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Influence of dynamic topography on landscape evolution and passive continental margin stratigraphy

Xuesong Ding (1), Tristan Salles (1), Nicolas Flament (2), and Patrice Rey (1)

(1) EarthByte Group, School of Geoscience, University of Sydney, NSW 2006, Australia (xuesong.ding@sydney.edu.au), (2) School of Earth and Environmental Science, University of Wollongong, Northfields Avenue, Wollongong, NSW 2522, Australia

Quantifying the interaction between surface processes and tectonics/deep Earth processes is one important aspect of landscape evolution modelling. Both observations and results from numerical modelling indicate that dynamic topography - a surface expression of time-varying mantle convection - plays a significant role in shaping landscape through geological time. Recent research suggests that dynamic topography also has non-negligible effects on stratigraphic architecture by modifying accommodation space available for sedimentation. In addition, dynamic topography influences the sediment supply to continental margins.

We use *Badlands* to investigate the evolution of a continental-scale landscape in response to transient dynamic uplift or subsidence, and to model the stratigraphic development on passive continental margins in response to sea-level change, thermal subsidence and dynamic topography. We consider a circularly symmetric landscape consisting of a plateau surrounded by a gently sloping continental plain and a continental margin, and a linear wave of dynamic topography. We analyze the evolution of river catchments, of longitudinal river profiles and of the χ values to evaluate the dynamic response of drainage systems to dynamic topography. We calculate the amount of cumulative erosion and deposition, and sediment flux at shoreline position, as a function of precipitation rate and erodibility coefficient. We compute the stratal stacking pattern and Wheeler diagram on vertical cross-sections at the continental margin.

Our results indicate that dynamic topography 1) has a considerable influence on drainage reorganization; 2) contributes to shoreline migration and the distribution of depositional packages by modifying the accommodation space; 3) affects sediment supply to the continental margin. Transient dynamic topography contributes to the migration of drainage divides and to the migration of the mainstream in a drainage basin. The dynamic uplift (respectively subsidence) of the source area results in an increase (respectively decrease) of sediment supply, while the dynamic uplift (respectively subsidence) of the continental margin leads to a decrease (respectively increase) in sedimentation.