



**UNIVERSITY OF
CAMBRIDGE**



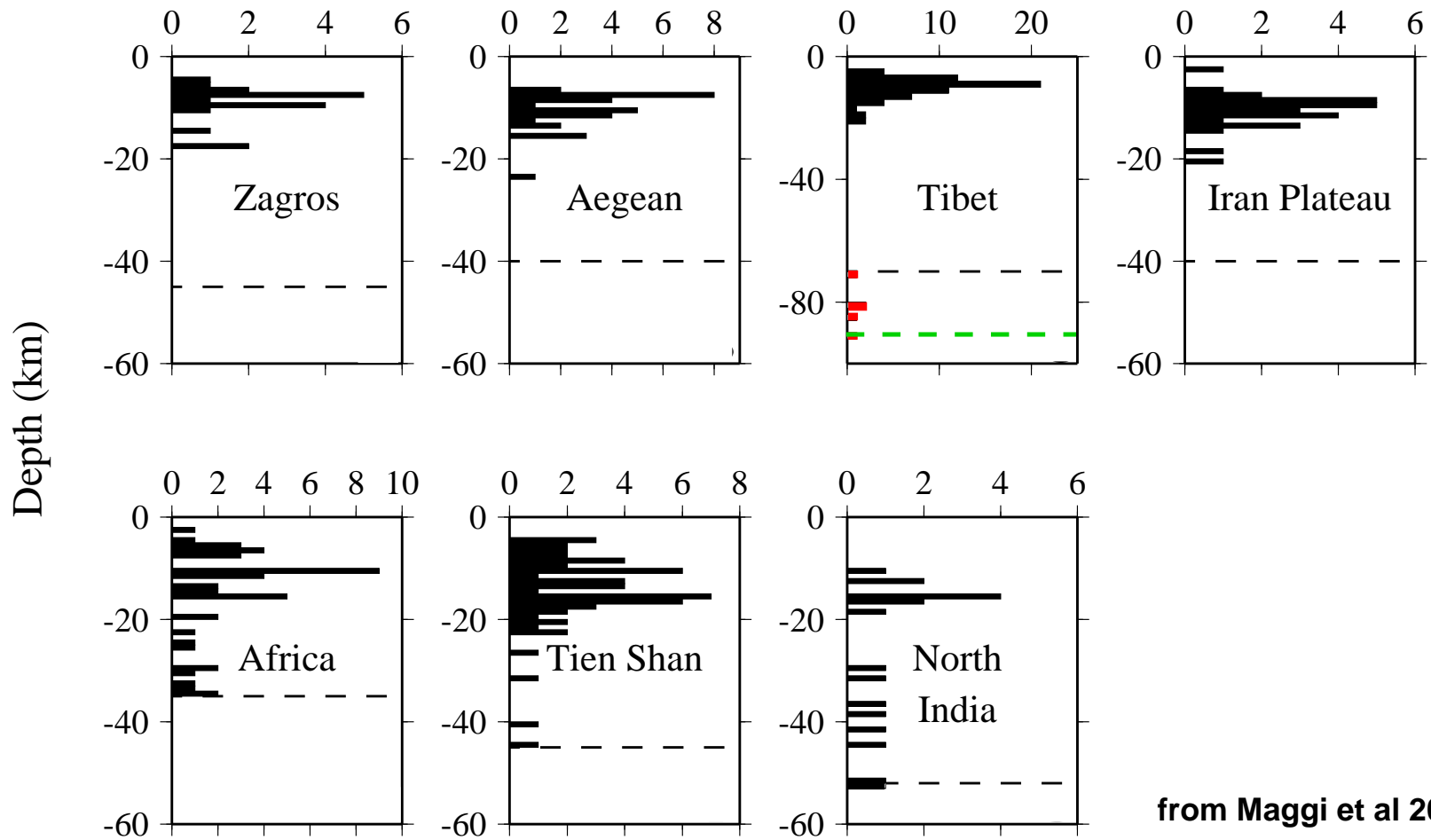
**BULLARD
LABORATORIES**

**DEEP EARTHQUAKES BENEATH THE HIMALAYA AND THEIR
RELATIONSHIP TO THE LITHOSPHERIC STRUCTURE**

Keith Priestley

(James Jackson, Eric Debayle and Dan McKenzie)

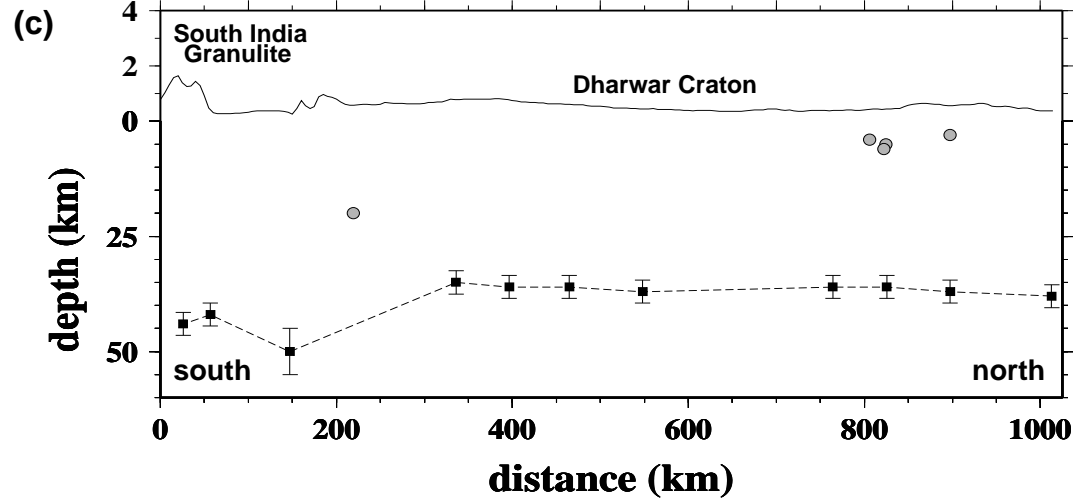
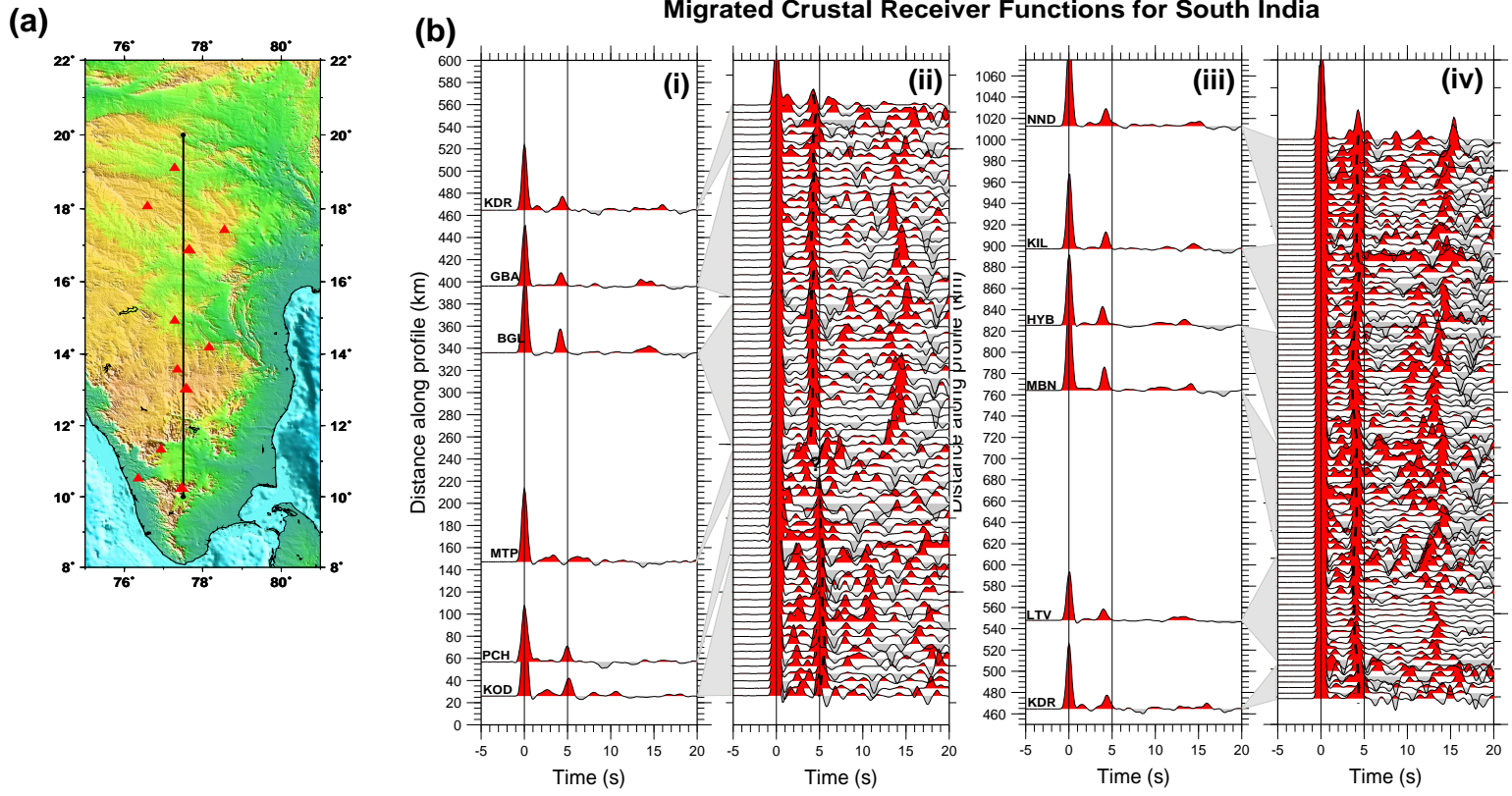
Summary of Earthquake Focal Depth



