Tracing salinity sources in the semi-arid Rio Grande River with a multi-isotope tracer (U, S, B, and Sr) approach

LIN MA[1], SANDRA GARCIA[1], SYPROSE NYACHOTI[1], ANNA SZYNKIEWICZ[2], JENNIFER MCINTOSH[3], JEROME GAILLARDET[4]

[1]Department of Geological Sciences, University of Texas at El Paso, TX, USA, lma@utep.edu
[2]Department of Earth and Planetary Sciences, University of Tennesee, Knoxville, TN USA
[3]Department of Hydrology and Water Resources, University of Arizona, Tucson, AZ, USA
[4]Institut de Physique du Globe de Paris, France

Irrigation with high saline Rio Grande water has led to accumulation of salts in soils and reduced crop productivity. The salinity sources in the Rio Grande have not been adequately quantified. Here, we combine U, S, B, Sr isotopic tracers to fingerprint the salinity sources. Our study area focuses on a 200 km long stretch of Rio Grande from Elephant Butte Reservoir, NM to El Paso, TX. Monthly river samples were collected from 2014 to 2016. Irrigation drains, groundwater wells, city drains and wastewater effluents were also sampled as possible salinity end-members. Our data suggest multiple salinity inputs from geological, agricultural, and urban sources. Natural upwelling of groundwater is significant for Rio Grande near Elephant Butte, as evidenced by high TDS values and high ($^{234}U/^{238}U$), $^{87}Sr/^{86}Sr$, $\delta^{34}S$ ratios. Agricultural activities (e.g. flood irrigation, groundwater pumping, fertilizer use) are extensive in the Mesilla Valley. Rio Grande waters from this region have characteristic lower ($^{234}U/^{238}U$), $^{87}Sr/^{86}Sr$, and $\delta^{34}S$ ratios, suggesting strong contribution from agricultural sources. Urban impacts on river chemistry were evident for downstream locations in Las Cruces and El Paso, due to wastewater effluents. This study improves our understanding of how human activity impacts water quality and elemental cycles in a semi-arid river.