Salinity and Sodicity Effects on Soil Erodibility and Dust Emissions

R. Scott Van Pelt – USDA-ARS Wind Erosion and Water Conservation

Soil Erosion Research Under a Changing Climate – January 9, 2023

Collaborators

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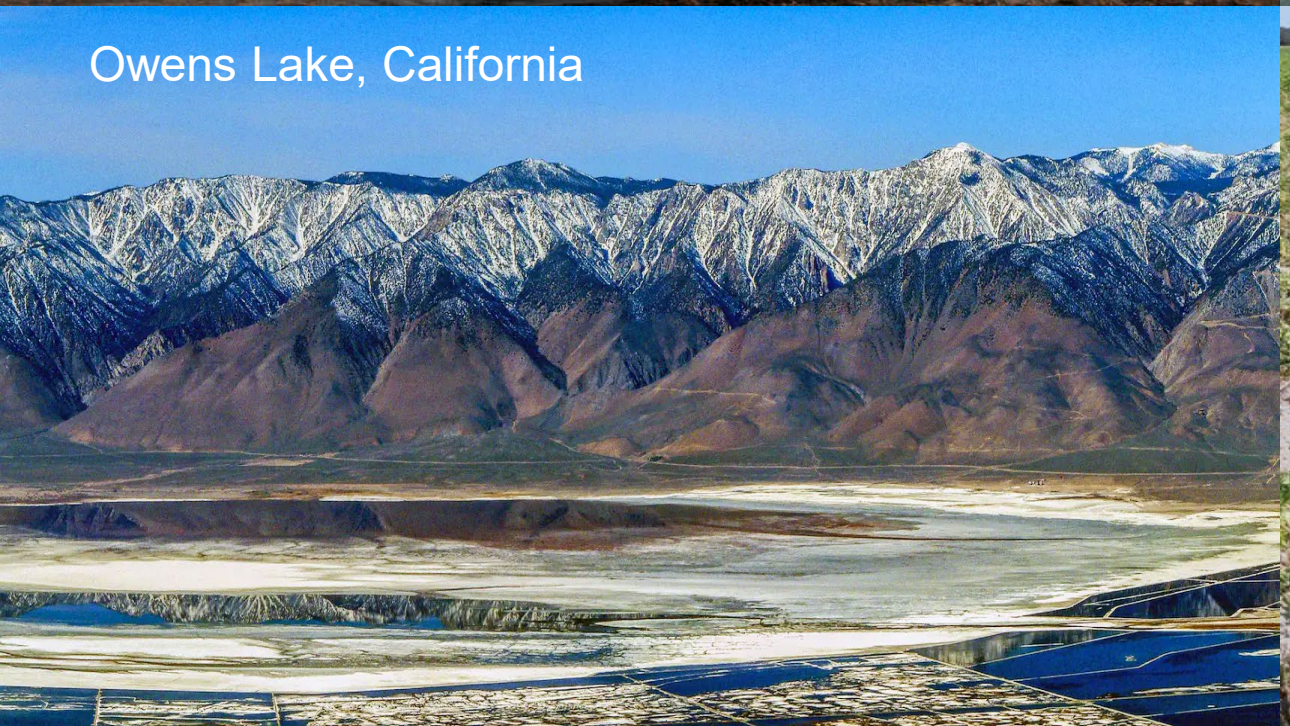
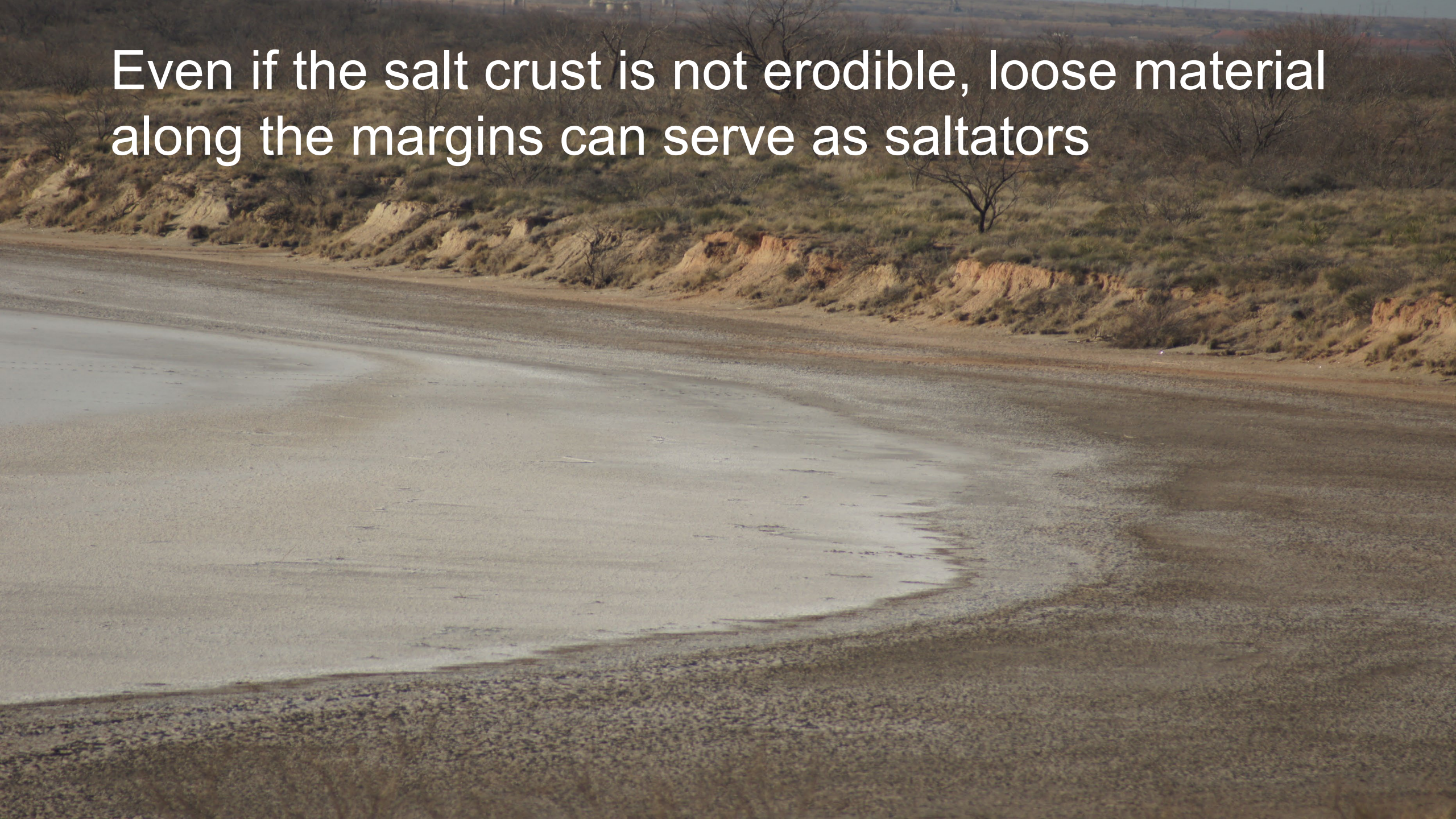
- May be due to deficit irrigation with saline water
- May be due to poor drainage or leaching of pedogenic salts to low spots on the landscape


