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Quantifying the effects of spatially variable lithology and uplift rates on landscape morphology

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The form of the landscape and the rate at which it changes is the result of the interplay of erosive and resistive forces. Recent work has tended to focus on factors that affect the bulk rate at which landscapes erode, in particular the effects of uplift rates and climate. Yet understanding why the landscape has the form it does is a fundamental aim of geomorphology. Such an understanding is complicated by the fact that morphology is non unique - different combinations of erosive and resistive factors can produce similar landscapes.

Nevertheless, previous studies have demonstrated that landscape form, in particular the hypsometry integral of a basin, correlates spatially with uplift rates and also the degree to which a basin's lithology resists erosion. Such studies have shown that analysing the hypsometric integral distribution can be a useful method to help understand the relative role of influences on a landscape. However as yet no study has attempted to quantify theses effects on hypsometry.

We present a systematic study that investigates, primarily through numerical modelling experiments, how landscape morphology changes over space and time in response to simple tectonic perturbations and different configurations of basement lithologies (i.e. spatially varying resistance to erosion). In particular, we focus on quantifying the effects that these factors have on the hypsometry of basins in linear mountain ranges. This study further demonstrates how hypsometric integral analysis can reveal valuable information about factors that affect landscapes.