Tectonic transitions in the Tibetan plateau during India-Asia collision: Findings from scaled laboratory models

Arnab Roy[1], Giridas Maiti[1], Joyjeet Sen[1], and Nibir Mandal[1]

[1]Jadavpur University

November 21, 2022

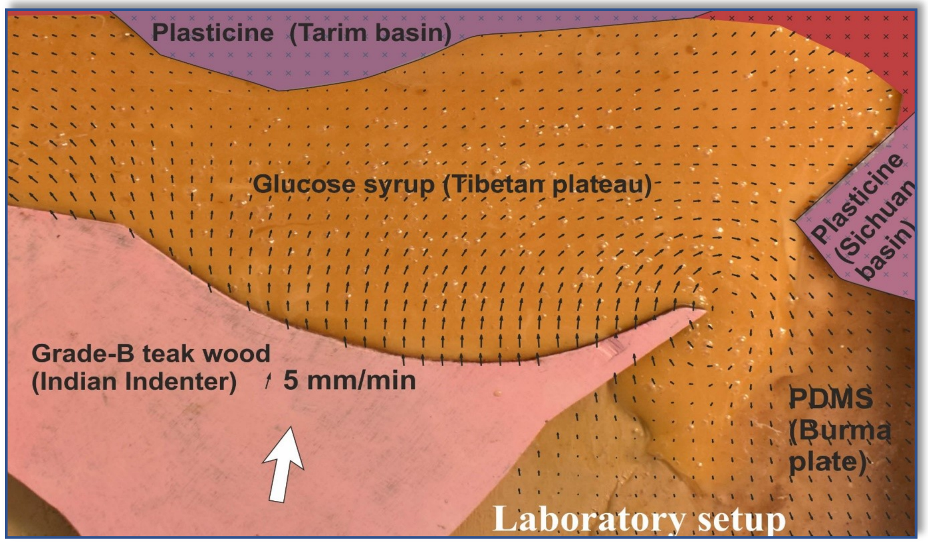
Abstract

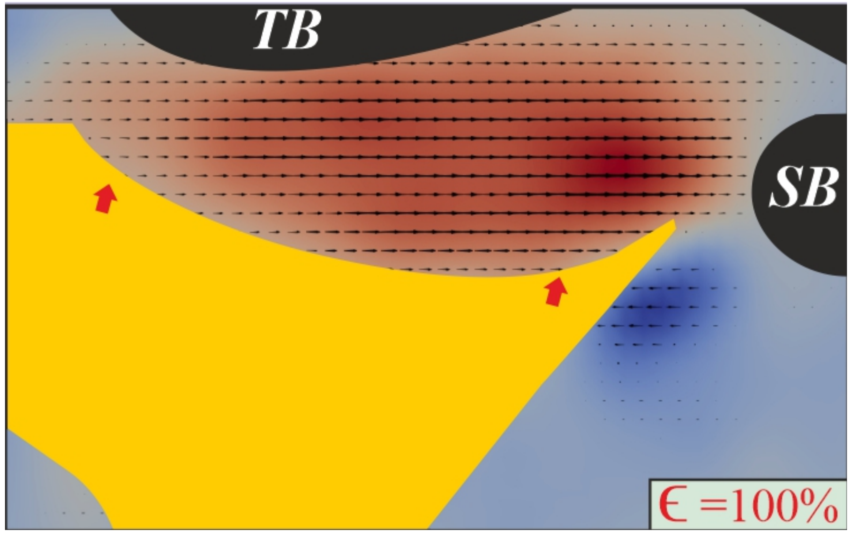
The India-Asia continental collision, starting at ~50 Ma, has resulted in about 2000 km crustal shortening to build the Himalaya-Tibetan plateau, which is one of the landmark terrestrial features on the Earth. In this study, using a thin viscous sheet approximation we performed scaled laboratory model experiments to investigate the spatiotemporal variation in the Himalaya-Tibetan tectonics. The experiments allow us to constrain the Tibetan plateau topography as a function of the varying India-Asia convergence rates. Our results suggest two rigid crustal blocks: Tarim and Sichuan basins steered the growth pattern in the Tibetan plateau. Because of the resistance from the rigid Tarim block western Tibet uplifted first relative to eastern part, creating a topographic elevation difference, which directed the crustal flows grossly to NE. We show from experiments the elevated plateau topography underwent gravitational collapse when the indentation velocity dropped to present average of ~3.5 cm/yr at around 18 Ma. This event eventually led to a transition from contraction to extensional tectonics, dominated by east-directed crustal flows in response to the eastward topographic gradient developed during the early stage of fast collision. We compare the present day crustal flow velocity field, strain rates, and topographic variations in the model Tibet with the actual observations in the Himalaya-Tibet Mountain System.