Great Salt Lake, Utah

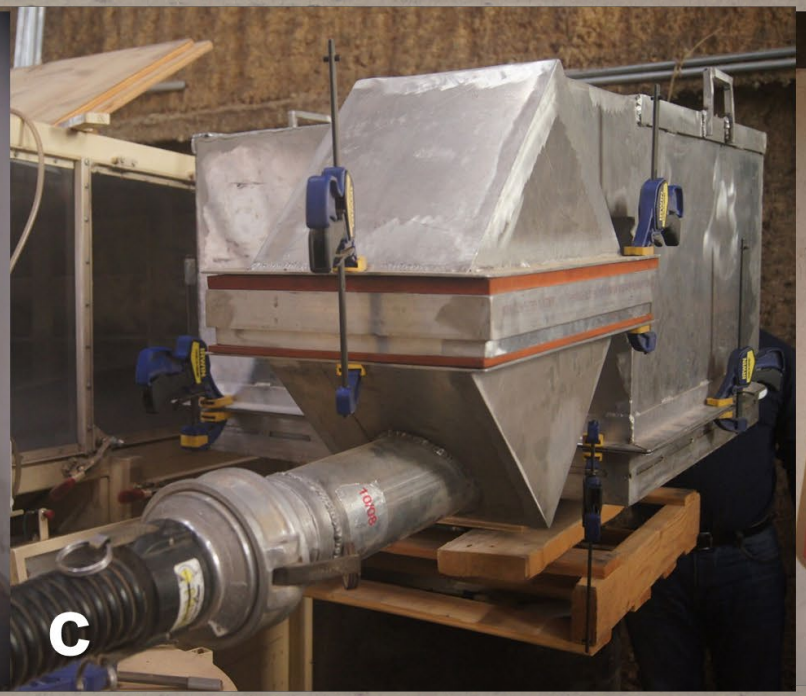

Salt Lake in Iran


Owens Lake, California

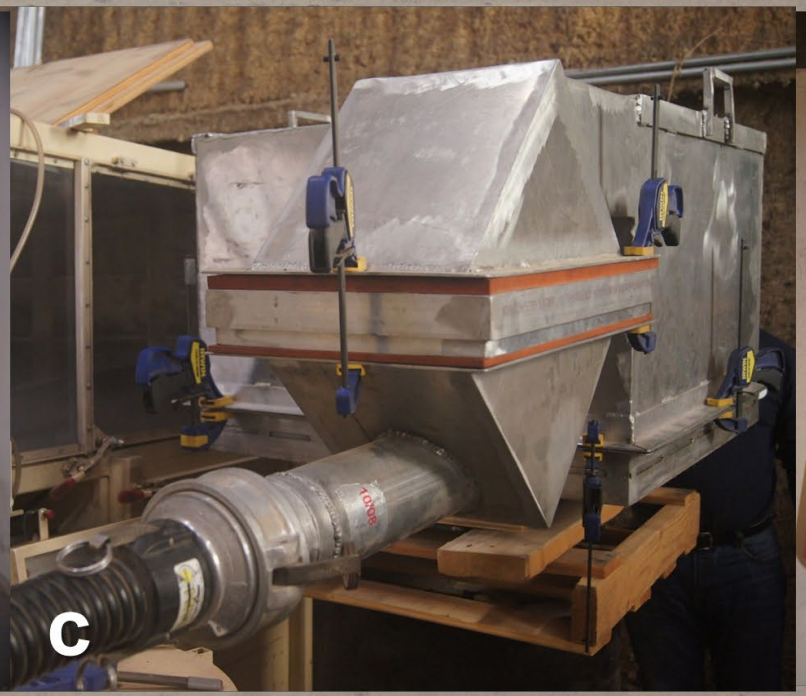

Salinized Farm Field


Even if the salt crust is not erodible, loose material along the margins can serve as saltators