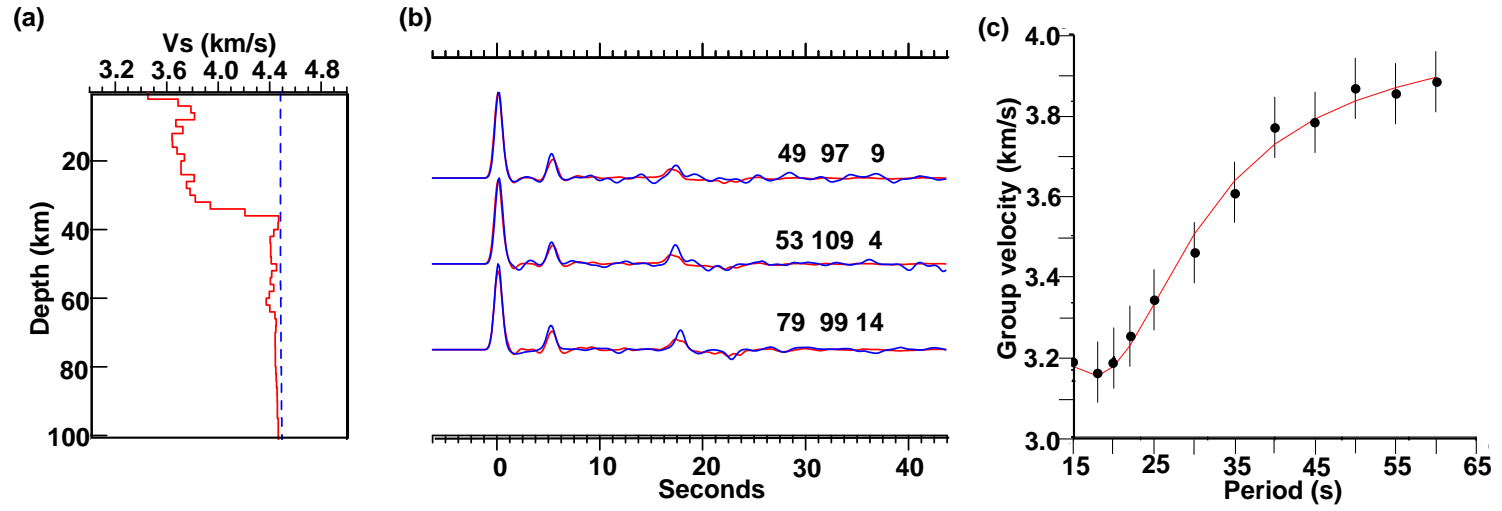
Overview

- Nature of the deep earthquakes in southern Tibet
- Variation in the seismic structure across India, the Himalaya and Tibet
- Relationship between the seismicity and the crust and upper mantle structure
- Crust and upper mantle temperature and composition and the relationship of these parameters to the earthquake distribution in Tibet

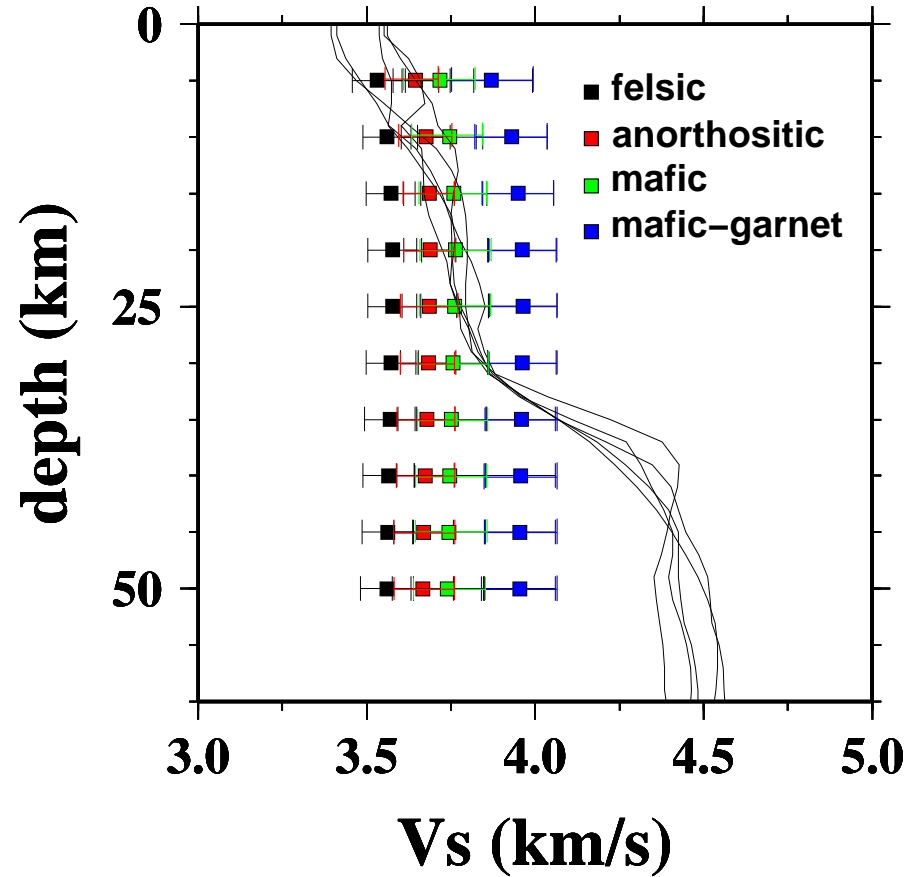
South Indian crust



Analysis of BGL receiver function / surface wave data

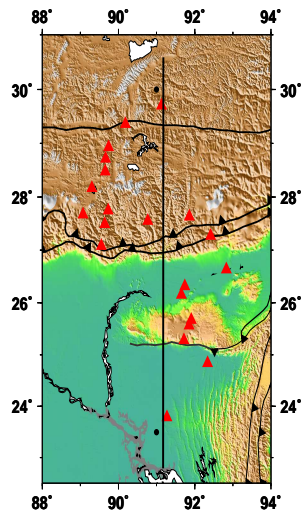


Comparison of receiver function and laboratory results



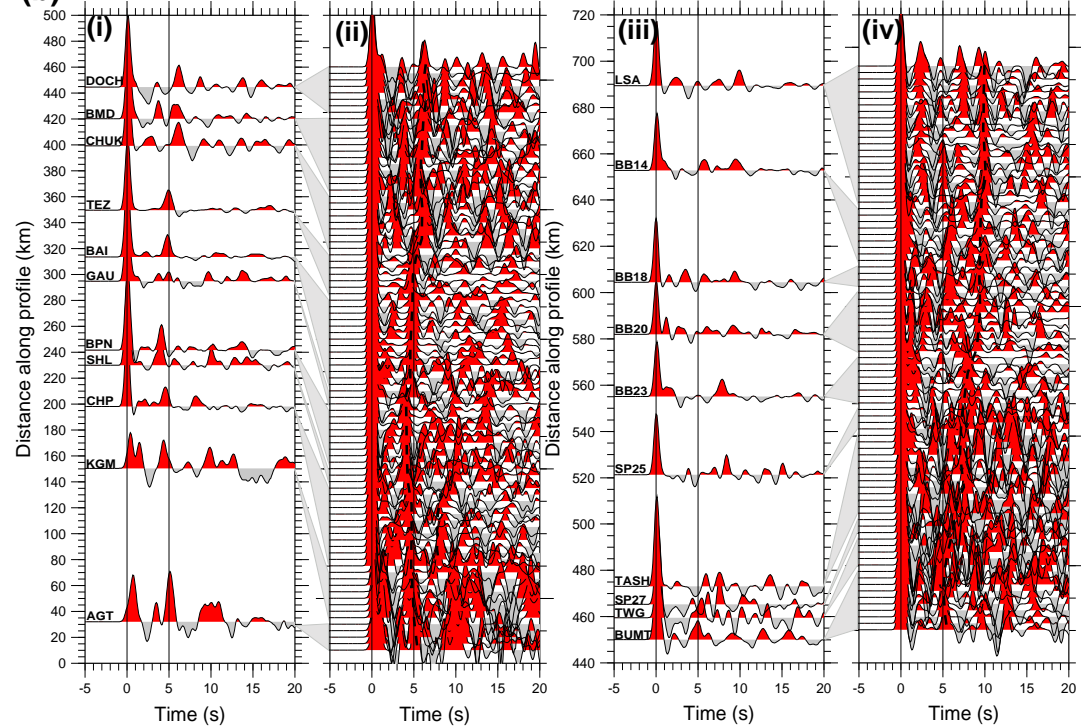
NE India -- SE Tibet crust

(a)

