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Lithology and landscape transience in a post-orogenic setting with rock uplift driven by denudational isostatic rebound

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Rock uplift commonly corresponds to base-level fall, triggering a ‘bottom-up’ wave of rejuvenation that propagates upstream through the drainage net as a knickpoint or knickzone. The results reported here from the post-orogenic high-elevation passive margin of SE Australia explore the ways in which lithologies of differing erosional resistances and character influence that knickpoint propagation and hence the duration of transience. Long profile data from modern channels and Early Neogene basalt-filled channels show that, in these post-orogenic settings of low discharges and low sediment fluxes, (i) relatively soft rocks, such as regionally metamorphosed mudstones and sandstones transmit base-level falls by knickpoint propagation relatively rapidly, and (ii) resistant and relatively massive lithologies, such as granites, slow knickpoint retreat for millions to tens of millions of years. Other resistant lithologies, such as a contact metamorphic hornfels that borders the metasediments where they have been intruded by the granites, do not slow knickpoint propagation because the hornfels is fractured and highly susceptible to bedrock knickpoint retreat by quarrying and plucking.

In such settings of knickpoint retardation by resistant lithologies, the landscape becomes compartmentalised into (i) those areas below the knickpoints, which are evolving by ‘bottom-up’ processes, at rates governed by the rate of rock uplift and the rate at which that base-level fall signal is transmitted to the drainage net, and (ii) those areas above the lithologically-pinned knickpoints, which are cut off from the rock uplift signal and evolving by ‘top-down’ processes reflecting water and sediment discharges. Cosmogenic nuclide data are used to quantify the rates of evolution of these landscape ‘compartments’, and hence the duration of transience in such post-orogenic settings.