

Playa and Lunette Sedimentation Response to Artificial Water Levels: Case Study of the San Luis Lake Area*

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Abstract

San Luis Lake, one of the largest playa systems within the aeolian environment of the San Luis Valley, has been artificially filled and modified, to keep it at levels suitable for fishing and recreational boating, for approximately 80 years. Recently, San Luis Lake has been allowed to fully dry out, exposing the playa sediments for the first time since artificial filling began. This has had a unique effect on the sedimentation patterns within the system. Prolonged high waters levels, that have not been allowed to drop, have cut off the supply of fine sediments to the adjacent lunette system, thereby causing the dunal system to begin to erode away. This is essentially a forced climatic response in the dunes, which respond directly to their playa derived source of fines. At present, the dunes record a prolonged wet climate even though that is not the climatic regime that has been in place over the valley. This is creating a conflicting climatic record in the dunal system, with most dunes recording the semi-arid, drought affected patterns of the region, and the lunettes, in contrast, recording a significant wet period.

The artificial filling has also forced a unique response in the lacustrine sediments found at the center of the playa. A thick, black, organic rich layer, not found elsewhere at the site, is found in the depocenter of the playa. This layer is up to 36 cm thick and has a pervasive, strong, sulfurous odor that can be smelled in the groundwater up to 150 m away from the edge of the deposit. This effect of this layer and the by-products it has been creating on the groundwater is currently unknown, but the layer does appear to be a response to the artificial fill in the playa. Other wet cycles in the region do not correlate to such layers, leading to the conclusion that forcing the system to remain filled and not allowing the cyclic dry/wet patterns has created a unique, human-related deposit in the center of the playa. This deposit is unique and while thinner versions may exist in other deposits elsewhere in the world, the thickness of this deposit is not known to be within normal ranges. While part of the thickness may be due to San Luis being located at the depocenter, the presence of such a thick layer and the fact it is impacting groundwater a fair distance from the edge of the deposit may be indicating that the deposit may be contributing to the degrading water quality in the valley.

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M.E. Brunhart-Lupo, PhD

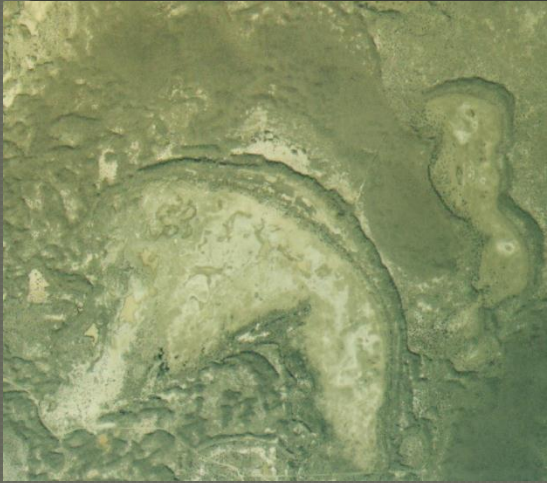
22 July 2014



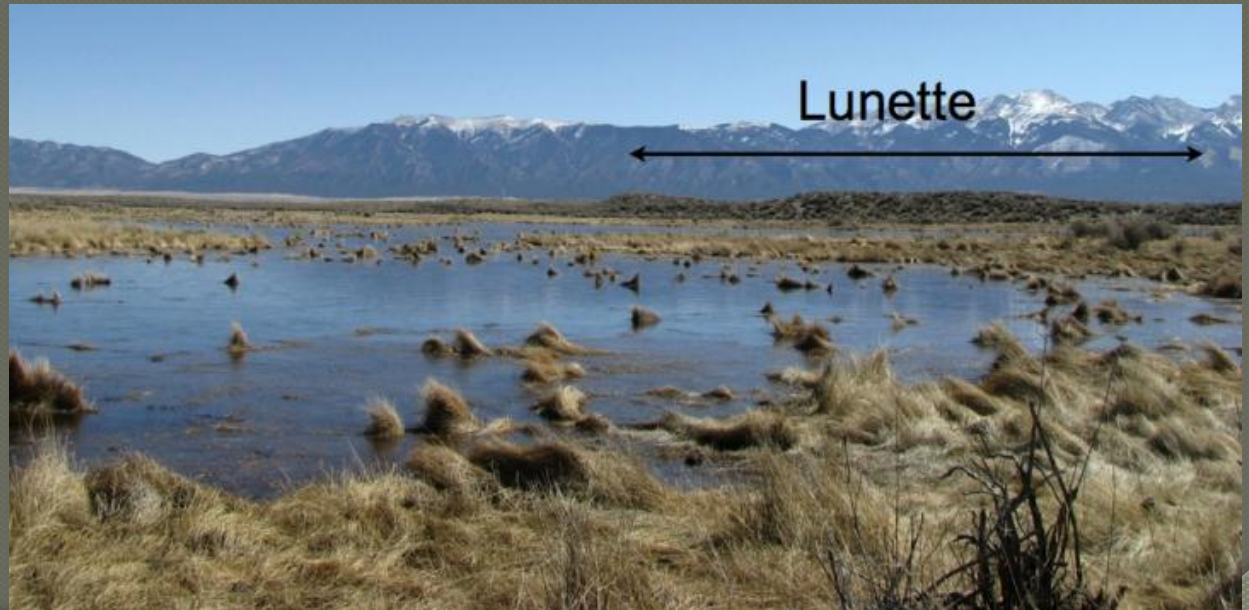
What is a Lunette?