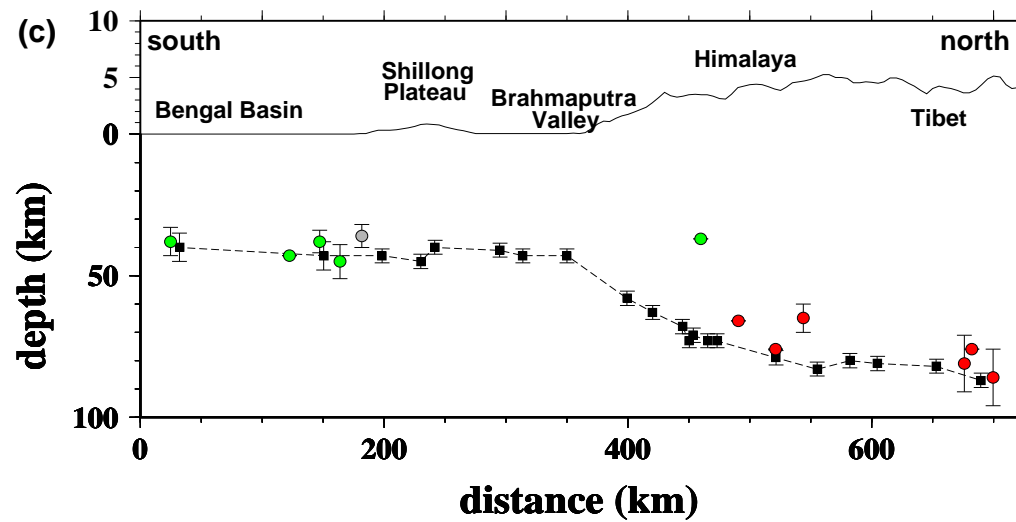


(b)

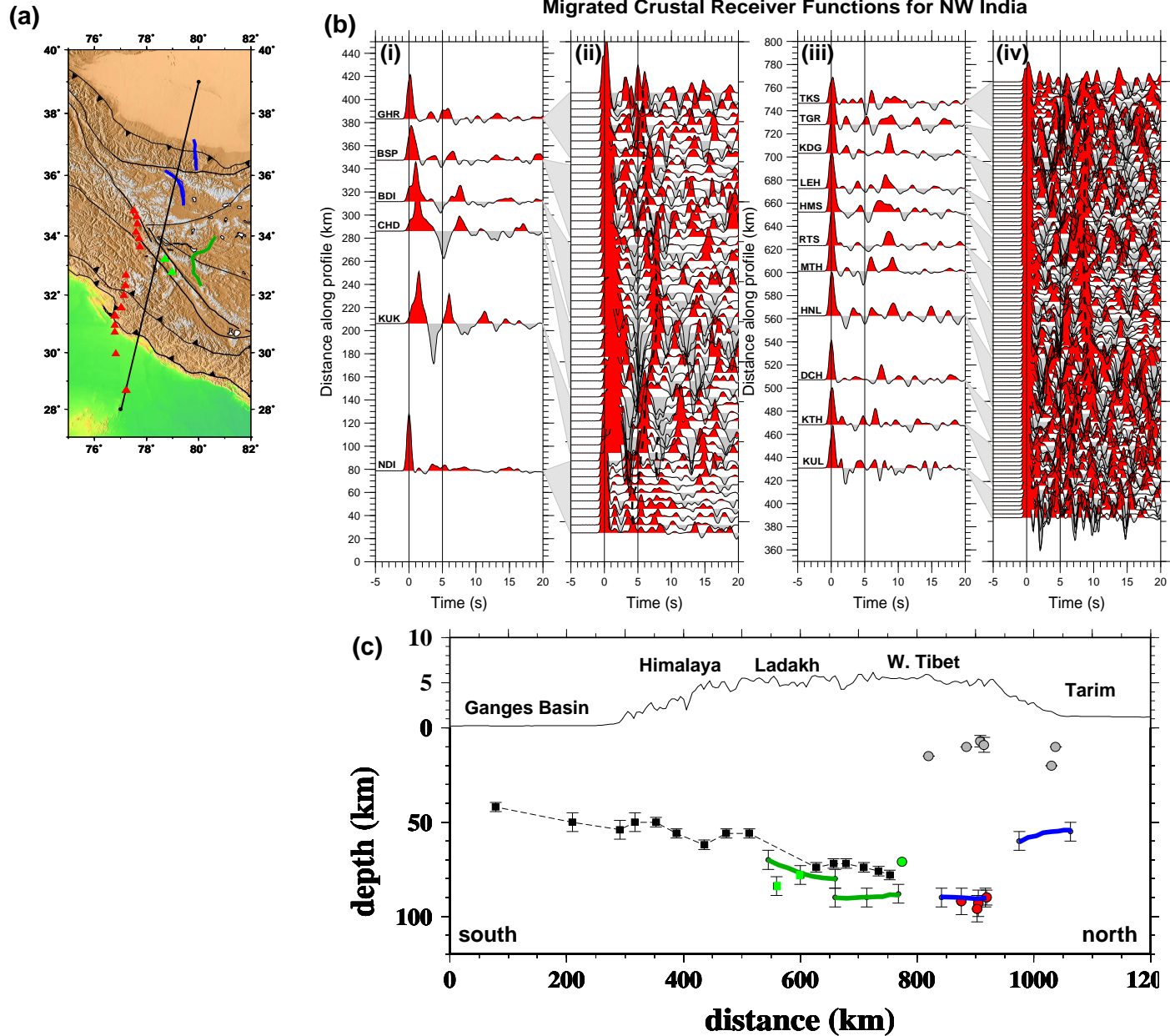
Migrated Crustal Receiver Functions for NE India and SE Tibet



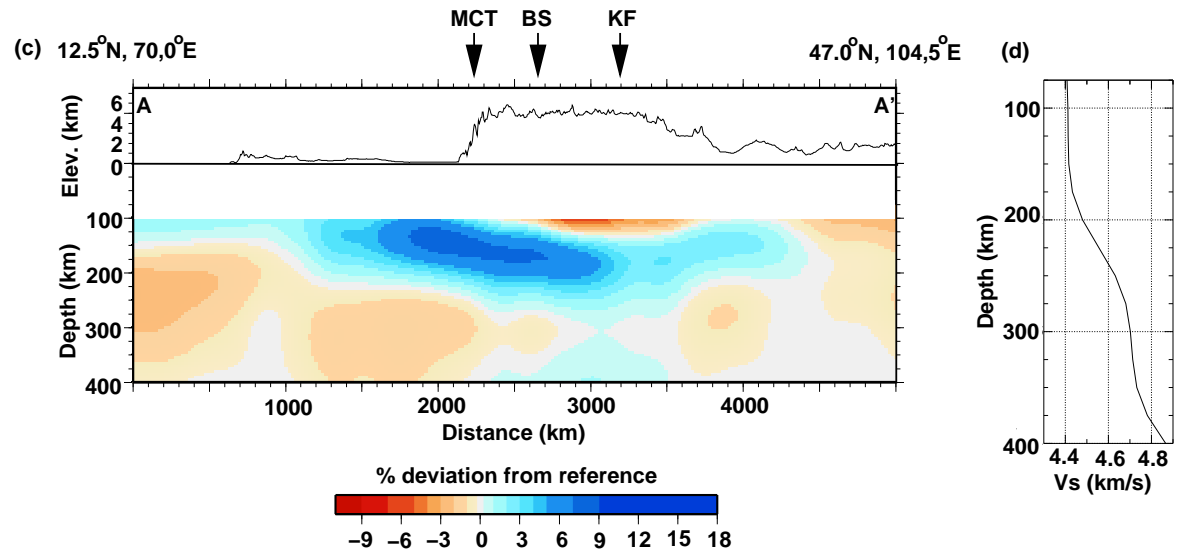
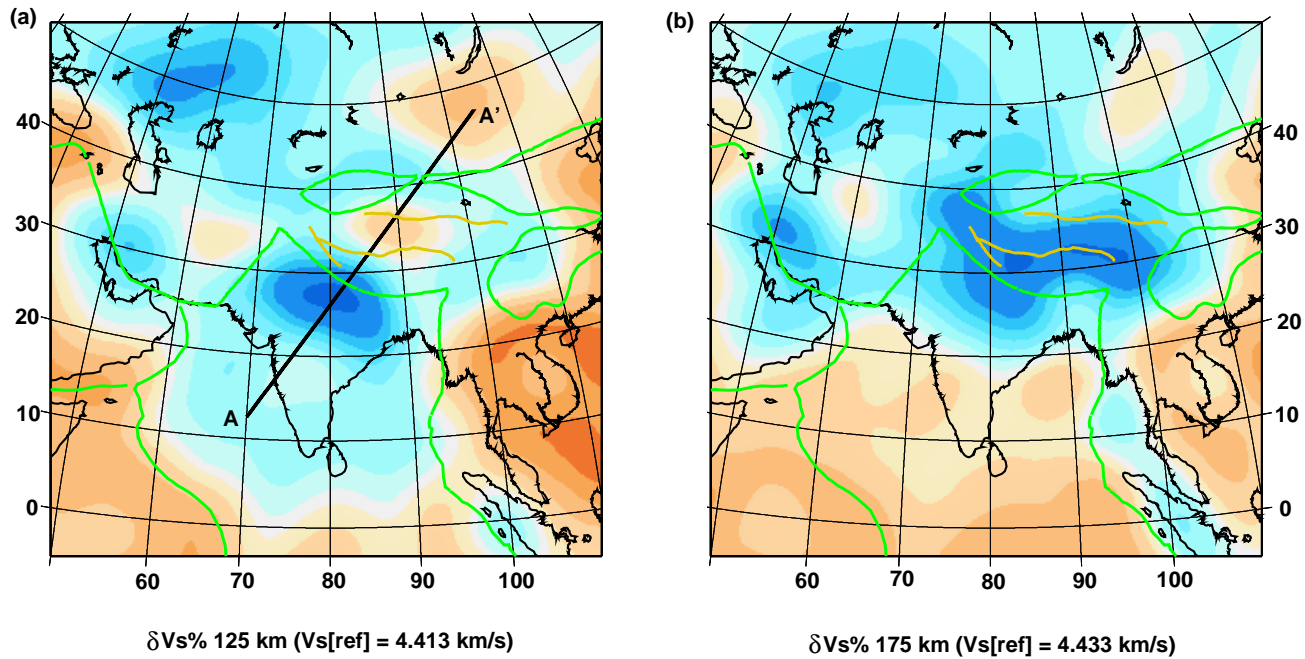
(c)



