

THE BALANCE OF AEOLIAN AND HYDROLOGIC PROCESSES AT GREAT SAND DUNES, COLORADO, USA. A. D. Valdez, National Park Service, Great Sand Dunes National Park & Preserve, 11500 Hwy 150, Mosca, CO 81146, andrew_valdez@nps.gov

Introduction: Great Sand Dunes (GSD) is a complex aeolian system, located in south-central Colorado, within the Alamosa Basin and adjacent to the Sangre de Cristo Mountains, Figure 1. It is developed along a topographic gradient and consists of playas and alkali flats at the western end, which transition into a sand sheet as elevation rises. Near the mountain front, the sandsheet changes to dunefield or sand ramps. The variability in sand deposits suggests that geologic processes vary within the system.

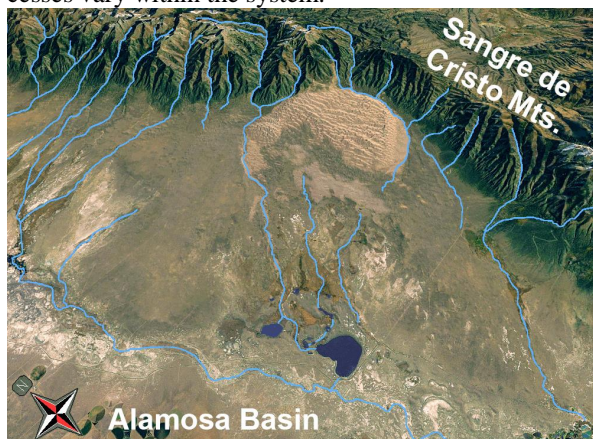


Figure 1. Oblique view of Great Sand Dunes aeolian and hydrologic system.

Superimposed on the aeolian system is a hydrologic system, Figure 1. Streamflow is generated in the Sangre de Cristo Mountains and it mostly infiltrates once it reaches the sand deposits. The larger streams can reach the playas during periods of high runoff. Groundwater also flows westward and as topography flattens, it emerges on the sand sheet and alkali flats. The playas are the terminus of the system.

At GSD, wind and water erode, transport and deposit sand so each plays a role in the development of the aeolian landscape. Wind transport is generally from the southwest to the northeast. Water flows in the opposite direction forcing equilibrium conditions to develop as the processes oppose each other.

Geologic Processes: The regional setting is controlled by rifting. The basin grabens are filled with sandy sediment that can easily supply aeolian activity. The mountain horsts produce streamflow and influence wind regime. Rifting also determines the location of GSD as it originates in the graben where subsidence creates a sump of an internally drained system [1]. The horsts bound the aeolian system as sand ramps climb, but are stopped by the rising bedrock.

Aeolian processes. Wind regime is unimodal from the southwest in the central Alamosa Basin. As the wind nears the Sangre de Cristo Mountains they become complex, especially near areas where mountain passes are developed. Thus the system has developed such that sand deposited in the playas is the source of aeolian sand; the sand sheet is a zone of transport; and the dunefield is the depocenter [2]. Migrating dunes types form in unimodal areas. Vertically growing reversing and star dunes form in the complex wind regime of the depocenter.

Hydrologic processes. Water is the overlooked agent at GSD. The sand originates in rocks of the nearby mountains and is transported to the sump by streams. Within the aeolian system, streams encounter aggregational areas such as the dunefield and sandsheet and are deflected. Mountain precipitation produces streamflow and on the basin floor arid conditions support grass and shrublands. The aquifer recharge by streams is enough that water tables are at or near the surface in the sump and evaporation is almost always occurring.

The balance. Wind dominates in the dunefield. The dunes have enough mobility so that vegetation cannot establish itself, except in the troughs between large dune forms. Streamflow does modify its perimeter as it erodes sand from the upper margin and deposits it along the lower margin, producing some of the large dune forms Great Sand Dunes is famous for.

The growth of vegetation is important on the sand sheet. Although sparse, it stabilizes most of the surface, but it can be removed by wind erosion. When the wind gets the upper hand, parabolic dunes form and migrate across the sand sheet. Most vegetation survives on arid levels of precipitation, but some shrubs tap groundwater if it is within a few meters of the surface.

Evaporation dominates the playas and alkali flats where groundwater has become saline and minerals such as trona hardened the surface. Sand is often trapped by vegetation downwind of playa, forming lunettes.

References: [1] Madole R. F. et al. (2008) *On the origin of the Great Sand Dunes, Colorado. Geomorphology*, v. 99, p. 99-119. [2] Fryberger S. G. (1990) *Modern and Ancient Eolian Deposits: Hydrocarbon Exploration and Production. Rocky Mountain Section. Society of Economic Paleontologists and Mineralogists. Denver. Colorado. Ch. 6.*