White Sands Dune Field, New Mexico: Age, dune dynamics and recent accumulations

Gary Kocurek a,⁎, Mary Carr a,1, Ryan Ewing a, Karen G. Havholm a,2, Y.C. Nagar b, A.K. Singhvi b

a Department of Geological Sciences, Jackson School of Geosciences, 1 University Station C1100, Austin, Texas 78712, USA
b Planetary and Geosciences Division, Physical Research Laboratory, Ahmedabad 380 009, India

Received 12 June 2006; received in revised form 11 October 2006; accepted 18 October 2006

Abstract

The White Sands Dune Field, situated within the Tularosa Basin in southern New Mexico, is thought to have been largely derived by a stepwise, progressive deflation of Pleistocene Lake Otero strata with the onset of regional aridity. Optically stimulated luminescence (OSL) dating of samples from a core that penetrated the gypsum accumulation of the dune field confirm a time of origin at ∼7000 yr. Dune sediment is characterized as lagged influx from previously stored Lake Otero sediment and contemporaneous influx derived from subsequent playas. Sediment became available for aeolian transport and dune-field construction because of a falling water table driven by the regional aridity. The current dune field is primarily a wet aeolian system in which the behavior of the accumulation surface over time is a function of the water table, although surface cementation by gypsum also imparts aspects of a stabilizing system. Dune crests are oriented borderline transverse to the annual transport resultant, and a monitored dune and its cross-strata show that transverse winds from the SW during the late winter and spring account for most of the crest-normal migration, but a significant along-crest component of migration of dune sinuosity occurs with fall and winter winds from the NW and N that strike the crests obliquely. Trenches across three interdune areas show dune sets and interdune strata climbing at about 0.1°. Depth of interdune scour increases with interdune streamwise length, which acts to enhance the probability of dune cross-strata deflation during arid years, but also increases the probability of interdune accumulation because the water table shows a net rise over time. Within the trenches, dune sets show a bundling of foresets between reactivation surfaces, interpreted as annual cycles that reveal lee-face reworking by the oblique NW and N winds and slipface progradation fostered by transverse winds from the SW. A progression from grainflow-dominated to wind-ripple-dominated cross-strata within a single set revealed in the longest trench is consistent with along-crest migration of dune sinuosity. Interdune laminations show light/dark couplets interpreted as annual varves reflecting dry/wet portions of the year. The number of laminations preserved in vertical sections across an interdune area shows that the record is incomplete, and endorses the interpretation of periods of interdune deflation. A calculation of the current accumulation rate as based upon the climbing strata within the trenches is significantly greater than the long-term accumulation rate determined by OSL dates taken from the core. In addition to compaction and possible...