

Kinematic analogy between delta front and dune slip face progradation

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For both Gilbert lake deltas and Aeolian sand dunes, progradation involves the forward migration of curved surfaces of constant slope, equal to the granular angle of repose, driven by mass flux across the upstream shoreline or brink line. For three-dimensional delta fronts, it was recently shown that the progradation rate can be predicted from the mass flux using a simple curvature-dependent law. We will show that a similar law can be written for the slip faces of three-dimensional dunes. An important difference, however, is that whereas the delta shoreline is a plane curve deforming in the horizontal plane, the dune brink line is a space curve evolving in three-dimensional space. The mathematics must therefore be generalized to account for this greater freedom. We will illustrate the law for the example of isolated barchan dunes, for which we will apply the theory to laboratory experiments conducted in a deep, wide water channel.

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