Tectonic transitions in the Tibetan Plateau during India-Asia collision: Findings from scaled laboratory models

***Arnab Roy**, Giridas Maiti, Joyjeet Sen, Nibir Mandal*
Dept. of Geological Sciences, Jadavpur University, India.

AGU Fall Meeting: December 10, 2020
AGU Abstract ID: 700806

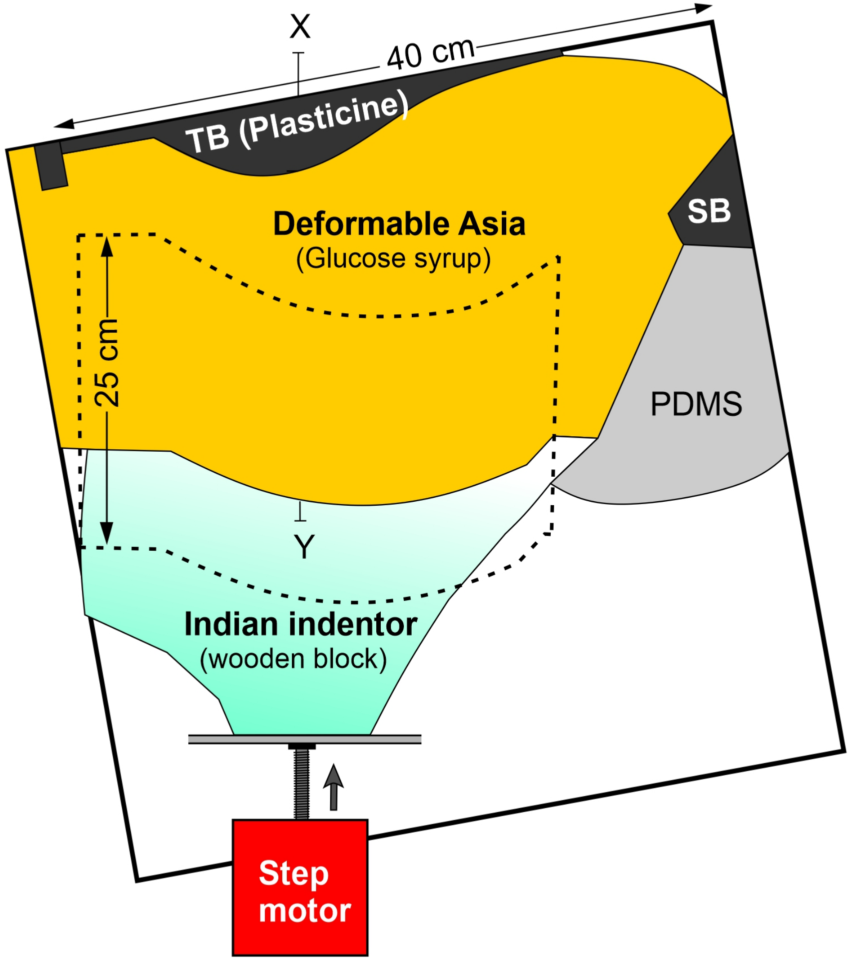




http://www.jugeodynamics.org/

The aim of our study

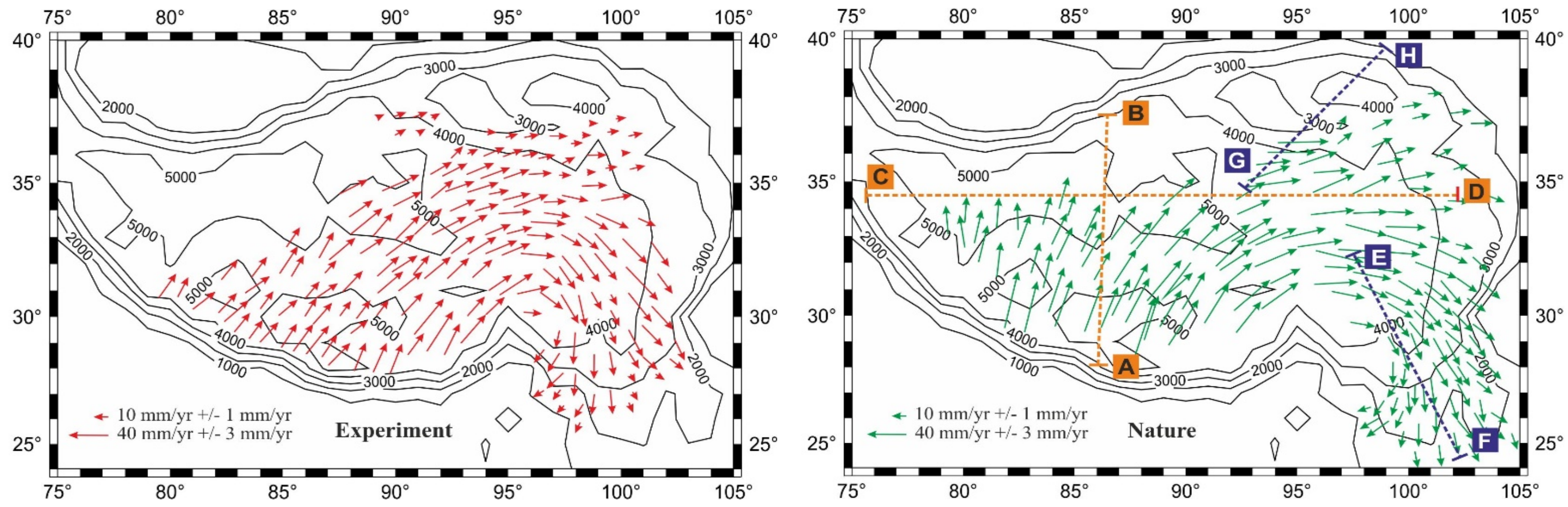
- To explore the **influence of the Indo- Asian collisional dynamics** in creating the present day **extensional regime** within the Tibetan Plateau.
- To understand the fundamental issues related to how the **E-W topographic gradient** in the Tibetan Plateau **came into existence** and what triggered the **gravitational collapse** of the plateau in the India- Asia collisional history.
- To review the **influence of the lateral crustal heterogeneities** (Tarim, Sichuan etc) around the Tibetan Plateau, in the **evolution of the Tibetan crustal flow**.



