

Elemental Analysis of Clastic Sediments to Determine Fluvial Sediment Sources

Mark S. Riedel¹ and David S. Leigh²

¹USDA Forest Service, Coweeta Hydrologic Lab, 3160 Coweeta Lab Rd, Otto, NC 28763

²Dept. of Geography, University of Georgia, Athens, GA 30602-2152

Biographical Sketches of Authors

Mark S. Riedel (mriedel@fs.fed.us) is a Research Hydrologist at the USDA Forest Service, Southern Research Station, Coweeta Hydrologic Laboratory. Dr. Riedel's research interests include land use legacy influences on water quality and fluvial processes, riparian land use impacts on stream stability, the cumulative effects of forest roads on erosion and sedimentation and the application and development of spatially explicit, process based water yield and sedimentation models to predict and explain the propagation of land use impacts on fluvial processes through time and space.

David S Leigh (dleigh@uga.edu) is a Professor of Geomorphology in the Geography Department, University of Georgia, Athens.

Abstract

The forested southern Appalachians provide water for approximately ten million people and hydroelectric reservoirs that generate more than ten billion dollars of electricity, annually. However, excessive sedimentation of surface waters have threatened water supplies and resulted in the establishment of sediment TMDLs for once pristine mountain streams. Forestland conversion for residential, commercial and industrial uses is largely unregulated, occurring at unprecedented rates and predicted to continue increasing over the next fifty years. This development drives the construction of steep, gravel roads into the steep, unstable mountain slopes. Such roads are estimated to account for 30% to over 80% of the contemporary sediment sources to streams. We have researched road erosion and sediment yield for a number of decades and used the results of our work to develop forest road best management practices. However, it is only recently that we have been able to directly quantify the sources of sediments within streams. We have employed total elemental analysis to characterize the mineralogical composition of clastic sediments from native soils, gravel roads and streambeds from southern Appalachian mountain streams. This method allows us to differentiate between weathered, native sources of coarse streambed sediments (sand size and greater) and fresh quarry-sources of streambed sediment. The strongest elemental signals occur as elevated sodium and calcium signatures in the road gravel and enrichment in stream sediments. We are using this method to directly quantify sediment budgets for these streams and improve our development of forest road best management practices.