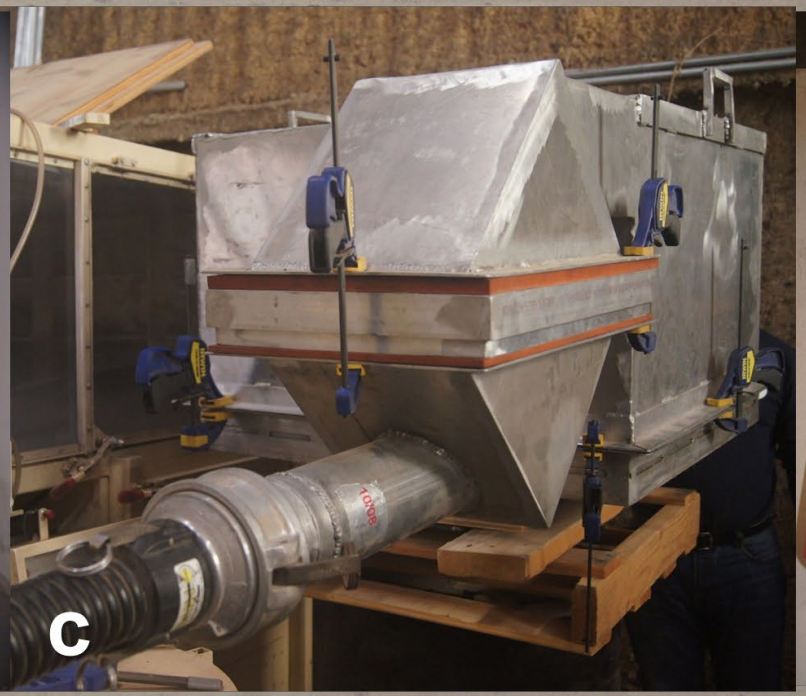
We used a suction type laboratory wind tunnel to test 2 kg of Harkey Clay Loam in 77 X 14 X 1.3 cm soil trays (a) that were wetted from the bottom with 300 g of selected soluble salts in aqueous solution and allowed to dry in a greenhouse to form the efflorescence.

