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Stratigraphic Aspects of the Upper Jurassic to Lower Cretaceous of Saudi Arabia

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The Upper Jurassic to Lower Cretaceous, Oxfordian to Valanginian, lithostratigraphic succession of Saudi Arabia is divided into the Jurassic Shaqra Group and the Cretaceous Thamama Group, the boundary of which lies within the uppermost Tithonian. This interval includes at least five third-order sequence boundaries and maximum flooding zones. J60 and K40 are two regionally recognized sequence boundaries, and J50 and J100 represent two regionally established Jurassic maximum flooding surfaces. The Upper Jurassic succession includes shallow- to deep-marine carbonates of the Hanifa (Oxfordian) and Jubaila (Kimmeridgian) formations, and shallow-marine carbonates and evaporites of the Arab (Kimmeridgian) and Hith (Kimmeridgian to Tithonian) formations. The Upper Jurassic to Lower Cretaceous succession includes the shallow to moderately deep carbonates of the Sulaiy Formation (Tithonian to Berriasian) with the overlying Yamama Formation being of Cretaceous age (Valanginian). These formations were deposited in a period of increasing global temperature, during a transitional phase leading to greenhouse.

Carbonates of each formation host grainstones and packstones of reservoir quality, including the Hanifa (Hanifa Formation), Arab D (Jubaila-Arab formations), Arab C to A (Arab Formation), Rimthan, Hith stringers and Manifa (Hith Formation), Lower Ratawi (Sulaiy Formation) and Upper Ratawi (Yamama Formation). Seals to these reservoirs are provided by transgressive muds of overlying sequences or, in the case of the Arab and Hith formations, by interbedded evaporites.

Chronostratigraphic control of the Oxfordian to Valanginian succession is determined using a variety of methods of variable refinement. Of the non-biostratigraphic techniques, the Callovian to Aptian strontium-isotope character is featureless except for a gradual increase in the $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio, and provides very limited stratigraphic control. Of the carbon and oxygen isotopes, $\delta^{16}\text{O}$ displays a gradual decline from the Kimmeridgian to Middle Valanginian, but $\delta^{18}\text{C}$ displays a clearly defined positive trend at the basal Berriasian. Although the Oxfordian palaeomagnetic character is highly variable, the Kimmeridgian to Valanginian displays palaeomagnetic reversals at a lower frequency and these can be used for regional correlation.

The succession is difficult to biostratigraphically date with precision, owing to the generally restricted palaeoenvironments and the mostly endemic nature of the regionally significant species. Type sections of Saudi Arabian formations within the age of interest have been dated at outcrop using ammonites and nautiloids, supplemented by foraminifera. Subsurface equivalents are easily recognized using biofacies, but are dated mostly on benthonic foraminifera and calcareous alga, as calpionellids have not yet been identified in the basal Cretaceous carbonates and planktonic foraminifera are rare and long ranging. The elusive Jurassic/Cretaceous boundary is based on calcareous nannofossil evidence. With cautious sensitivity to biofacies diachroneity, high-resolution intraformational stratigraphy is possible with establishment of local biofacies-based events of correlative value.