- Lunettes are horseshoe shaped deposits found in association with playas
- These deposits have a mix of aeolian and lacustrine deposits, occasional layers of evaporites
- Often curve roughly $\frac{2}{3}$ around the playa, with the $\frac{1}{3}$ windward face having no deposit

LUNETTES



NPS aerial archive



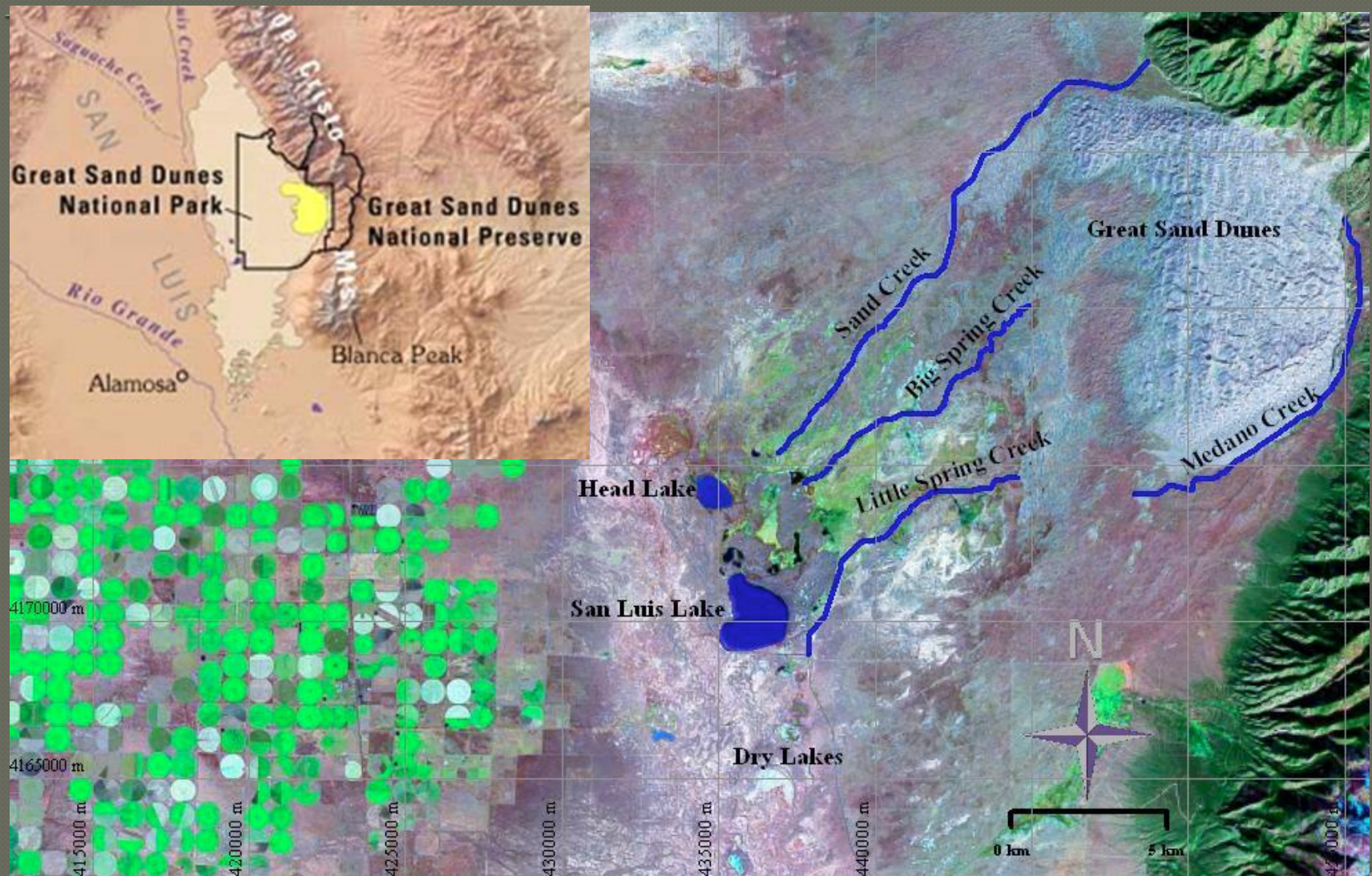
Formation of Lunettes

- Formation begins with a low ridge of sand along the lee edge of a playa
- During dry periods, fines from the dry playa blow onto the ridge, providing a small amount of cohesive material
- Uppermost layers of the lunette are not stable, but underlying layers can be incredibly hard to erode
- Sand is also accumulated onto the feature during this time