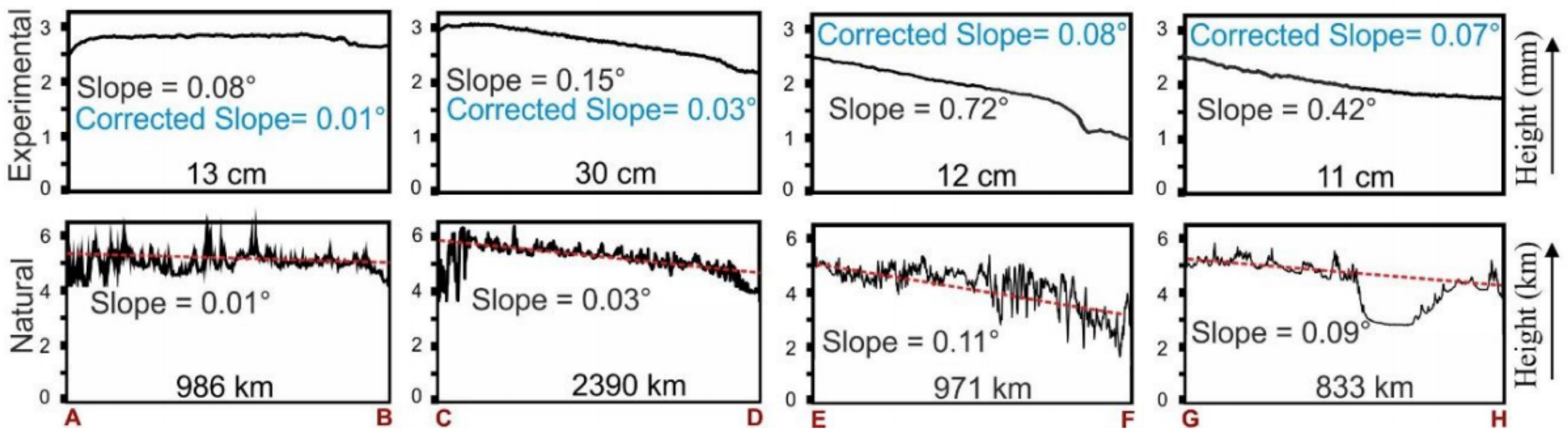
A schematic presentation (plan view) of the laboratory setup.

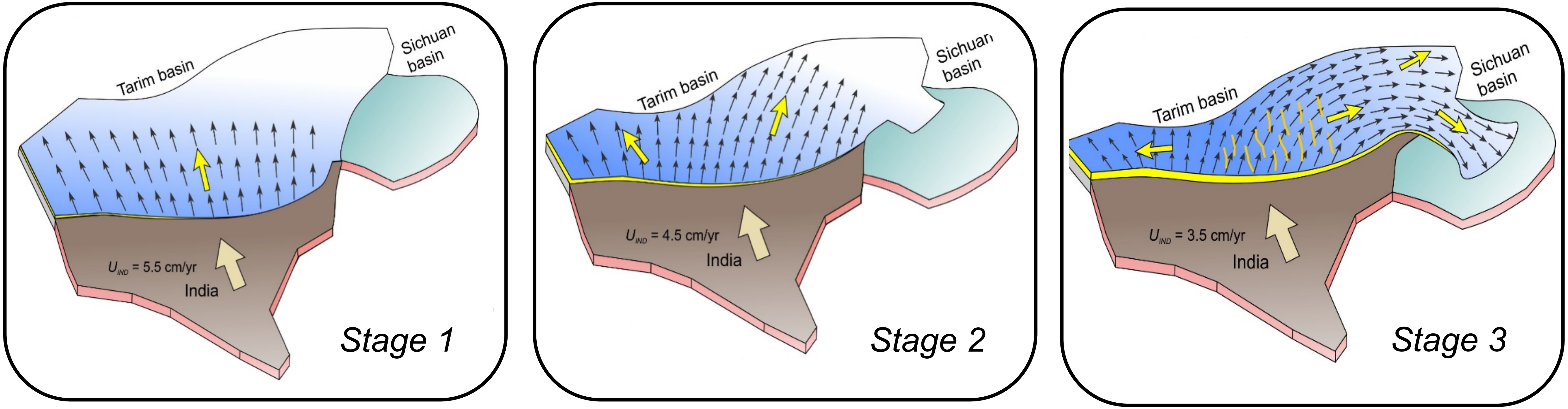
Comparison of model results with natural data shows very good consistency.

Comparison of surface velocity



Comparison of topographic profile





A cartoon representation of the three-stage evolution of crustal-flow pattern in the Tibetan plateau with decreasing Indian indentation velocity (U_{IND}).

This study explains the **onset of E-W extension in Tibet** as a consequence of **decreasing Indian indentation velocity** in India-Asia collision history.

ARNAB ROY

CSIR- SRF FELLOW, HPT LAB,

JADAVPUR UNIVERSITY

Profile :https://www.researchgate.net/profile/Arnab_Roy6

Mail: royarnabroy18@gmail.com