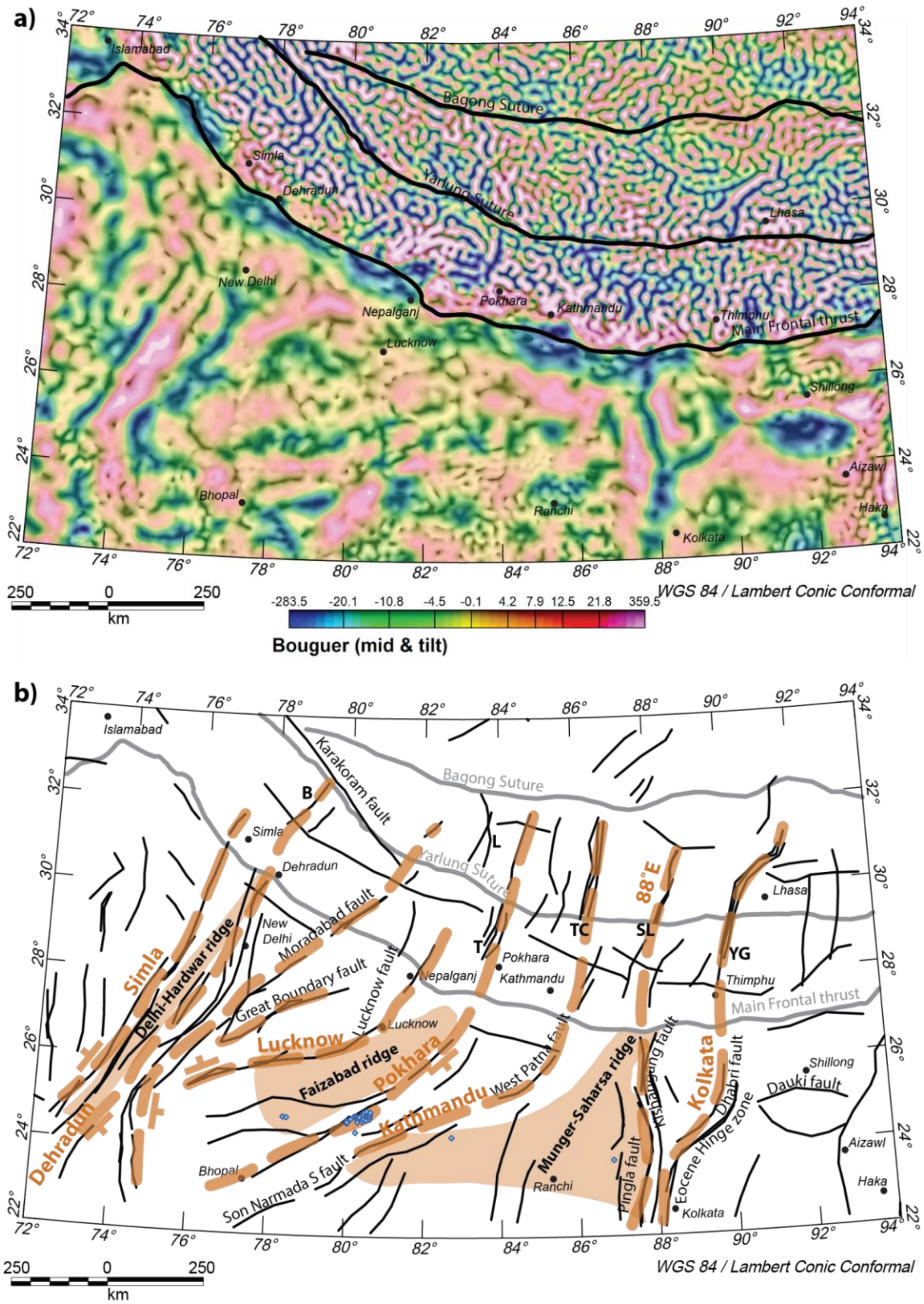

Figure 1. (**a)** Bouguer gravity map with high-frequency noise removed and data isolated to show the 'mid-' wavelength component only, on which a tilt angle enhancement was overlain. **(b)** Map showing location of the three Indian basement ridges, major graben systems developed in southern Tibet (B, Burang; L: Lunggar; TC: Tangra Yum Co; T, Thakkhola; SL, Senza-Laze; YG, Yadong-Gulu), and traces of the most important lineaments interpreted from the 'mid-' and 'long-' wavelength components of the Bouguer gravity data (black lines). The dashed light brown lines are interpreted as major cross-strike Indian basement lineaments connecting underplated Indian faults with upper crustal graben faults developed on the overlying crust north of Main Frontal thrust. Dip directions are indicated based on worm data; lineaments without one are interpreted to represent near vertical discontinuities. Blue diamonds locate known late Mesoproterozoic kimberlites and lamproites (Gregory et al. 2006; Rao 2006; Masun et al. 2009).