Geophysical Research Abstracts
Vol. 21, EGU2019-323, 2019
EGU General Assembly 2019

Continental rheology and the evolution of mountain belts: constraints and caveats from stable-isotope palaeoaltimetry

Camilla Penney (1,2) and Alex Copley (2)

(1) Queens' College, University of Cambridge, Cambridge, United Kingdom (cp451@cam.ac.uk), (2) COMET, Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Cambridge, United Kingdom

Controversy surrounds the evolution and behaviour of mountain ranges. In particular, the rheology of the continental lithosphere, and the control which this exerts on lithospheric deformation, has been the subject of significant debate. Such deformation controls the shape and temporal evolution of topography, determining the climatic changes, erosion and sedimentary records associated with mountain building. We investigate the rheology of the continental lithosphere, and the effects of lateral rheology contrasts, by combining seismological and geodetic results with recently published data from stable-isotope palaeoaltimetry and numerical modelling. Stable-isotope palaeoaltimetry provides the constraints on vertical motions necessary to determine whether, or not, a complex vertical rheology (such as a low-viscosity lower-crustal channel or high exponent power law) is required to explain the deformation of South East Tibet. We combine recently published results with numerical models of a mountain range growing into a region of pre-existing strength contrasts (analogous to the contrast between the relatively undeforming Sichuan Basin and Central Lowlands of Myanmar and the rapidly deforming south-eastern margin of Tibet). We find that mountain growth in a region of pre-existing strength contrasts results in first order features of the topography, GPS velocity field and earthquake-derived strain rate in South East Tibet, suggesting that such contrasts play an important role in determining the shape and temporal evolution of topography. Combined with observations of low uplift rates ($<$0.2 mm/yr) and Eocene high topography from stable-isotope palaeoaltimetry, our models suggest that the available data from South East Tibet do not require a low-viscosity, lower-crustal channel, but can be explained by a simple, vertically homogeneous rheology. These models also suggest that increased river incision observed in this region at 13–5 Ma is unlikely to results from changes in the underlying tectonics, and is probably climatic in origin. Finally, we discuss the importance of considering the large-scale lateral transport of rocks during topographic evolution in determining and interpreting the palaeoaltimetry of active mountain ranges.