Anthropogenic Impacts on Urban Watersheds: Insights from Laser Ablation ICP-Q-MS Analyses of Bald Cypress Tree Cores

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Urban areas in Texas are growing rapidly. This growth impacts the natural watersheds in this area and contributes to the degradation of water quality that is part of urban stream syndrome. We evaluate the effects of urbanization on watershed water quality in the Austin area using cores taken from bald cypress trees as novel proxies of historic water quality. Tree rings are useful indicators of the temporal changes in the elements absorbed because they can be precisely dated over the time scales of urban growth in the US. Tree core elemental concentrations are being analyzed by laser ablation inductively coupled plasma quadrupole mass spectrometry (LA-ICP-Q-MS). This method provides higher temporal resolution than the solution mode ICP-MS methods. Well-characterized standard materials are fundamental to developing such LA methods. We have characterized two standard materials - Beech wood and Valerian root (*myStandards GmbH*). These were selected because they have similar porosity to that of bald cypress wood. Replicate analyses were performed on these standards to characterize their geochemical variability, and the analyses returned significantly repeatable values.

The dendrochronology of the tree core rings (Banner et al., in review), establishes their age range and indicates a yearly temporal chronology. The LA-ICP-Q-MS analyses of the tree core rings will focus on elemental concentrations associated with urban growth (Al, Zn, Cu, Ti contributed by vehicles), wastewater and municipal water leakage (Na and K contributed by aging infrastructure), as well as agricultural runoff (Mg, K, Na, and Ca from reclaimed water used for irrigation). Comparisons will be made between two watersheds in the Austin area with different extents of urbanization, namely urbanized Waller Creek and the rural Onion Creek. Statistical analysis using R will compare trees in the same watershed and trees between watersheds. In addition, cores from the same tree will be compared to establish whether there is movement of elements between tree rings (i.e., translocation). EPA Positive Matrix Factorization software is going to be used to determine the relative contribution of each pollution source (i.e., urban growth vs aging infrastructure vs other sources) and help to identify any currently unaccounted for pollution sources. Furthermore, the analysis seeks to correlate changes in elemental concentrations to changes in pollution sources.

Work is on-going to collect tree cores for this study. An original set of samples were collected in 2018-19 from both watersheds but was processed by sanding and gluing onto wooden mounts prior to the dendrochronology analysis. Although this type of tree core processing is well established in the literature, it likely contaminated the original samples (Sananda et al., in progress). As a result, a new set of tree core samples using a glue-free and sanding-free methodology will be analyzed. Next, we will conduct LA-ICP-Q-MS analysis on the new tree cores and compare these temporal elemental trends with urban development temporal variables such as infrastructure age and extent.

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