Facies Models for Wet Eolian Systems and Their Role in Predicting Permeability Barriers in Eolian Reservoirs

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Water table rise in conjunction with dune migration is the fundamental mechanism that enables accumulation and long-term preservation of wet eolian systems. Water table rise may be either absolute, due, for example, to a climatic shift to wetter conditions, or relative, whereby the water table remains constant but the accumulation subsides through it. A shallow water table, either at the depositional surface or within its capillary fringe, ensures that moisture at the interdune surface is at least sufficient to raise erosional threshold values to the point where the surface is largely protected from deflation, thus increasing preservation potential. Wet eolian systems may thus preserve climbing sets of dune-interdune strata, even when eolian sediment supply is low. These concepts form the basis for generic and numerical models that account for the wide variety of dune-interdune geometries described in the literature. Systems are classified according to downwind continuity of interdune deposits (a function of flood event longevity and dune migration rate) and the angle of climb of the system (a function of rates of water table rise and dune migration, and the net eolian sediment budget, which controls dune size). The interaction of these parameters results in a spectrum of preserved architectural styles. These are illustrated with examples from the Triassic Helsby Sandstone Formation, UK and the Permian Cedar Mesa Sandstone, Paradox Basin, Utah. The developed models are used to predict the spatial distribution and continuity, and the temporal evolution of damp/wet interdune strata that act as permeability barriers in eolian reservoirs.