Using $^{87}Sr/^{86}Sr$ ratios of carbonate minerals to quantify dust fluxes from desert playas to the urban Wasatch Front, Utah, USA

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Issue and approach

Dry lakebeds (playas) are important dust sources globally, with potentially harmful impacts on downwind urban areas. The Wasatch Front (population >2 million) in northern Utah, USA, is located adjacent to multiple playas, including the Great Salt Lake (GSL). As water levels on GSL continue to decline due drought and water diversions, there could be intensified dust emissions from the newly exposed lakebed. To quantify fluxes from GSL relative to other playas, we developed geochemical and isotopic fingerprints of dust sources and compared them to dust deposition along the Wasatch Front. Dust emissions were sampled at GSL and seven playas in western Utah, including Sevier Dry Lake, and dust deposition was sampled at four locations in the Wasatch Front, including Provo, Salt Lake City, Ogden, and Logan. All dust samples were analyzed for mineralogy, bulk chemistry, $^{87}Sr/^{86}Sr$ and other isotope ratios on multiple leachate fractions.

Results and discussion

Sr isotope ($^{87}Sr/^{86}Sr$) ratios in the carbonate mineral fraction was variable in the playa dust sources, ranging from 0.7100 in Sevier Dry Lake to 0.7150 in GSL. Wasatch Front dust deposition samples fell within these endmember values, ranging from 0.7110 to 0.7130. Using $^{87}Sr/^{86}Sr$ ratios and elemental concentrations, we developed a mixing equation to quantify seasonal fluxes from GSL and Sevier Dry Lake to the Wasatch Front. Using $^{87}Sr/^{86}Sr$ and the U/Sr ratios, GSL contributed ~10% to ~50% of the dust flux along the Wasatch Front in Fall 2015. GSL was a less important dust source in Spring 2016, contributing ~0% to ~15% of the total dust flux. These findings suggest that elemental concentrations and $^{87}Sr/^{86}Sr$ of carbonate minerals may be useful for evaluating dust emissions from playas worldwide, and that $^{87}Sr/^{86}Sr$ measurements should not be restricted to the silicate fraction for dust provenance studies.