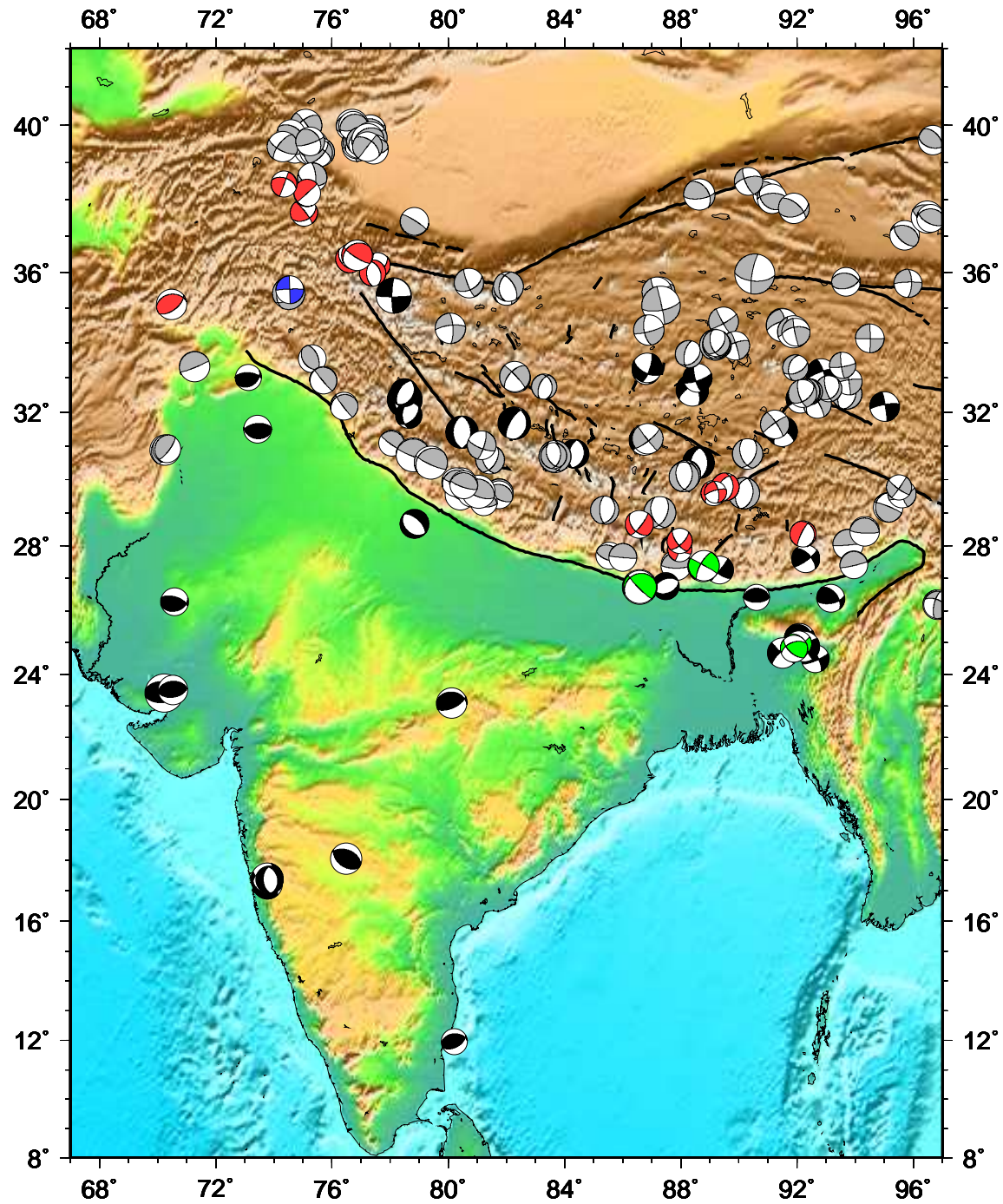
NW India -- W Tibet crust



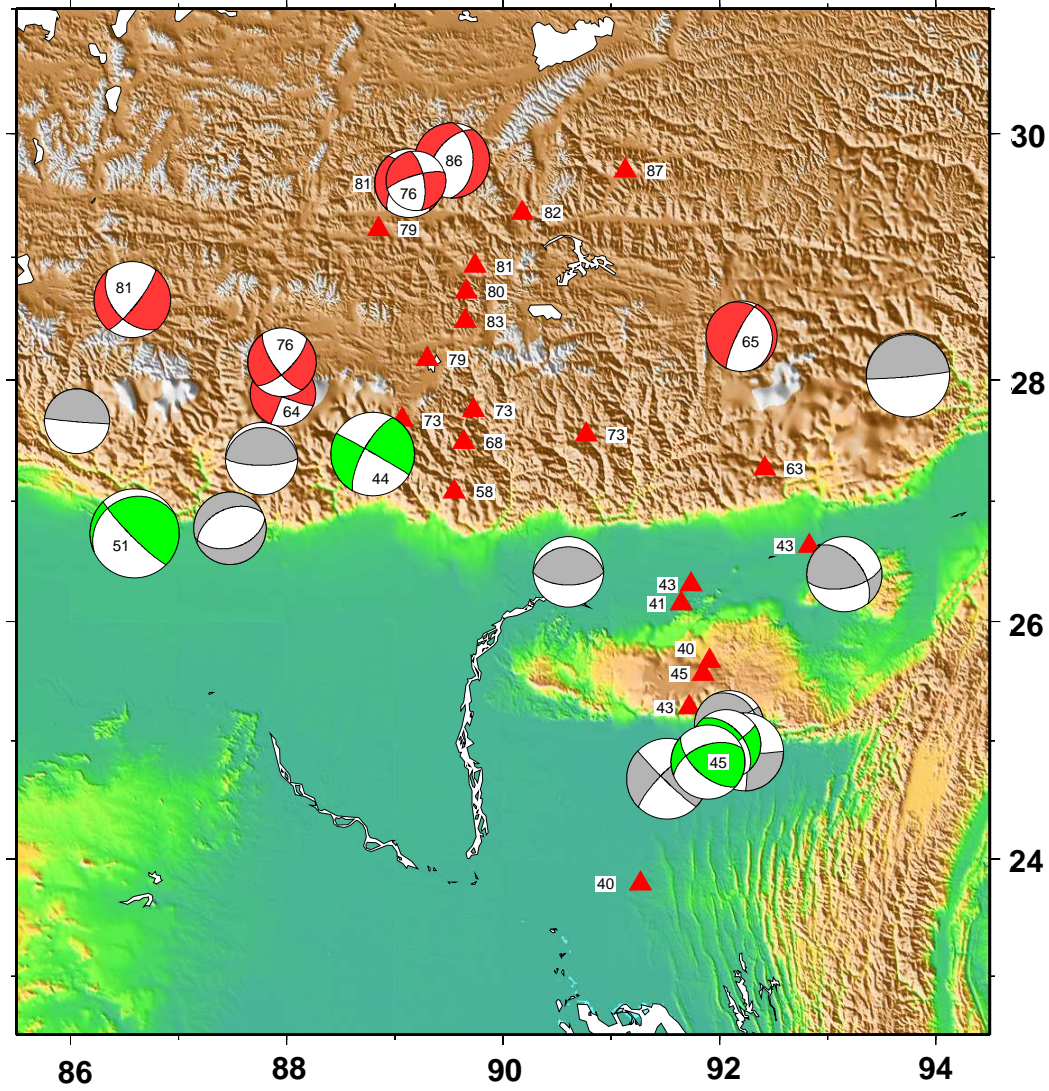
India -- Tibet upper mantle

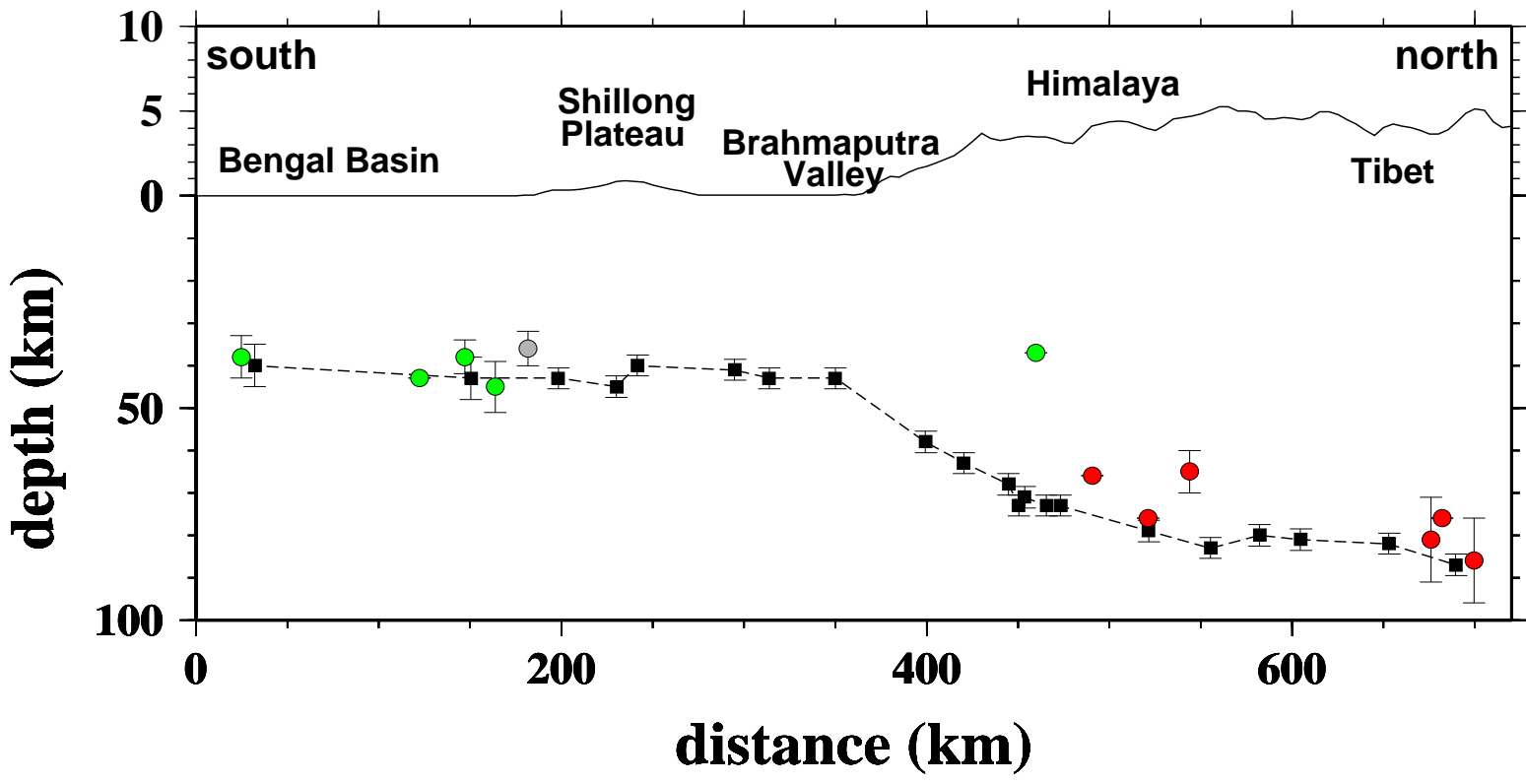


India and Tibet earthquake mechanisms and focal depths

