Longer-term and contemporary denudation rates, and the role of extreme events along a passive margin, Australia

G.S.HUMPHREYS[1], K.M. TOMKINS[1], M.T. WILKINSON[1], D. FINK[2], R.A. SHAKESBY[3], S.H DOERR[3], P.J. WALBRINK[4] AND W.H. BLAKE[5]

[1] Macquarie University, Australia; ghumphre@els.mq.edu.au; ktomkins@els.mq.edu.au; marsh.wilkinson@people.net.au
[2] Australian Nuclear Science & Technology Institute; fink@ansto.gov.au
[3] University of Wales, UK; R.A.Shakesby@swansea.ac.uk; S.Doerr@swansea.ac.uk;
[4]CSIRO Land & Water, ACT; Peter.Wallbrink@csiro.gov.au
[5]University of Plymouth, UK; william.blake@plymouth.ac.uk

Denudation rates, integrated over various timeframes, were assessed for the Blue Mountains Plateau in the Sydney Basin to test whether or not extreme events are required to explain rates of landscape evolution along a passive margin.

Contemporary denudation rates were determined using 40 years of river sediment load data from the Nattai catchment with an analysis of post-fire erosion using the 2001-2 wildfires as an example. Longer-term average denudation rates, relevant over timescales of 10 ka-100 Ma, were obtained from cosmogenic ^{10}Be and ^{26}Al cosmogenic nuclides (CN) of stream bed samples (~0-1 Ma) and existing data on apatite fission track thermochronology (AFTT), vitrinite reflectance (VR) and post-basalt valley incision (PBVI).

The results indicate that contemporary denudation rates of 5-9 mm ka^{-1} (= m Ma^{-1}) are much less than average longer term rates of 18.6 m Ma^{-1} (range 16.3-20.9) for CN, 24.3 m Ma^{-1} (14-40) for PBVI, 21.7 m Ma^{-1} (6.8-41.1) for VR, and 24.1 m Ma^{-1} (13.8-29.2) for AFTT.

The consistency between the longer term rates spanning a 10^4-10^8 year timeframe indicates that higher denudation rates have been sustained during the Cenozoic and thus implies a degree of stability to the pathways of landscape evolution. This study also indicates that contemporary rates provide an unreliable estimate of longer term denudation rates because they are unlikely to capture extreme events.

Existing data indicates that large floods (return period, RP, >10 years) accounts for *c.* 65% of the contemporary erosion rate with post fire events contributing a further 5% with the balance transported via numerous smaller events. As for the longer-term, the contribution of extreme events in the landscape is indicated by the presence of both high level slack-water deposits in the Nepean Gorge signifying major floods with RP's >>200 years, and the occurrence of as yet unreported landslides (>1 M m^3).