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Rb-Sr Isotope Fingerprinting the Impacts of Human Land Use on Sediment Provenance in the Apalachicola-Chattahoochee-Flint River Watershed, USA

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Human alterations to landscapes through timber harvest, agriculture, dam construction, and urbanization can greatly influence watershed-scale sedimentary processes. In this study, we utilized bulk sediment Rb-Sr isotope systematics to investigate the impacts of human land use on sediment provenance and transport in the Apalachicola-Chattahoochee-Flint 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, created through construction of the Jim Woodruff Dam in 1954. We utilized a bathymetric survey to identify and collect sediment cores from the inundated paleo-river channels and floodplains of the Chattahoochee and Flint Rivers.

Reservoir sediment $^{87}Sr/^{86}Sr$ ratios from both the Chattahoochee and Flint-arms of Lake Seminole varied over a similar range from 0.718–0.722 and generally increased with core depth. Reservoir sediment from each arm is distinct in Rb-Sr isotopic composition, potentially due to the substantial differences in land use that exist between the regions drained by each river and consequent impacts on erosion and sediment transport. Additionally, we identified the stratigraphic transition from pre-reservoir to reservoir sediment within two sediment cores from the Flint-arm paleo-river channel and floodplain, marking the construction of the dam to create Lake Seminole in 1954. Relative to reservoir sediment, the paleo-floodplain contains more radiogenic $^{87}Sr/^{86}Sr$ values (0.723–0.725) that increase with core depth, while river channel sediment is substantially more variable (0.716–0.727). Rb-Sr isotope ratios also vary greatly between pre-reservoir and reservoir sediment and suggest an important shift in upstream provenance or transport following the construction of Lake Seminole. We also collected lakebed grab samples that provide a spatial record of modern sediment influx to Lake Seminole, and found Chattahoochee-arm sediment to contain much more variable $^{87}Rb/^{86}Sr$ and $^{87}Sr/^{86}Sr$ ratios than Flint-arm sediment, likely reflecting differences in both sediment provenance and transport processes, as we observed a negative correlation between $^{87}Sr/^{86}Sr$ ratio and grain size in the grab samples. Future analysis of additional bedrock and sediment cores upstream of Lake Seminole will be utilized to further constrain human impacts in the catchment.