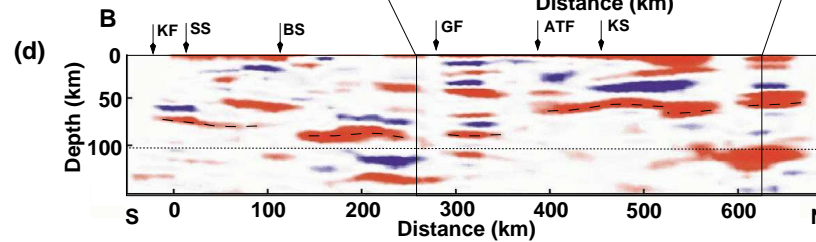
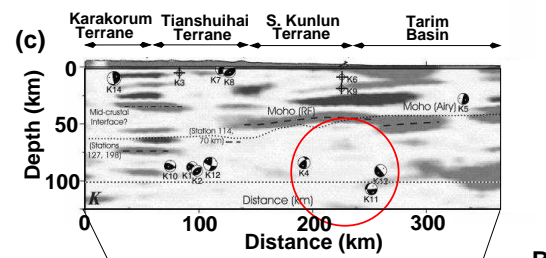
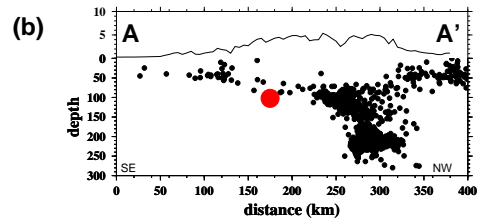
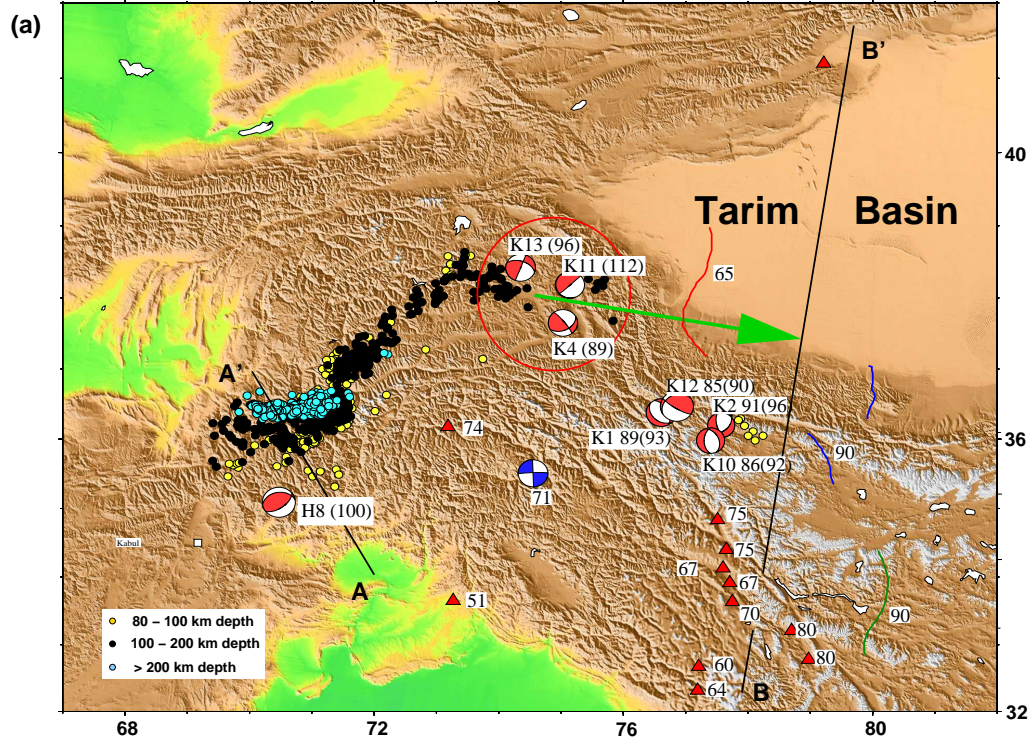


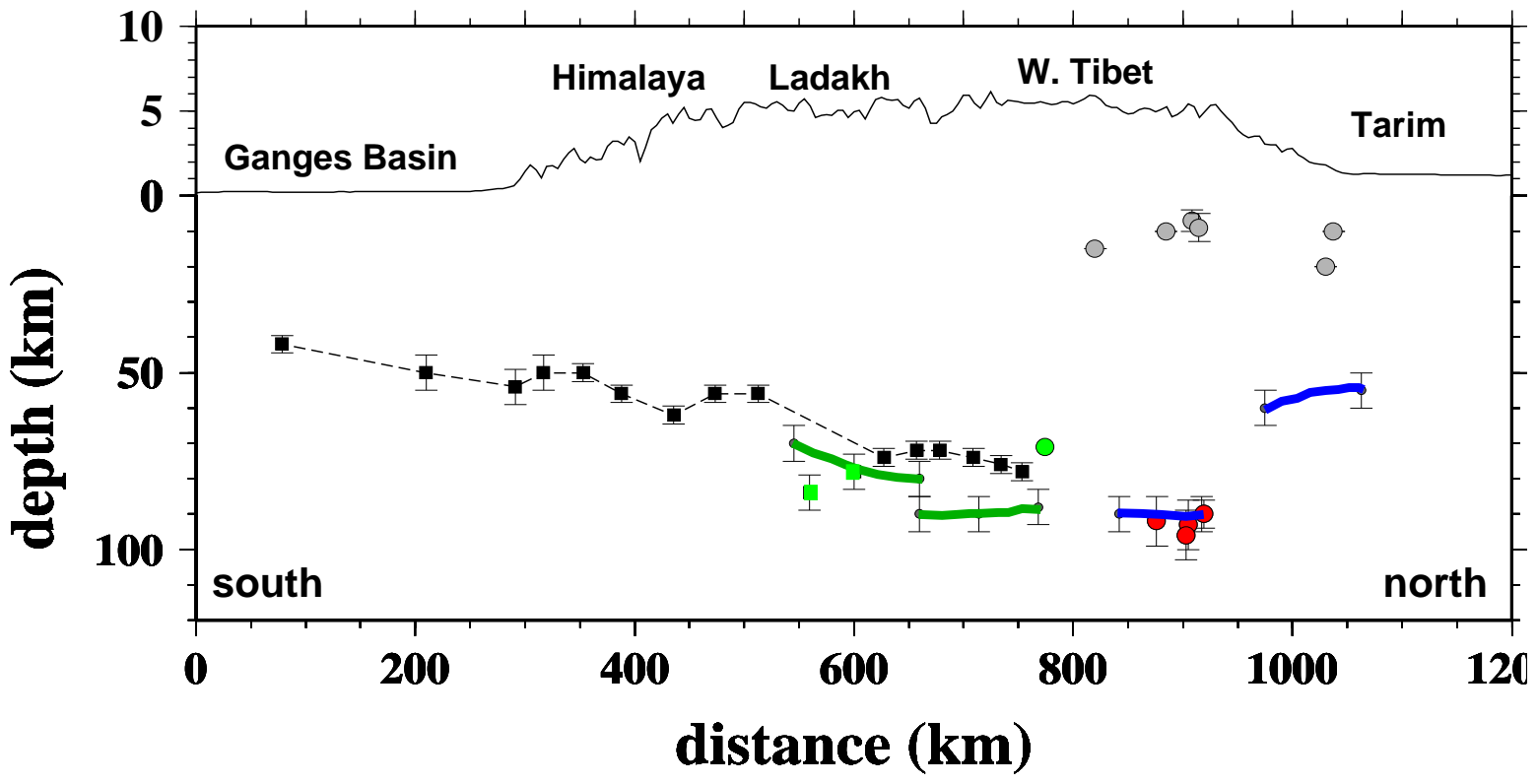
Eastern Himalaya -- Southeast Tibet Earthquake and Moho depths



