Spatial variation of erosion rates and passive margin escarpment embayment from New England, NSW and Bellenden Ker, Queensland, Australia: an analysis using GIS and in-situ 10Be basin-wide cosmogenic nuclides

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Introduction

The eastern seaboard of Australia is characterized by a passive margin and a continental divide that defines the inland-draining rivers from those that drain to the coastal and Tasman seas (Figure 3). Seaward of this divide lies the Great Escarpment (GE) of Australia that separates a moderate relief coastal plain from a low relief, high elevation plateau (figure 2). Quantifying the spatial variation of erosion rates from temperate New England (NE), New South Wales (NSW) and tropical Bellenden Ker (BK), Queensland (QLD), two regions with distinctly different climates and escarpment embayment (figures 1 and 2), could help constrain erosional controls that contribute to escarpment form. In this study, we compared forty detrital 10Be samples collected from the main trunk and tributaries of five major rivers: the Macleay, Bellinger and Clarence in NE (figure 1A) and the Russell-Mulgrave and North Johnstone in BK (figure 1B). We then traced the escarpment position in ARCGIS and calculated a sumarity ratio to better compare the degree of embayment in each region. Across both datasets we found that for NE, which has deep gorges cutting into the plateau, the degree of embayment was more than twice that of BK, whereas the escarpment position is significantly less embayed (ratio of ~4 vs. 3.5), and that erosion rates were more significantly variable (figures 4 and 5).

Erosion rates in low slope areas, such as on the plateau, were universally low with no other significant controlling factors. There was no correlation between erosion rates and catchment area, and that our data possibly echo previous studies that found that once mean rainfall passes above an approximate threshold (around 2000mm/yr), basin characteristics that are known to control erosion rates, such as slope and lithology (figure 3), are possibly subdued.

Figure 3 shows the location of the transects from this study (blue symbols corresponding column to the New England region of New South Wales (NSW) and Bennett's Creek in the Bellenden Ker region of Queensland (QLD)). All river data were generated from the 30m resolution SRTM dataset, using the hydrologically balanced D8 Inflow model generated from the Australian national database.

Box 1 shows the calculated slope (m) for each grid using a 3 by 3 moving window so the regional DEMs do not fall for each point in percent edge classification values. The dark brown points indicate the location of the escarpment as it does the low to high topography of the high gradient extent (bottom portion of the plot) from the most to the highest point on the coastal plain.

Box 2 shows a map~plot of mapped unit (map) from each river basin using the 30,000 m2 digital elevation model. Each river basin is selected based on the primary drainage lines in the watershed, with some of the larger basins being the main river. Slope values are then summed in the catchment area and the sum divided by the total number of grid cells to produce a value for each basin. Data were derived from the Australian national database.

Figure 4 shows the location of the transects from this study (blue symbols corresponding column to the New England region of New South Wales (NSW) and Bennett's Creek in the Bellenden Ker region of Queensland (QLD)). All river data was generated from the 30m resolution SRTM dataset, using the hydrologically balanced D8 Inflow model generated from the Australian national database. The dark brown points indicate the location of the escarpment as it does the low to high topography of the high gradient extent (bottom portion of the plot) from the most to the highest point on the coastal plain.

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References


