Tracing gypsiferous White Sands aerosols in the shallow critical zone at White Mountain, New Mexico using Sr/Ca and $^{87}Sr/^{86}Sr$ ratios

PAT REA[1], LIN MA[1], THOMAS GILL[1], JORGE GARDEA-TORRESDEY[2], CARLOS TAMEZ[2], LIXIN JIN[1]

[1]Department of Geological Science, Univerity of Texas at El Paso, El Paso, TX 79968, USA, ljin2@utep.edu

[2]Department of Chemistry, University of Texas at El Paso, El Paso, TX 79968, USA

Dry deposition significantly affects evolution of the critical zone by supplying nutrients and contributing to soil genesis. Dust deposition and its mobility in soils, however, are difficult to quantify. White Sands, New Mexico, emits gypsum dust with a unique chemical and isotopic signature, providing an opportunity to investigate its loading and movement. This case study evaluated the mobility of White Sands dust particles in the active critical zone at White Mountain, New Mexico, a highland 100km downwind. Four soil profiles were collected over bedrock of different reactivities, from the most reactive limestone, mixed limestone, igneous, to sandstone bedrocks, as well as leaves of local grass, shrubs, cacti, and pines, regional dust, and White Sands. All samples were analyzed chemically, mineralogically, and isotopically ($^{87}Sr/^{86}Sr$).

Bulk soil chemistry was mostly controlled by weathering over carbonate substrates, whereas the dust signal was only detectable in shallow soils over the least reactive sandstone. Although ony making up a small portion of a bulk soil in mass, White Sands dust, along with wet precipitation, dominantly controlled the chemistry of the water leachable fraction of the soils. Indeed, the $^{87}Sr/^{86}Sr$ ratios of soils in the water leachable fractions were very similar among all four sites, within the endmembers of rainfall and White sands dust. Dust particles were very soluble, and concentrtions of dissolved Ca^{2+} and SO_4^{2-} typically increased with depth as gypsum dissolved and reprecipitated as it reaches the impermeable bedrock-soil interface.

The $^{87}Sr/^{86}Sr$ and Ca/Sr ratios in plants, just like soil leachates, varied narrowly, and were dominantly sourced from dust and rain. Although absolute concentrations of Ca and Sr concentrations differed widely among four sites and among different plants, Sr/Ca ratios were largely controlled by plant type, and thus the rooting depth. Overall, this study tracked White Sands dust input to the soils, and provided better understanding of long-distance dust transport and the effects of gypsum dust on sources of bioavailable plant nutrients in an active critical zone.