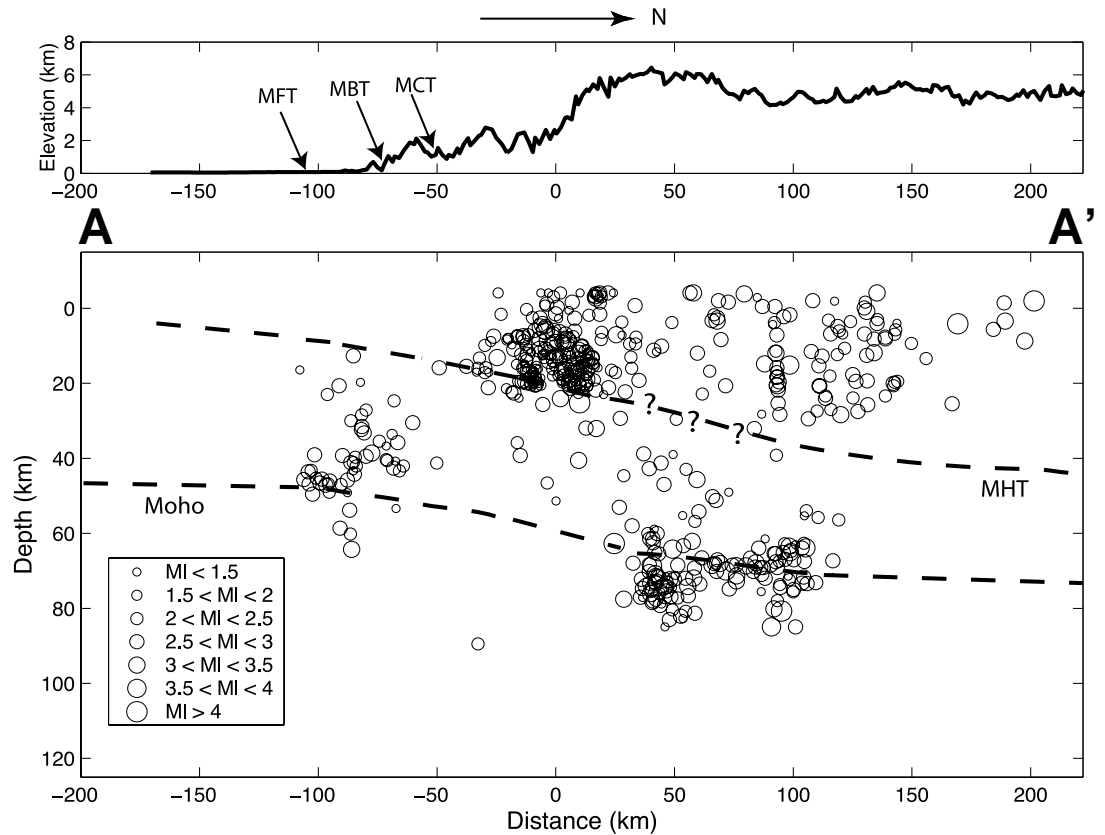
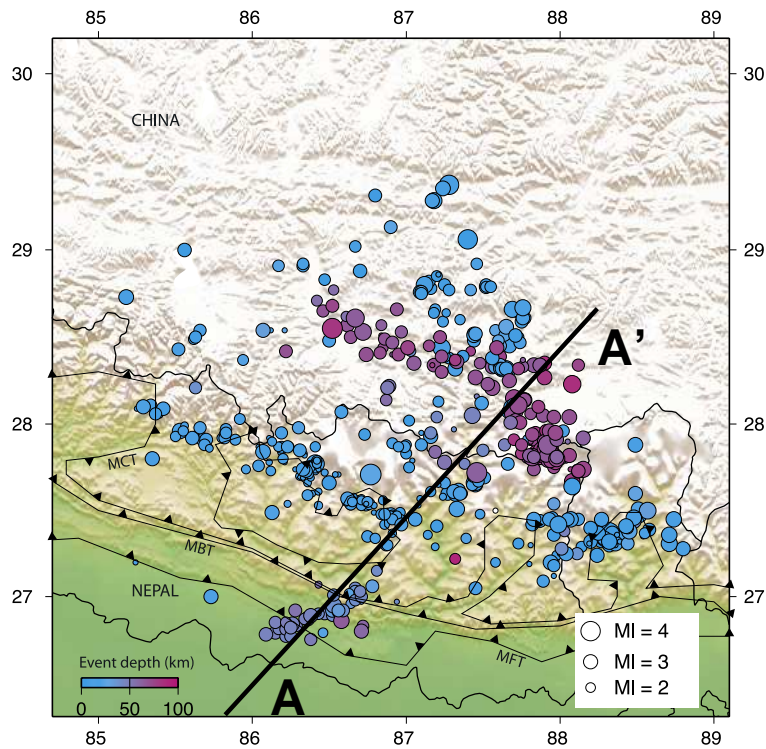