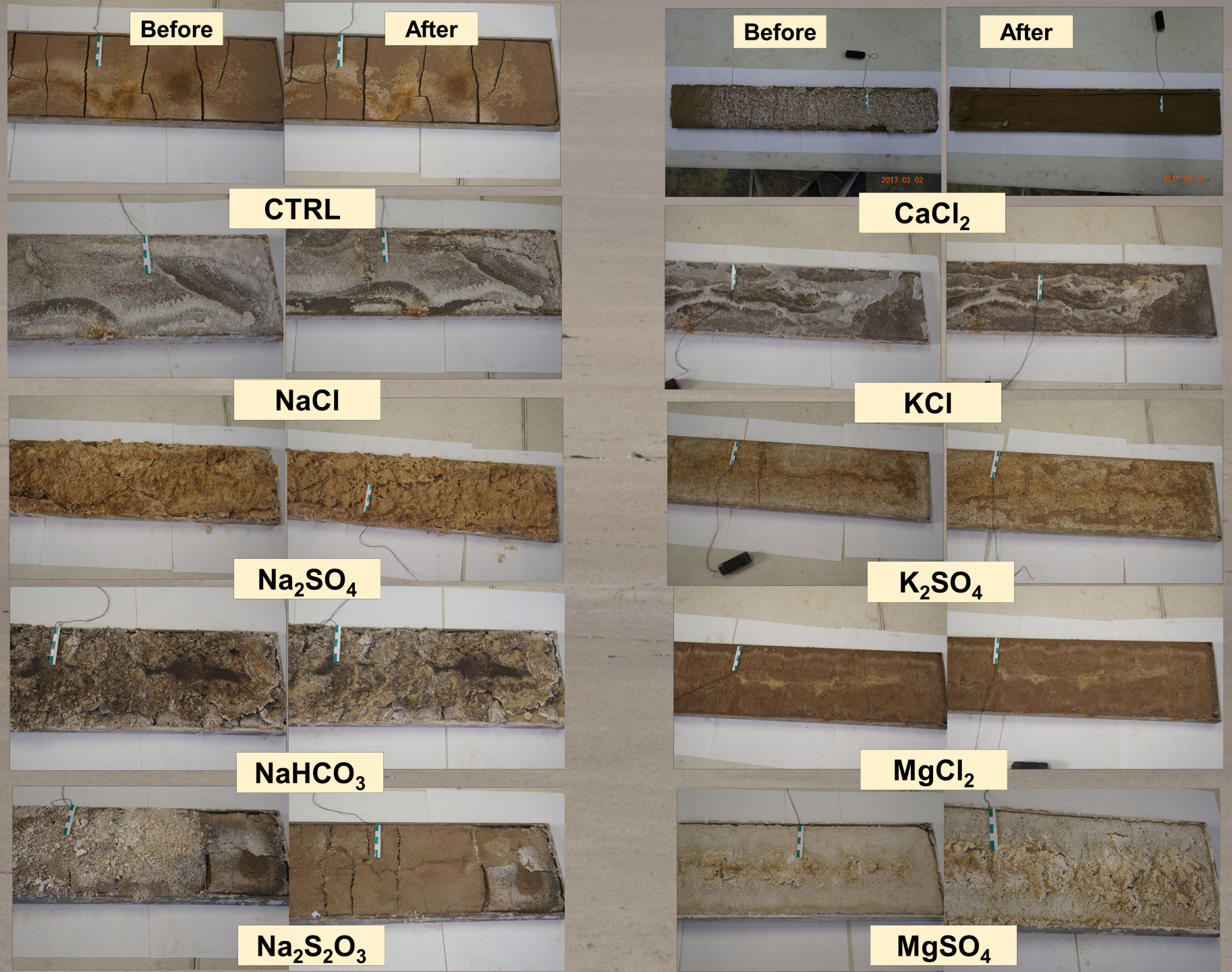


Dry soil trays with efflorescence were bombarded with 40 mesh sand as saltators at a centerline wind velocity of 12.5 m s^{-1} for a period of 20 minutes (b).

