Aeolian additions: The downwind effects on soil and vegetation in Owens Valley

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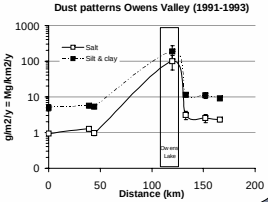
Introduction

Owens Lake playa is an important source of mineral aerosol that has been activated during the 20th century due to human use of water. The dry lakebed is a source of salts containing potentially toxic trace elements as well as fine-grained silicate minerals. In view of the potential hazard to human health exhibited by the dust clouds produced by the playa, the chemistry and mineralogy of the playa and the dust has been analyzed in reasonable detail. By contrast, the impact of the dust on the soils and ecosystems in Owens Valley has been less well studied.

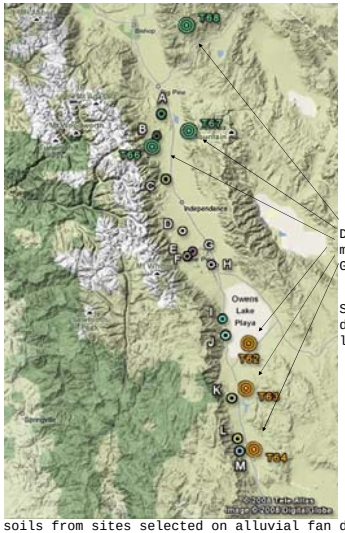
Dust-flux measurements on material collected in above-ground traps suggest that significant quantities of salt-rich dust has been incorporated into the soils in the region around Owens Lake playa (Reheis 1995).

Dust traps created by Marith Reheis of the US Geological Survey. Dust traps T68, T67, T66, T64, T63 and T^@ (no longer extant) are located in Owens Valley (see map)



Sampling locations

Soil pit at location (G)



Av horizon near the Alabama Hills

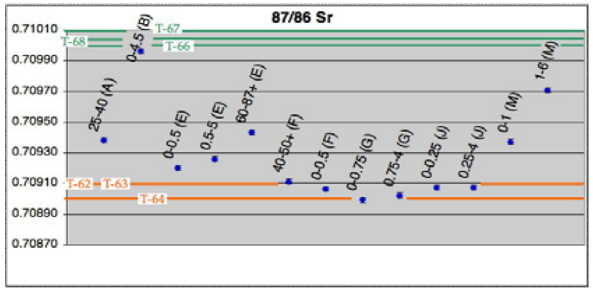
Dust Traps monitored by the US Geological Survey

Soil pit locations designated by letters A-M

Soil pit location (J) with Owens Lake playa in view

Sampled soils from sites selected on alluvial fan deposits emanating from the Sierra Nevada Batholith granites. We know that there is a distinct contrast in trace element chemistry, Sr isotopic composition and particle size among the granitic parent material, the playa sediments and the regional dust rain.

Results--Strontium isotopes



Preliminary Strontium 87/86 isotope ratio values from select horizons (depth given in cm) in soil pits at locations A, B, E , F, G, J and M. Green lines on graph represent Sr isotopic ratio values measured from dust trap samples located north of the Playa. Orange lines are values from dust traps located south of the Playa.

Conclusions

Soils: Preliminary results do show an increase in pH, EC and silt in soils situated near the NW end of the playa. EC is generally highest at the top of the soil profile, decreases, and then increases again lower in the profile, leading us to believe that salt-rich aeolian material is being added to the surface, and salts are being washed down through the profile by precipitation. Sr values show a clear playa dust signal in the soils closest to the playa (locations E, F, G, J).

Ecosystem: The sodium adsorption ratio, electrical conductivity, pH and soil textures at all but one of the sampling locations fall within the 'normal soil' range for all but the most sensitive of plants. Therefore, though salts and fines may be added to the soil by playa dust, it appears as though there would be no significant effect on the vegetation in the sandy soils of the alluvial fans.

Study and Methods

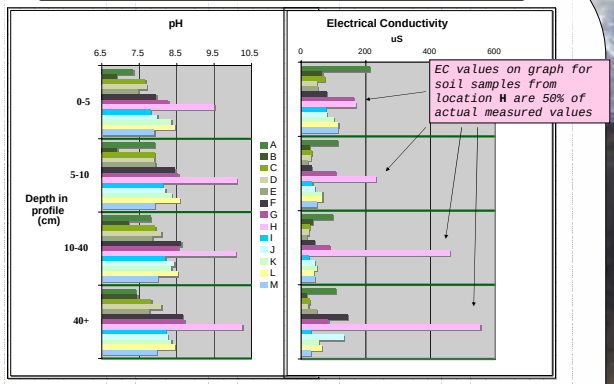
What is the effect of Owens Lake Playa dust on soils and ecosystems in the valley?

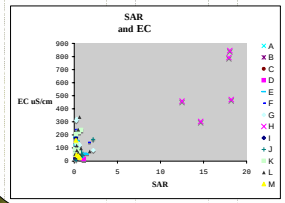
The dust-trap transect covers more than 150 km and provides a baseline against which we can evaluate dust accumulation in soil. The dust has saline-sodic properties suggesting that soils and ecosystems near the playa should exhibit the effects of high salt levels and elevated pH associated with high levels of sodium bicarbonate. The research has correlative and tracer components. We are sampling soils down the length of the along-valley transect to quantify soil profile salt composition, pH, EC, SAR, and particle-size properties. The salt component of the playa sediments has elevated Sr concentrations (Gill et al. 2002) and its Sr isotopic ratio ($^{87}Sr/^{86}Sr$) is about 0.7092 (Pretti and Stewart, 2002). By contrast, $^{87}Sr/^{86}Sr$ values lie between 0.706 to 0.708 for most of the surrounding Sierra Nevada granitoid bedrock and alluvium (Kistler and Peterman, 1973), providing a difference between dust and parent material values great enough to allow us to quantify mixing of ions from the two sources in soil solutions.

Particle Size Analysis; 1:1 pH; 1:1 Electrical Conductivity (pipette method)

Elemental Analyses (Ca,K,Mg,Na) (Ba,Li,As,Sr)-ICP-AES
1:1 H_2O Leachate
Strontium Isotopes --Thermalization Mass Spectrometer

Results--Soil Properties





Particle Size Distribution:

Sampled soils have textures of sandy loam, loamy sand or sand.

Clay ranges from 2-8% and silt from 10-40%

Soils located near the NW end of the Playa show an increase in silt fines.

Acknowledgements

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