Western Himalaya and Tibet Earthquake and Moho depths



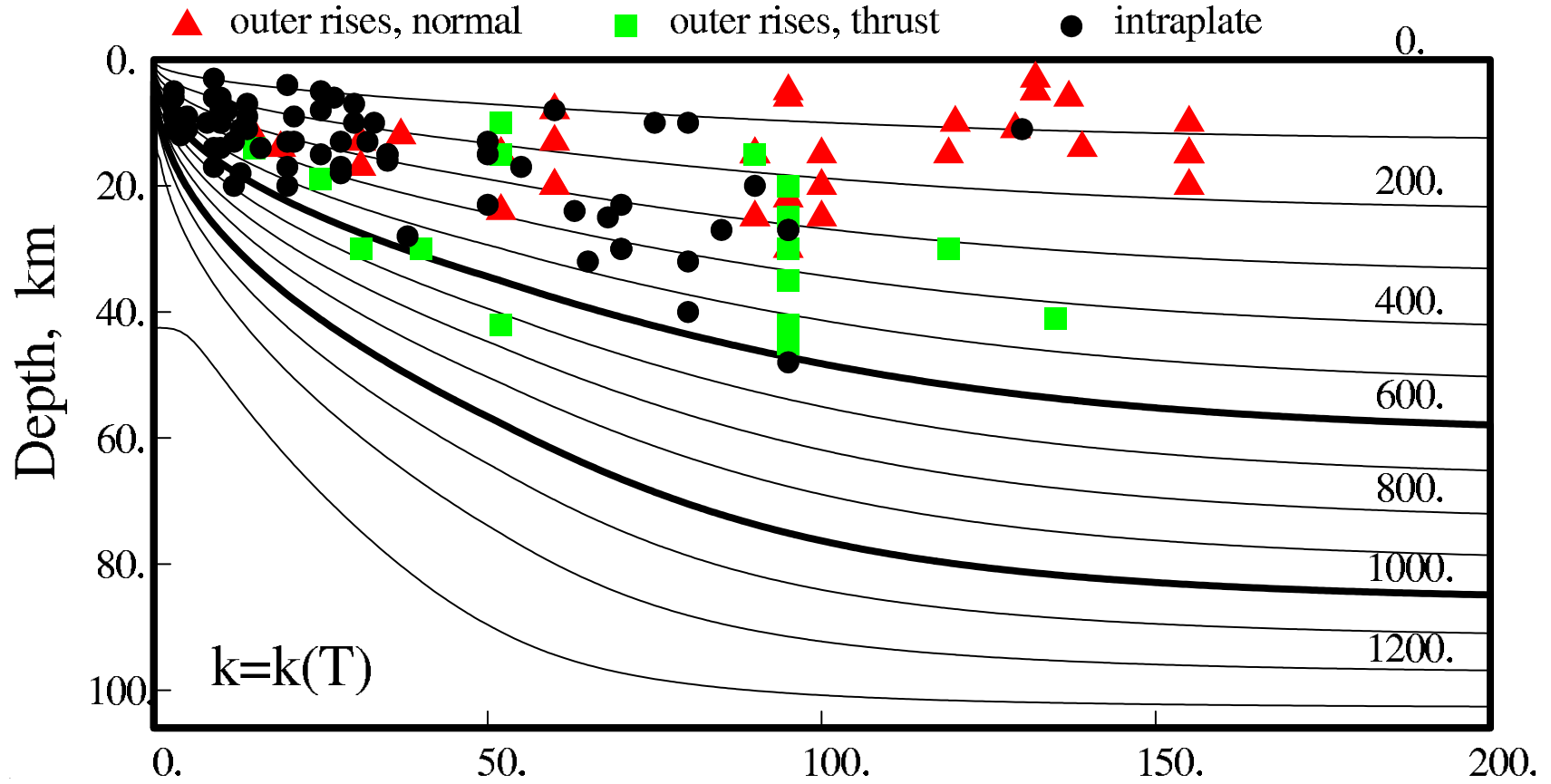


Eastern Nepal and southern Tibet local seismicity



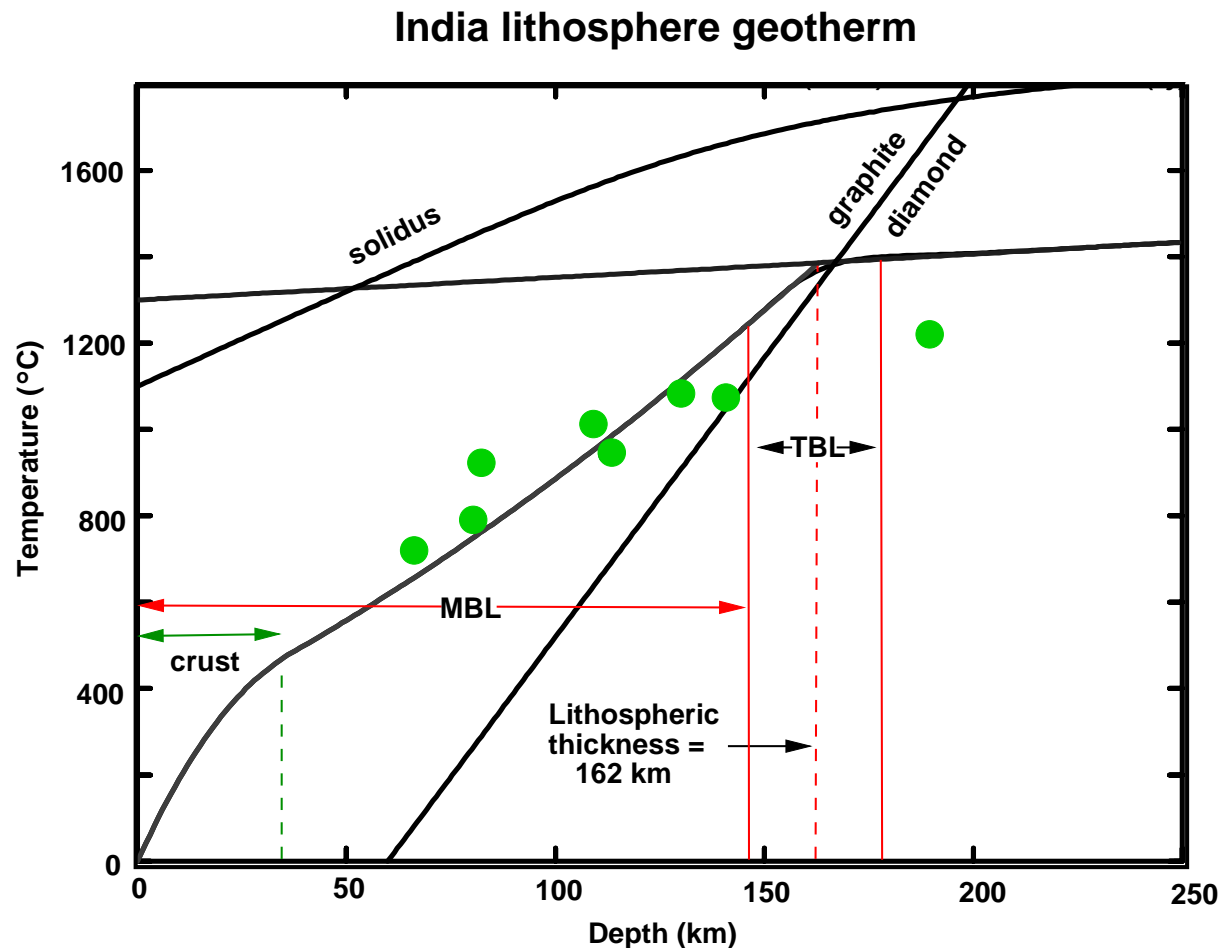
Monsalve et al (2006)

Earthquake depths



McKenzie *et al*, 2005

- Heat flow of south Indian Shields is in the range 25-50 mWm^{-2} (Roy and Rao, 2000)
- Moho temperatures of 285-410°C (Roy and Rao, 2003)



Evidence for a hot, wet Tibetan mid-crust

- Low average crustal velocities (Chun and Yoshii, 1977; Romanowicz, 1982) and a low velocity (Kind *et al*, 1996; Brown *et al*, 1996), low resistivity (Chen *et al*, 1996) zone in the crust

Evidence for a hot, wet Tibetan mid-crust

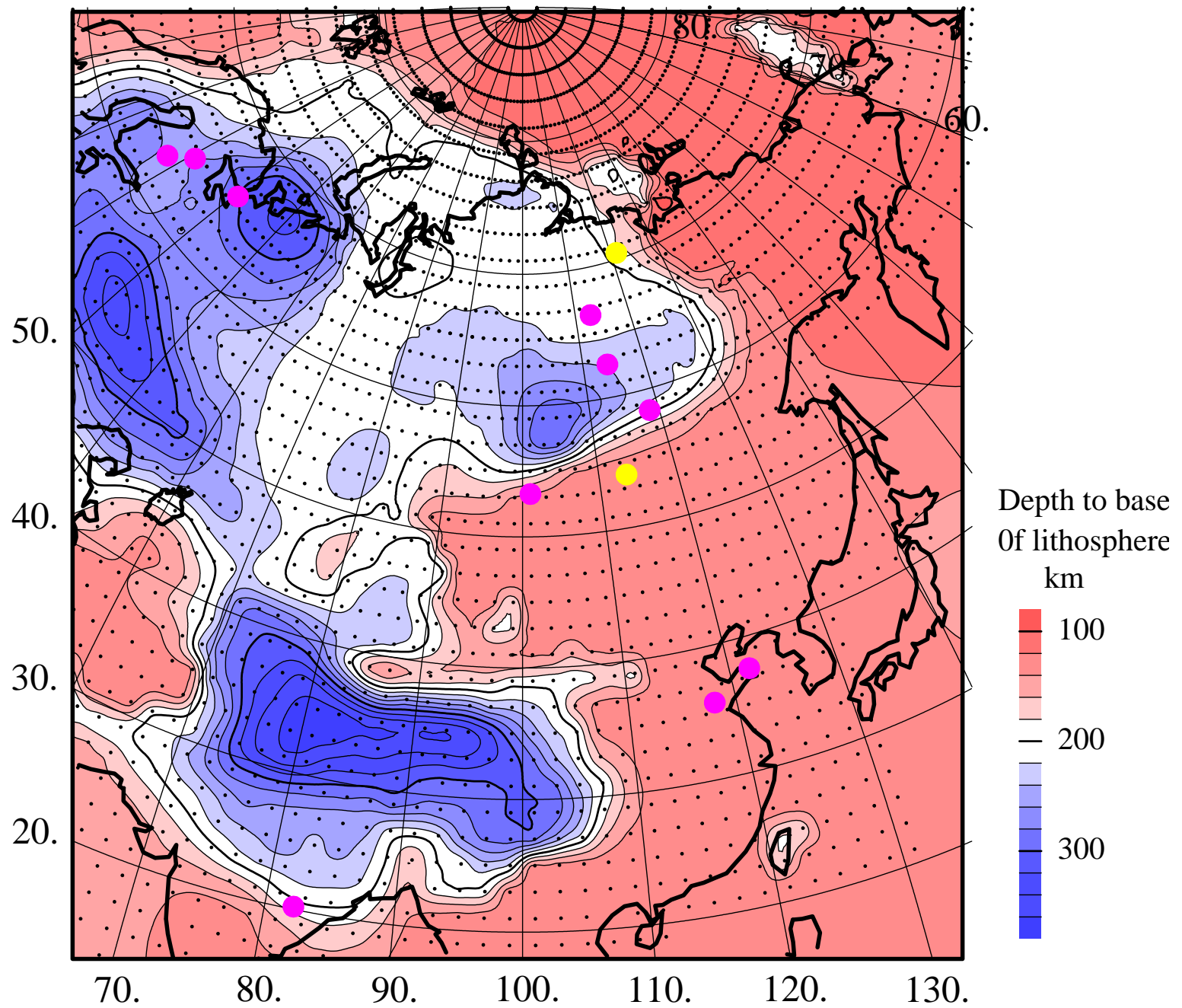
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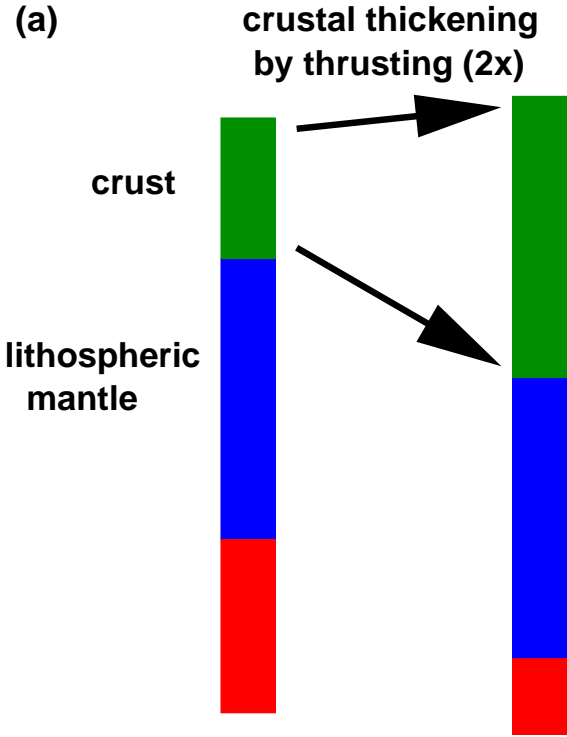
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- Seismic signature of the $\alpha - \beta$ quartz transition implies temperatures of 770-815°C at 32 km depth 150 km south of the Bangong suture but 685-710°C at 18 km depth north of the suture (Mechie *et al*, 2004)