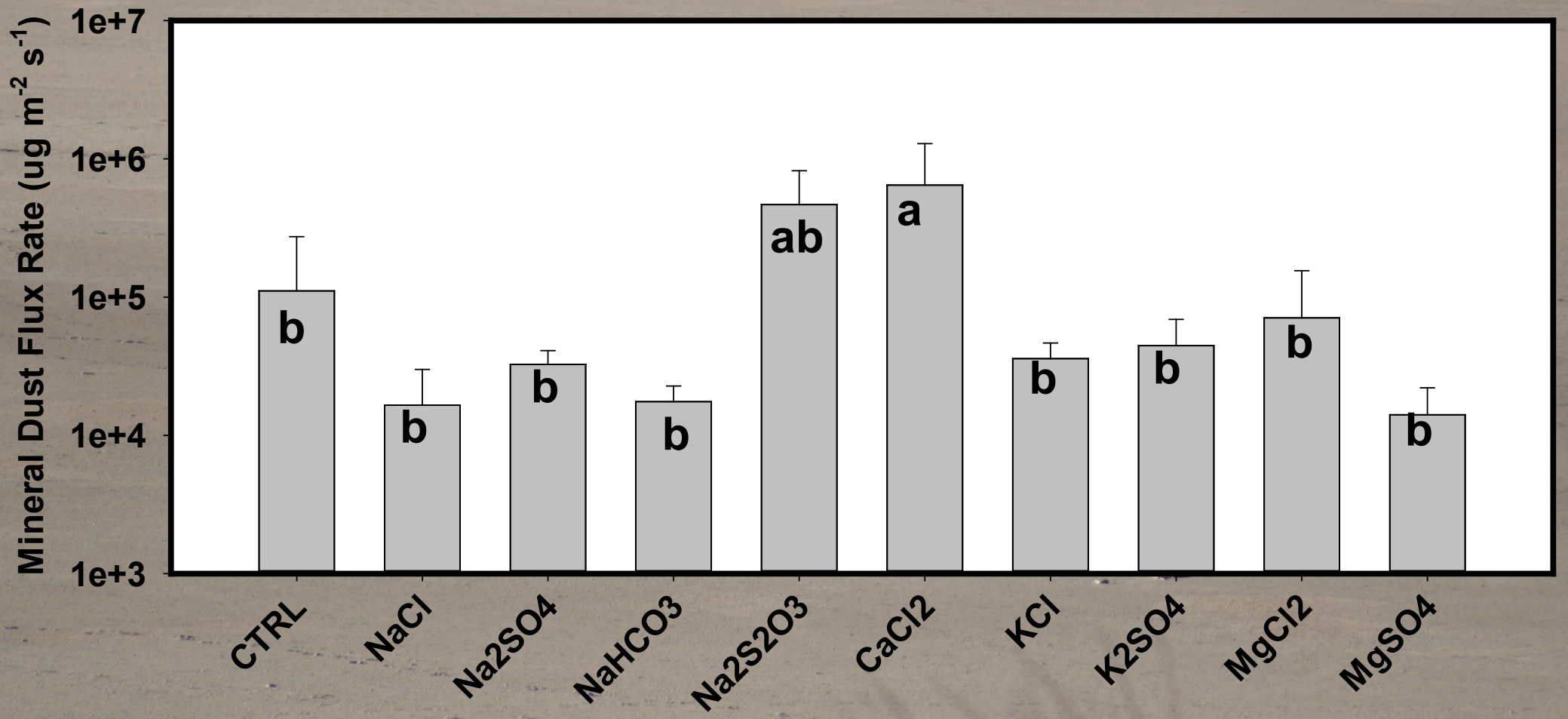


All material (abrader sand, eroded efflorescence, soil in the tray, and emitted dust were drawn through an aspirated sediment recovery system (c) before finally passing through glass fiber filters (d).




