The Lost Landscapes of Tibet and how they Changed the World

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Working in Tibet is not easy, being a region with a long history of being embroiled in complex geopolitical issues and often closed to foreigners, as it largely is now. With much of the Tibetan Plateau being at around 5 km in elevation, logistics and physical work are challenging. Over the past 30 years or so I have had the privilege of doing fieldwork in Tibet many times, and this is the story of that research.

Our understanding of the Late Cretaceous and Cenozoic evolution of the Pan Tibetan Highlands, a region that encompasses the modern high Tibetan Plateau, the Hengduan Mountains, the Himalaya and the Mountains of Central Asia has been transformed within the last 10 years, and it is likely that whatever you learned about the formation of the Tibetan Plateau is wrong. The 'classic' view was that the formation of the Tibetan Plateau was solely the result of the ongoing collision of India with Eurasia, with India pushing all before it. However, ideas involving a unitary or progressive northeastward rise of the Himalaya and Tibetan Plateau, or a north-south expansion of a proto-plateau, have now been superseded by more complex growth models. These envisage a Paleogene pre-collisional Central Tibetan lowland bordered by the Gangdese Arc highlands (~4.5 km) to the south and the Central Watershed (Qiangtang) Mountains in the north (~4 km). The transition to the modern plateau involved 1) a rise of eastern Tibet during the Eocene, closing off the eastern end of this central lowland by a planated upland (~3.5 km) that subsequently underwent erosion to form the high relief and deep valleyed Hengduan Mountains, and 2) an east to west progressive rise and infilling of the central lowland throughout the later Paleogene. The nascent modern plateau with internal drainage had formed by the late Oligocene to early Miocene, followed in the mid Miocene by the rise of the Himalaya to exceed the height of the newly formed plateau.

These new topographic reconstructions have largely come about through an iterative mutual improvement of both altimetric proxies and numerical climate modelling, validated by consilience across methodologies and disciplines. What has emerged is that the Asian monsoon system evolved progressively in tandem with regional topographic development and the impact of changes in atmospheric pCO_2 was minimal, which demands that realistic reconstructions of past landscapes are required for correct interpretations of climate and altitude proxy data. Asian monsoons in geological history were not what we see today in terms of extent, precipitation intensity and seasonal distribution, and air parcel trajectories, etc., and monsoon circulation continues to change, even in the present. Geological proxies that require an understanding of past air parcel trajectories to reconstruct ancient land surface heights (e.g. stable isotope fractionation) cannot assume a modern monsoon circulation system, nor a similar thermodynamic profile, and past air parcel trajectories can only be simulated in numerical climate models using high spatio-temporal resolution past landscapes. With past landscape reconstructions that reflect reality we can

begin to understand the evolution of both the Asian monsoon system and the incredibly diverse biota that it supports, as well as how best to conserve ecosystem services for the future.

For those who wish to do some pre- or post-talk reading, see:

Spicer, R.A., Farnsworth, A., Su, T., Ding, L., Witkowski, C.R., Li, S.F., Xiong, Z., Zhou, Z., Li, S., Hughes, A.C., Valdes, P.J., Widdowson, M., Zhiang, X., He, S., Liu, J., Huang, J., Herman, A.B., Xu, Q., Liu, X., Jin, J., Pancost, R.D., Lunt, D., Zhang, S. 2024/2025. The Progressive Co-evolutionary Development of the Pan-Tibetan Highlands, the Asian Monsoon system and Asian Biodiversity. Geological Society of London Special Publication 549 “Asian Geodynamics and Biodiversity”. **https://doi.org/10.1144/SP549-2023-180**