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Geochemically Fingerprinting the Impacts of Human Land Use on Sediment Provenance

DYLAN M. SEAL[1], ETHAN F. BAXTER[1], NOAH P. SNYDER[1], KASEY CORRADO[1], TASSILO SAJONIA-COBURGO[1], AYDEN SCHIRMACHER[1], TIMOTHY L. COOK[2], TRAVIS DAHL[3] AND KELSEY FALL[3]

[1]Boston College

[2]University of Massachusetts Amherst

[3]U.S. Army Corps of Engineers Engineer Research and Development Center

Presenting Author: seald@bc.edu

Human alterations to landscapes through timber harvest, agriculture, dam construction, and urbanization can greatly influence watershed-scale sedimentary processes. In this study we test the viability of utilizing Rb-Sr isotope systematics and elemental geochemistry as fingerprints of human influences on sediment provenance and transport in two watersheds with varied land use histories. First, we analyzed a >1,200-year sediment core record collected from Little Kennebago Lake (LKL) in Maine, USA where widespread timber harvest began around 1900, prior to which human influence was negligible. We find that the onset of logging coincides with lower and more variable $^{87}Sr/^{86}Sr$ ratios (<0.722500) and greater variation in elemental concentrations relative to the undisturbed watershed. We also measured $^{87}Rb/^{86}Sr$ ratios that reveal a strong linear correlation with $^{87}Sr/^{86}Sr$ in the pre-logging period and yield an apparent Devonian isochron age of 368 ± 12 Ma (MSWD=1.3, n=28). Devonian-aged granitic plutons in the northern part of the catchment do not match pre-logging $^{87}Sr/^{86}Sr$ observations and are therefore not a primary source. Metamorphic rocks near LKL were likely metamorphosed during the Acadian (Devonian) Orogeny and thus represent likely sediment sources for further testing. After the onset of logging, isotope ratios are less radiogenic and form an 'errorchron' with greater scatter and an apparent Carboniferous age of 332 ± 16 Ma (MSWD=4.7, n=8). No Carboniferous-aged rocks exist in the catchment, therefore this shift likely represents the introduction of additional unradiogenic sediment sources. We apply these same methods to investigate human impacts in the Apalachicola-Chattahoochee-Flint (ACF) river system, where the Chattahoochee and Flint rivers are punctuated by numerous dams and drain a variety of land use types and urban centers including Atlanta, GA. The confluence of the two rivers is Lake Seminole, where we collected two sediment cores from the Chattahoochee and Flint arms of the lake that display decreasing trends in $^{87}Sr/^{86}Sr$ values through time, and surface sediment transects suggesting a coupling between $^{87}Sr/^{86}Sr$ ratios and grain size. We will quantify Rb-Sr isotope and elemental systematics of bulk sediment and determine the relationship of each geochemical fingerprint with grain size and mineralogy to further constrain human influences on sedimentary processes.