Paper Number: 2725

Key challenges in Himalayan tectonics and climate-tectonic interactions

Webb, A.A.G.[1], Guo, H.[2], and Clift, P.D.[2]

[1]Department of Earth Sciences, University of Hong Kong, Hong Kong, China, aagwebb@gmail.com
[2]Department of Geology and Geophysics, Louisiana State University, Baton Rouge, U.S.A.

Himalayan tectonic models have displayed tremendous creativity for over 30 years, as instigated by the discovery of the South Tibet detachment. This structure separates the crystalline core of the range from less metamorphosed (meta-)sedimentary rocks above, along a north-dipping, top-to-the-north shear zone. Because this shear zone has the first-order appearance of a major arc-parallel normal fault, innovative models have been invoked to explain it. These models include wedge extrusion concepts and the famous channel flow model, in which exhumation of high-grade rocks to the surface is governed by the southwards expulsion of a low-viscosity hot crustal channel and climate-modulated, orographically-focused erosion. In recent years, two discoveries have changed our understanding: (A) local preservation of the leading edge of the crystalline core shows that these rocks were emplaced at depth rather than extruded to the surface [1], and (B) southwards-younging thrust faults partition the crystalline core, which has led to models of its assembly as a thrust duplex [2][3][4].

In the near future, a new wave of Himalayan tectonics concepts will be required to address two key challenges. First, Himalayan climate-tectonics models offer a chicken-vs-egg problem: it is unclear whether tectonic shifts forced climatic changes, or climatic shifts generated new tectonic regimes. Specifically, the rise of the Himalayan mountains is thought to explain the development of the South Asian monsoon [5], but the major mountain uplift phase is widely considered to be triggered by erosion resulting from the onset of the monsoon [6][7]. If these processes are coupled, how did this coupling initiate? Second, nearly all tectonic evolutionary models are two dimensional, portrayed in cross-section [4][6][7]. Impressively, these can satisfy constraints along most cross-sectional slices through the Himalaya. However, modern geo-/thermo-chronological data sets are revealing along-strike variations in the timing of orogenesis, highlighted by a west-to-east younging of tectonic processes [8][9]. New hypotheses will be required to explain this along-strike propagation. In order to address these challenges, we will present a new synthesis revealing how climate-tectonic coupling may have shaped the Himalayan mountains in three dimensions through time.

References:

[1] Webb A et al. (2011) EPSL 304: 483-495
[2] Reddy S et al. (1993) In: *Himalayan Tectonics*: Geological Society of London Special Publication 74, 375-389
[3] Corrie S and Kohn M (2011) GSAB 123: 1863-1879
[4] He D et al. (2015) International Geology Review 57: 1-27
[5] Boos W and Kuang Z (2010) Nature 463: 218-222
[6] Beaumont et al. (2001) Nature 414: 738-742
[7] Clift et al. (2008) Nature Geoscience 1: 875-880
[8] Leloup et al. (2010) EPSL 292: 1-16
[9] Warren C et al. (2014) Lithos 200-201: 94-110