

The strength of tectonic plates caused the unique shape of the Tibetan plateau

With the support of the National Natural Science Foundation of China, a collaborative study by Dr. Chen Lin (陈林) from the Institute of Geology and Geophysics, Chinese Academy of Sciences, Dr. Fabio Capitanio from Monash University, Dr. Lijun Liu from the University of Illinois at Urbana-Champaign and Taras Gerya from Swiss Federal Institute of Technology Zurich demonstrates that the unique shape and complex deep structure of the Tibetan plateau may be controlled mostly by the strength heterogeneity of the tectonic plates during collision. The new findings were published in the journal *Nature Communications* (2017, 8: 15992, doi:10.1038/ncomms15992).

The Tibetan plateau, formed by the convergence of the Indian and Asian tectonic plates, dwarfs other mountain ranges in height and breadth on our planet. Most other mountain ranges look like narrow scars of raised flesh, while the Tibetan plateau appears like a broad and asymmetrical scab surrounded by craggy peaks. For example, the western side of the Tibetan plateau is relatively narrow and its eastern side is very broad, and recent seismic investigations also reveal that the subsurface structure of the Tibetan plateau varies largely along the collisional zone, which existing models have failed to explain. Why does the Tibetan plateau have such dramatic orogen-parallel changes?

To address the above question, Chen and his co-authors looked at what happens when the two colliding tectonic plates are made from rocks with different strength. A series of 3-D thermo-mechanical continental collision models were used to test this idea. The researchers first looked at two scenarios: a weak Asian plate and a strong Asian plate, while maintaining a strong incoming Indian plate in both models. They found that the strong Asian plate led to a narrow orogen, but the weak Asian plate resulted in a broad orogenic plateau. Then they ran a third model which is a composite of the strong and weak Asian plate models. An Asian plate with a strong western side and a weak eastern side produces a continental plateau very similar to the present-day Tibetan plateau in shape. This model also predicts some of the complex subsurface structures revealed from seismic investigations at the Tibetan plateau.

Because lithospheric strength heterogeneities are common in continents, these findings provide new insights into the development of mountain chains and plateau topography around collisional margins.

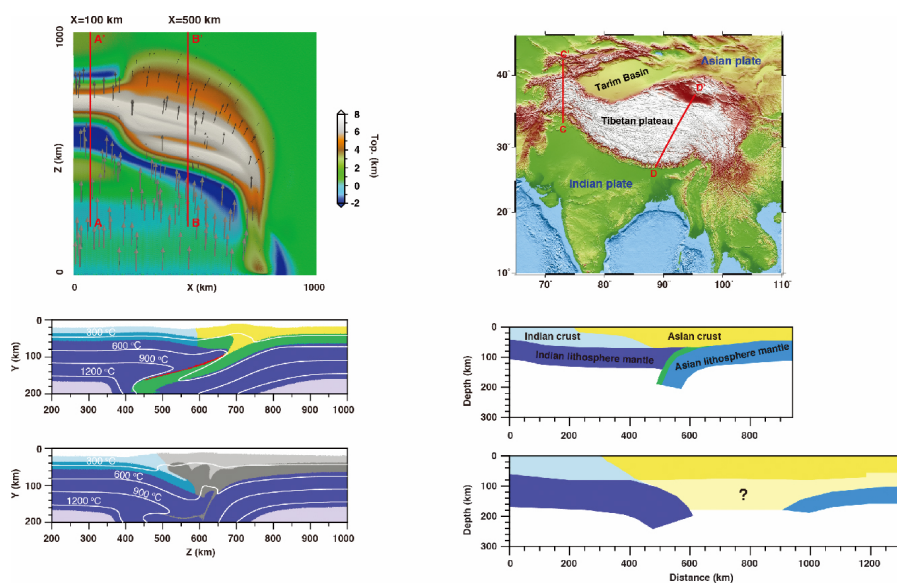


Figure Comparison between the composite model predictions (left) and the observations from the Tibetan plateau (right).