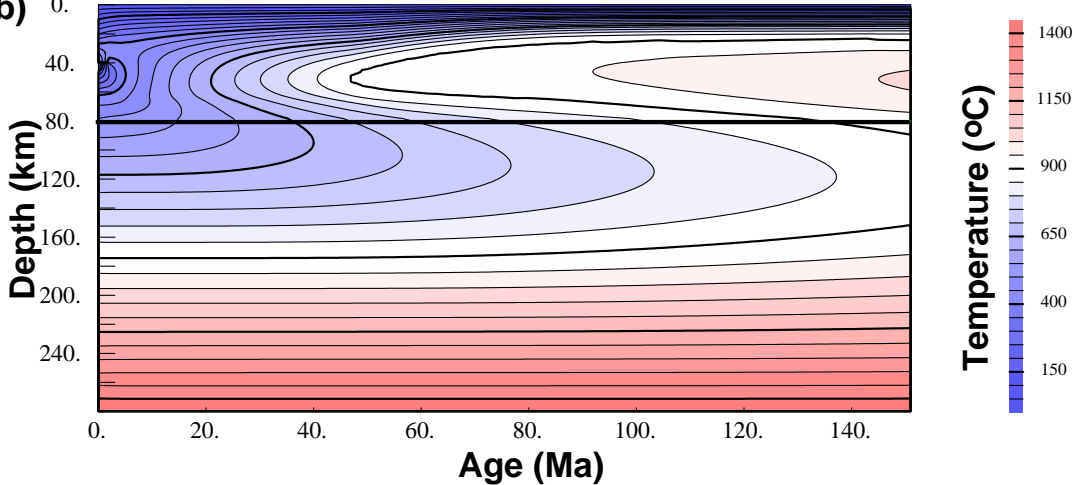


Thermal evolution of the lithosphere

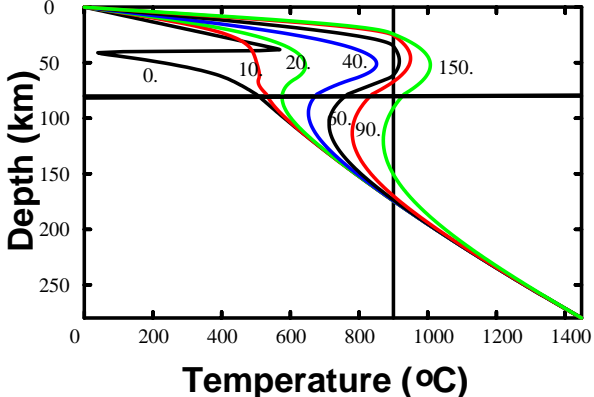
(a)



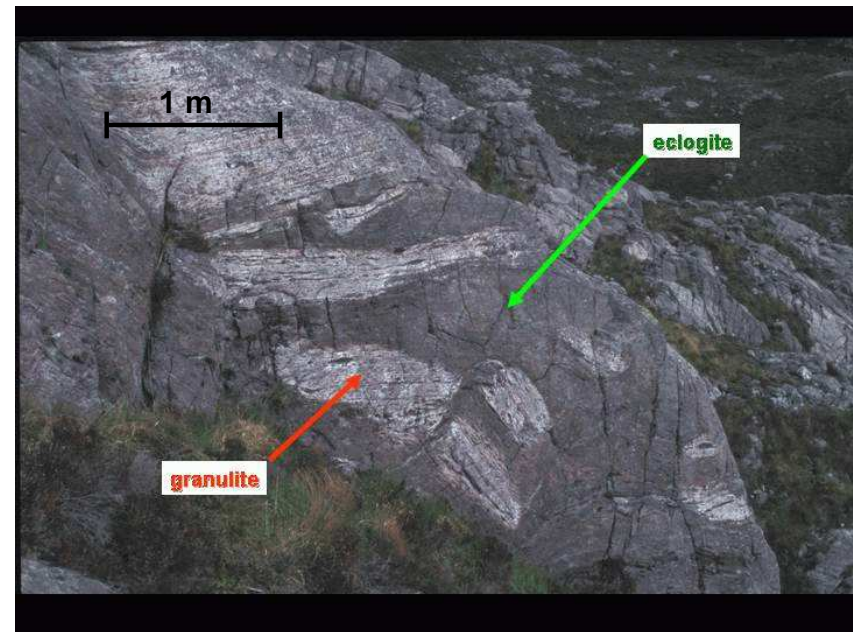
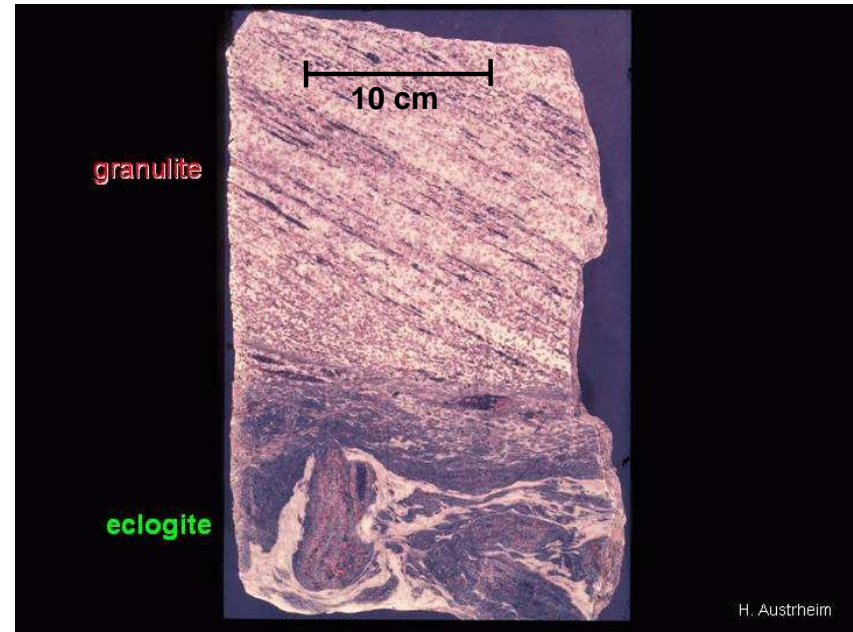
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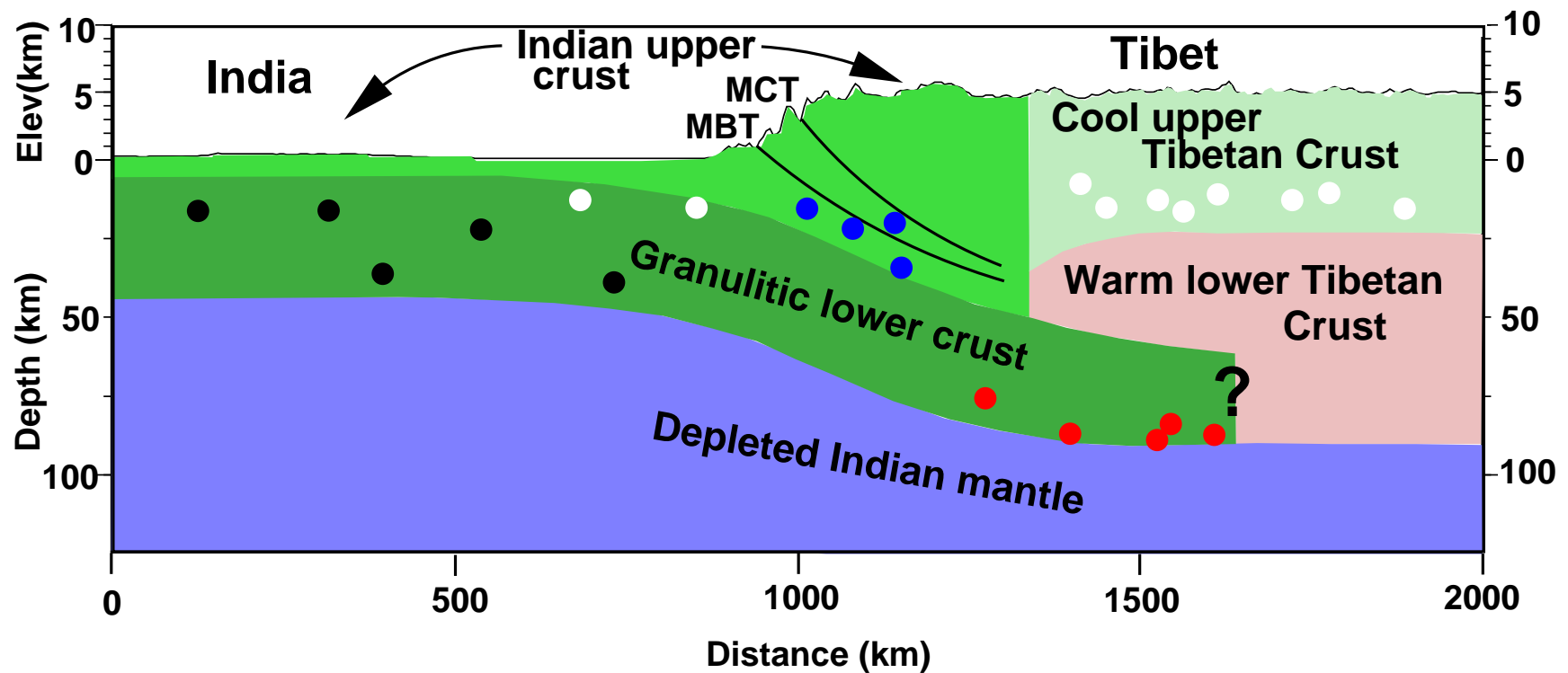


(c)



HOLSNOY NORWAY METAMORPHISM





- Indian lower granulitic crust underplates southern Tibet
- Depleted, cool upper mantle underlies all of Tibet
- Tibetan crust heated by radioactive decay
- Deep south Tibet earthquakes occur in cool India granulitic lower crust