Before
After
Before
After
CTRL
$CaCl_2$
NaCl
KCl
Na_2SO_4
K_2SO_4
$NaHCO_3$
$MgCl_2$
$Na_2S_2O_3$
$MgSO_4$

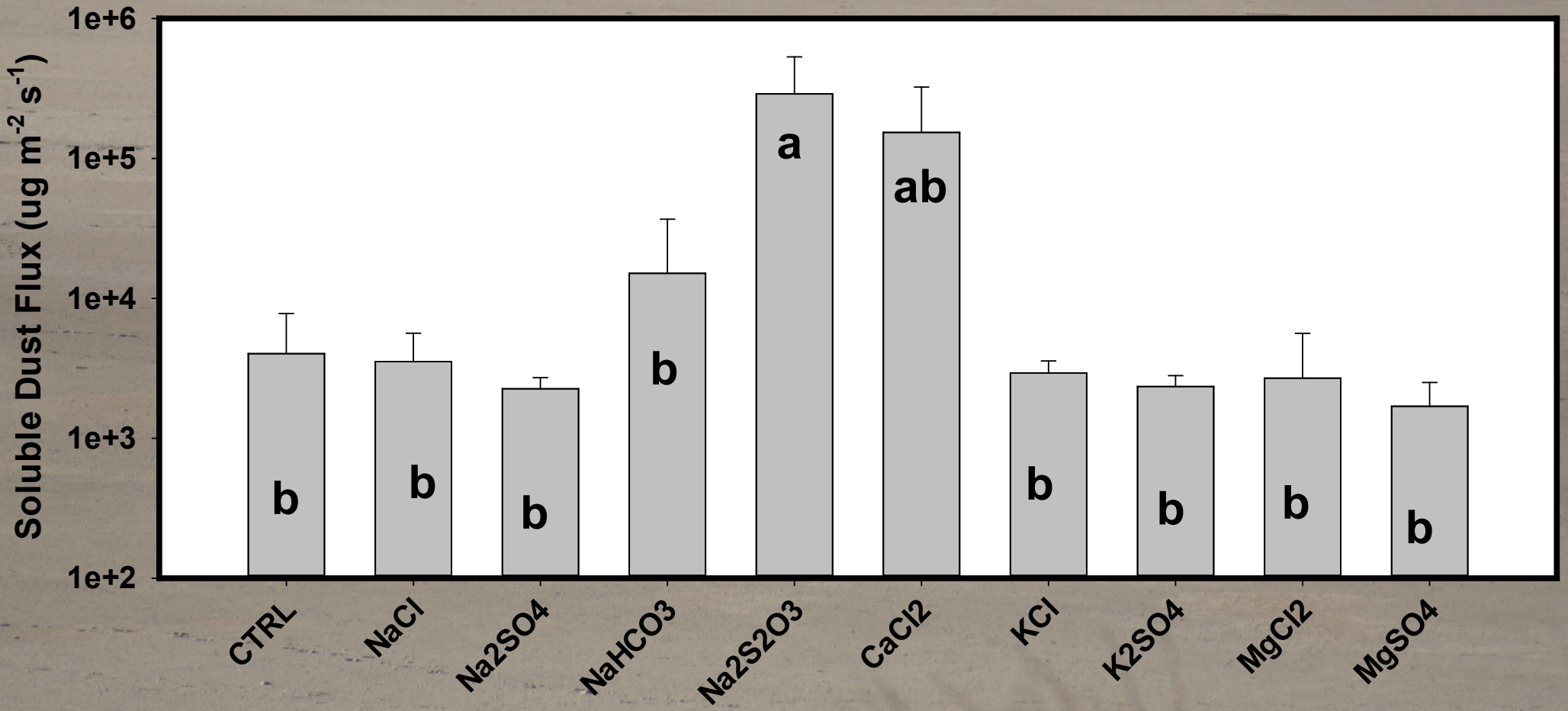
Most salts decreased the dust emissions and, by proxy, erodibility when compared to the control



