Special Topic: The Tibetan Plateau

World’s roof regulates the earth system

Zhengtang Guo

Continuing in the NSR tradition to focus on a specific topic within each issue, the present volume includes a major section devoted to the study of the Tibetan Plateau. Nearly a half-century ago, the geoscience community already started to discuss the timings, amplitudes, mechanisms and effects of the Tibetan Plateau uplift. Since then, these basic research themes have not substantially changed, although some terminology has been renewed. Like many scientific issues, the Tibetan plateau evolution is so complex that we do need decades to understand. The relevant scientific knowledge is also an indispensable for understanding the operation of the earth system.

Approximately 60 million years ago, plate tectonics caused the collision of the Indian and Eurasian continents. Uplift of the Himalayan–Tibetan complex, which probably occurred much later, is a direct consequence of this geological event. The subsequent topography changes had a profound impact on the atmospheric circulation, leading to the formation of the monsoon-dominated climate and inland deserts in Asia. It also resulted in a reorganization of the Asian riverine system, which has greatly influenced the fluvial transports to the ocean and led to the formation of the eastern China plains.

Meanwhile, the inland deserts provide a substantial amount of eolian dust, which not only formed the Chinese Loess Plateau, but also settled into the ocean and influenced the atmospheric CO₂ concentration through modulating marine productivity. The uplift-induced erosion, the monsoon-reinforced chemical weathering and the relevant riverine transports also affect the CO₂ level. These are thought to have significantly helped the Cenozoic global cooling, i.e. the formation and expansion of the polar ice sheets. Given that global cooling may also affect mountain erosion, the induced isostasy adjustments may cause further uplift. These processes constitute a spectacular plateau dynamic chain that is still operating today. Any additional intervention, including human activity and small-amplitude climate pulses, may affect this chain, and hence, disturb the earth system.

Although the above overall picture has become clearer in the past decade, many key issues remain unresolved and a series of new complexities have arisen. For example, the deep processes causing the surface uplift and deformation are still controversial. Hot debates persist with regard to the timing of the uplifts. Little is known about what happened from the Indian-Eurasian collision to the major uplift. The onsets and dominant causes of the Asian monsoon climate and inland deserts are still under discussion. The relevant biogeochemical processes remain hypothetic and need to be quantified. Some ‘remote effects of the Tibetan uplift’ may have been mistakenly identified and require exploring the possible influences of global climate and Pacific tectonics. At the society timescale, how human activity and recent climate changes affect the plateau dynamic chain would be a critical issue as it is directly relevant to our life today.

The current issue of NSR rightly focuses on these facets, including the collision process in the Himalayas (by Wenjiao Xiao), the elevation history of the plateau (by Tao Deng and Lin Ding), the roles of uplift on the Asian monsoon and deserts (by Xiaodong Liu et al.), the uplift-related changes of the Yangtze River (by Hongbo Zheng), the threshold effect of vegetation response to climate (by Yan Zhao et al.), the impacts of climate on plant phenology (by Miaogen Shen et al.), and the relevant hazards characteristic of mountain regions (by Peng Cui and Yang Jia). A comprehensive overview on the spherical interactions is offered by Tandong Yao et al. in highlighting the most recent progresses. This special topic also includes an interview with Tandong Yao and Weiming Fan, in which they share with audience what it’s like to work on the Tibetan Plateau and why international collaboration is crucial in this region.

Some contributions provide new views or new evidence on the debates while others offer highly novel visions. These results, coherent or controversial, illustrate the importance of a solid understanding on the plateau dynamic chain in both theoretical and practical aspects. They also confirm the infinite scientific charms of this research field; some may not be immediately recognized by everyone, but would keep us all on our toes.

Finally, I would like to express my deep gratitude to all the authors, reviewers and NSR office staff for their joint efforts in editing this special topic. The strong supports from Professor Zhonghe Zhou are highly appreciated.

Zhengtang Guo¹²

¹ Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences
² CAS Center for Excellence in Tibetan Plateau Earth Sciences

E-mail: ztguo@mail.iggcas.ac.cn