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Geochemical Indicators of Urban Development in Austin, TX Streamwater

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Urbanization can cause significant changes to both flow and water quality in streams and tributaries. In the Austin, Texas, area, previous studies have demonstrated that streamwater strontium isotope compositions ($^{87}Sr/^{86}Sr$) correlate with measures of urbanization when comparing non-urbanized streams to their urban counterparts. The inclusion of municipal water into natural surface water is inferred from the mean $^{87}Sr/^{86}Sr$ value found in urbanized streams, which falls between the high value in treated municipal water and the lower values found in local surface streams sourcing from non-urbanized catchments. Fluoride is added to municipal tap water in the treatment process, and a correlation between $^{87}Sr/^{86}Sr$ and fluoride is observed in streamwater sampled from the watersheds around Austin. These relationships represent some of the principal findings reported in Christian et al. (2011). Current research is testing the hypothesis that municipal water influx in urban areas is a primary modifier of stream- and spring-water chemistry in a single watershed that contains a strong gradient in land use. We compare $^{87}Sr/^{86}Sr$ and other chemical constituents with potential contributing endmembers, such as municipal tap water and wastewater, local soil and rock leachates, and land use within the Bull Creek watershed. As a consequence of the history of land development, some Bull Creek tributaries are sourced and flow almost entirely in fully-developed areas, whereas others are located in protected natural areas. Thirteen tributaries were monitored and classified as either urbanized or non-urbanized based upon land use within the tributary catchment. Springs in the Bull Creek watershed were also sampled and are similarly classified. The Bull Creek watershed is composed of Lower Cretaceous limestone with significantly lower $^{87}Sr/^{86}Sr$ than that of municipal water taken from the Lower Colorado River, which is underlain in part by Precambrian rocks upstream of Austin. There are notable differences in urbanized vs. nonurbanized watersheds in mean concentrations of fluoride (urbanized: 0.27 ± 0.08 vs. non-urbanized: 0.19 ± 0.01 ppm), sodium (34.7 ± 17.3 vs. 8.4 ± 1.0 ppm), and potassium (2.9 ± 0.8 vs. 1.2 ± 0.2 ppm), consistent with higher concentrations in municipal water contributing to the urbanized tributaries. Springwater demonstrates similar divergences for these ions. $^{87}Sr/^{86}Sr$ for the springs falls within a narrow range for non-urbanized springs (0.7079-0.7081), similar to Cretaceous limestone values, whereas urbanized springs contain a larger range (0.7077-0.7087). These results are consistent with urbanization effects in the Bull Creek watershed.

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