Significant lithological heterogeneities in eolian successions arise from the juxtaposition of dune elements with generally favorable reservoir properties against interdune elements that may act as baffles to flow. Prediction of the arrangement of such elements in subsurface successions is therefore important in developing eolian reservoir models, yet such predictions are difficult because the preserved thickness, continuity and internal facies composition of both dune and interdune elements vary spatially both locally and regionally. Important controls on spatial architectural variability include the morphology and migratory behavior of the original bedforms and their intervening interdunes at the time of accumulation.

The Rub'Al-Khali desert of Saudi Arabia is covered by the latest generation of public-release satellite imagery, which reveals a varied range of dune types, the morphology of which changes systematically from the dune-field center to its margins. Analysis of geomorphic relationships between dune and interdune sub-environments documents how the morphology, geometry, internal facies arrangement and relationship of the various depositional architectural elements produced by these geomorphic features vary over space from central to marginal settings. A series of quantitative approaches have been employed to characterize the complexity present in areas where large, morphologically complex and compound bedforms gradually give way to smaller, simpler bedform types at dune-field margins. Parameters describing bedform spacing, parent morphological type, style of subordinate bedform superimpositioning, bedform orientation, lee-slope expression, along-crest sinuosity and amplitude have each been recorded in a relational database, as have parameters describing interdune size (long and short axis dimensions), orientation, style of connectivity to neighboring interdunes, substrate condition (dry, damp, wet), and nature of any associated sedimentological processes. Results have been used to generate a series of synthetic 3-D stratigraphic architectural models with which to illustrate the range of possible sedimentological complexity expected for preserved eolian dune and interdune successions. This work has applied implications because interdune and dune-plinth elements typically act as principal and subordinate baffles to flow, respectively, in eolian hydrocarbon reservoirs, whereas dune lee-slope elements typically represent effective net reservoir.
Spatial variability in eolian dune and interdune morphology in the Rub' Al-Khali dunefield, Saudi Arabia

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Location of Study Area

Example of data demonstrating relationships present in aspects of dune bedform morphology in the Rub Al' Khali dune field showing the relationship between different parameters measured in the study area.

Maps of south-eastern Saudi Arabia showing the location of the studied areas, named 1, 2, 3, and 4.

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Spatial variability in eolian dune and interdune morphology in the Rub' Al-Khali dunefield, Saudi Arabia: implication for reservoir prediction

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Transport direction

Wind direction

Interdune

Dune

Distance km

Interdune (Basin)

Dune-field centre

Eolian fluvial interactions induce sand transport), chiefly because of the action of trade winds margins of the dune fields, where the supply of sand and its potential (the energy of surface winds in terms of their capability to size, with the size and continuity typically increasing toward the

The Rub' Al-Khali region is influenced by winds with a high drift different types. Interdunes in the Rub' Al-Khali vary in shape and in

Self-organised patterns of eolian bedforms and adjoining dunes, which attain heights in excess 200 m in some areas in

The latest generation of public-release satellite sand dunes in sand seas are commonly separated from each other by extensive field center to in excess of 21 km at the margin.

Regions that are elevated up to 25 m above the regional level and this bedform construction enabled by a large sand supply. Transects show

In transects oriented in an upwind-to-downwind direction located in

one another to generate an accumulation.

There exists a general reduction in dune height and wavelength, central and marginal parts of the dune field (e.g. transects G-G' and H-

interdune width in a downwind direction and

H'), there exists a general reduction in dune height and wavelength, central and marginal parts of the dune field (e.g. transects G-G' and H-

In transects across

2, 3, and 4 for this study.

and associated increase in interdune width in a downwind direction and

and adjacent columns. Transects show the

development of more sophisticated architectural-element and sequence stratigraphic models.
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