Solubility of the fine dust was assessed by taking 2 g of dust from the filters, placing the sample in a weighed filter paper, and leaching with 50 ml of distilled water in a funnel.

The insoluble dust remaining and filter paper were dried and weighed

Soluble dust emissions varied from less than the control of which 3.6% of total emissions were soluble to $Na_2S_2O_3$ which had over 60% solubles



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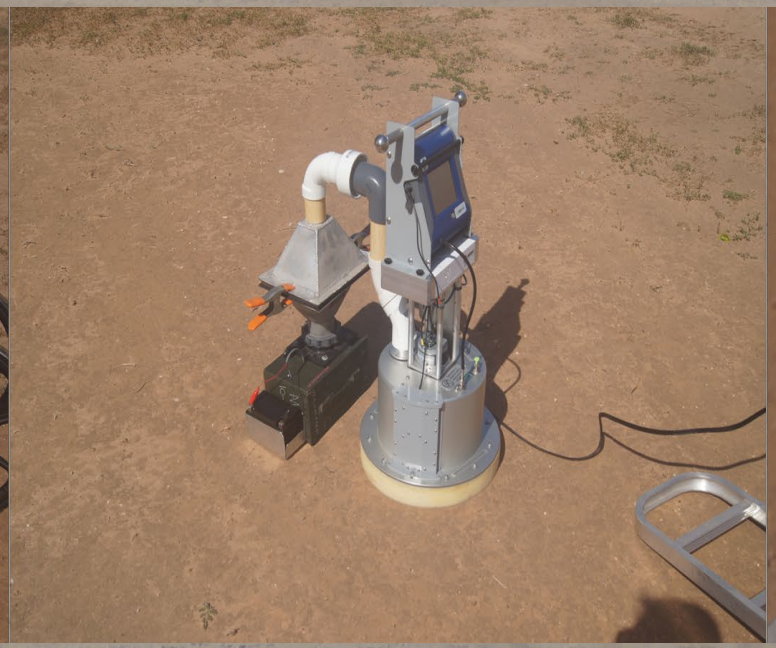
- $CaCl_2$ and $Na_2S_2O_3$ resulted in increased dust emissions compared to the untreated control
- The soluble components of dusts emitted from salt efflorescence covered surfaces can be greater than 60%
- These salts were pure and non-toxic. Most natural salt sinks have salts of other metals, some of which are toxic

Future Work

- Repeat experiment with complexes of Sodium, Calcium, and Magnesium salts consistent with irrigation with water from depleted Ogallala aquifer water with different target salinities and also sodium salts to create soils with different sodicities
- Field testing of naturally salinized soils and sodic soils if available with a Portable In-Situ Wind Erosion Laboratory (PI-SWERL) along with sediment capture appliance



Paolo (L) and Sujith (R) testing salt mixtures in the Big Spring Field Station wind tunnels.


Questions??