Formation of Lunettes Cont'd

- During wet periods, the lunette still receives aeolian sand, but the source of fines is cut off
- Instead, fine materials are deposited directly onto the edge of the lunette via lacustrine sedimentation
- Lunette is more or less stabilized during wet phases, though some of the feature may be lost into the playa

FIELD LOCATION







San Luis
State Park

Ln 6 N

Ln 6 N

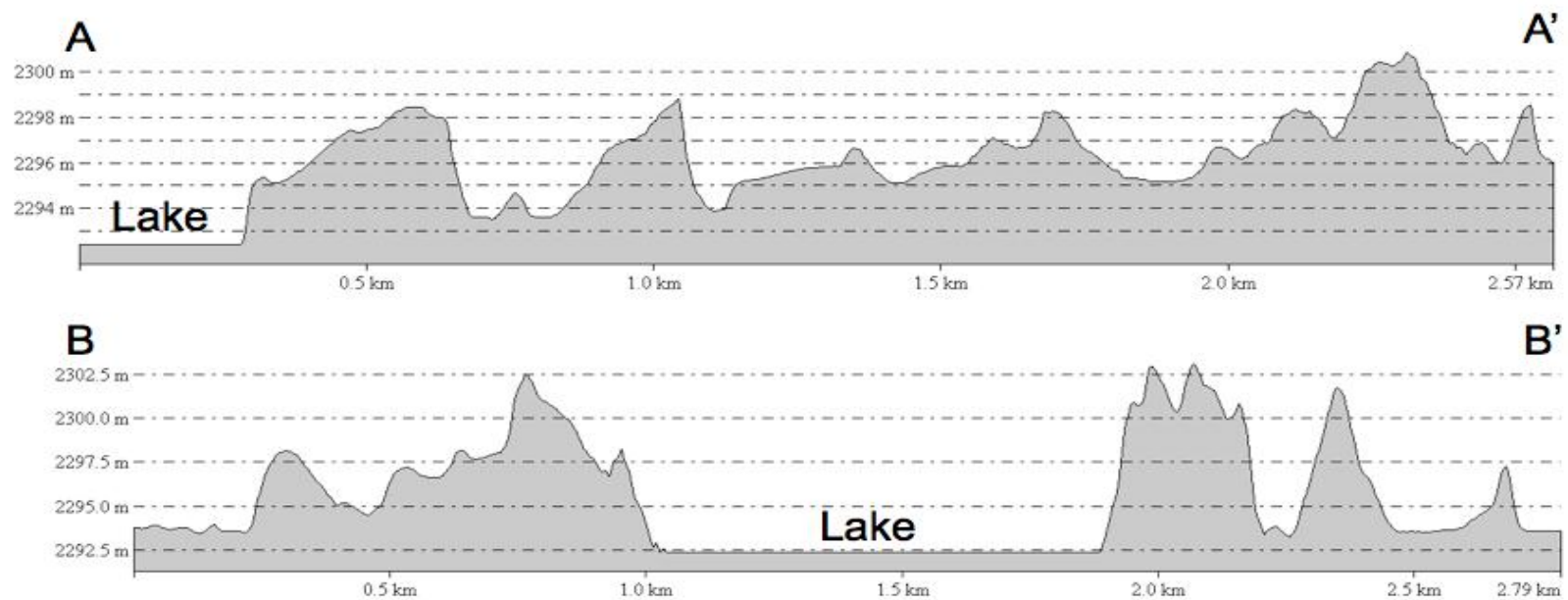


San Luis Lake

- Undergone artificial control for roughly 80 years
- Lunette system has begun to degrade due to the playa remaining filled: record of artificially long wet season
- Playa allowed to dry out for the first time since creation of the state park
- Center of the playa to edge tested



Fluvial Modified Lunette



Central Playa Deposit

- Black, thick clay consistency
- 36 cm thick, 8 cm from the surface
- Prevalent sulfurous odor
- Smell traceable in groundwater up to 150 m from test pit at center of playa
- Deposit likely due to artificial water levels and the stalling of the natural playa/lunette cycle

Central Playa Deposit Cont'd

- ◉ Deposit thins towards edge of playa
- ◉ Abrupt stop 6-7m from lunette/playa edges
- ◉ Material is not found within lunette deposit, nor is it found on the non-playa side of the lunette
- ◉ Of 26 playas tested, deposit only found at San Luis Lake











Blanca Wetlands

- Had been originally used to help stabilize water flow to other parts of the valley
- By 1900 the entire system was dry
- Park Service began restoring the wetlands in 1965 – a process that is still ongoing
- Multiple playas smell of sulfur much like the deposit at San Luis, but are rimmed with trona









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Conclusions

- ◉ Deposit likely due to forced fill of the playa
- ◉ May be contributing to groundwater contamination within the valley
- ◉ Deposit unique to one playa

Ongoing Work

- Establishing range of age for the entire deposit (sands, layer 1, sands)
- Mapping the extent of the deposit
- Isopach of the deposit
- Comparisons to Blanca Wetlands
- Mapping of the groundwater plume

Thank you

Thank you for attending this presentation,
and for your questions.

