Using ^{10}Be to quantify rates of landscape change in 'dead' orogens - millennial scale rates of bedrock and basin-scale erosion in the southern and central Appalachian Mountains *(Invited)*

Details

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Abstract

The Appalachian Mountain chain stretches north-south along the eastern margin of North America, in places rising a thousand meters and more above the adjacent piedmont. Here, Davis built his paradigm of landscape evolution, seeing landscape rejuvenation and dissected peneplains, a transient landscape. Hack saw the Appalachians as a dynamic system where topography was adjusted to rock strength, a steady-state landscape. Neither had quantitative data by which to test their theories. Today, we approach landscapes of the Appalachian Mountains quite differently. Over the past decade, we and others have measured in situ-produced ^{10}Be in more than 300 samples of quartz isolated from Appalachian drainage basin sediments and in more than 100 samples from exposed Appalachian bedrock outcrops, most of which are on ridgelines. Samples have been collected from the Susquehanna, Potomac, and Shenandoah drainage basins as well as from the area around the Great Smoky Mountain National Park and the Blue Ridge escarpment, and from rivers draining from the Appalachians across the southeastern United States Piedmont. Most areas of the Appalachian Mountains are eroding only slowly; the average for all drainage basin samples analyzed to date is ~18 m/My (n=328). The highest basin-scale erosion rates, 25-70 m/My are found in the Appalachian Plateau and in the Great Smoky Mountains. Lower rates, on the order on 10-20 m/My, characterize the Shenandoah, Potomac, and Blue Ridge escarpment areas. There is a significant, positive relationship between basin-scale erosion rates and average basin slope. Steeper basins are in general eroding more rapidly than less steep basins. On the whole, the erosion rates of bedrock outcrops are either lower than or similar to those measured at a basin scale. The average erosion rate for samples of outcropping bedrock collected from the Appalachians is ~15 m/My (n=101). In the Potomac River

Basin and the Great Smoky Mountains, bedrock and basin-scale erosion rates are similar implying long-term steady erosion consistent with dynamic steady state as advocated by Hack. However, in the Susquehanna drainage, basin scale erosion rates are significantly higher than those measured from outcrops suggesting that over time, relief is increasing. The Susquehanna River basin appears to be responding to a transient perturbation, ala Davis.

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