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Sequence Boundaries, High-Frequency Cyclicity, and Porosity Evolution in the Early Cretaceous of Saudi Arabia

Core and outcrop provide excellent data on two sequence boundaries from the Tuwaiq Escarpment, near Riyadh, to the Arabian Gulf. These sequence boundaries approximately coincide with formational contacts between the Sulaiy and Yamama formations and between the Yamama and Buwaib formations. Although the Yamama-Buwaib sequence boundary is well established, the Sulaiy-Yamama sequence boundary is subtle, possibly due to a relatively brief period of sea-level fall and subaerial exposure.

Combining paleontologic and lithologic data facilitates analysis of high-frequency cycles in the Sulaiy and Yamama formations. The Yamama generally has poor biocomponent diversity and abundance, but faunas indicate the lower part was deposited in deeper conditions than the upper. The Sulaiy Formation is characterized by repeated successions of microfaunas that indicate small-scale shallowing cycles. Within each cycle, faunal elements indicate a maximum flooding zone. These contrasting data provide additional confirmation of the sequence boundary between the two formations. In a few wells, core provides documentation of subaerial exposure and weathering at the sequence boundary.

In contrast, the Yamama-Buwaib sequence boundary represents several million years of missing time. This extensive exposure produced a heavily karsted surface, which included dissolution caverns. Upon subsequence burial, these caverns collapsed and produced extensive fracture networks.

Producing reservoirs beneath these two sequence boundaries differ, primarily due to differences in duration of exposure associated with the overlying sequence boundary. Reservoir porosity beneath the Sulaiy-Yamama sequence boundary is predominantly inter- and intra-particle. Porosity beneath the Yamama-Buwaib sequence boundary is predominately fracture porosity related to karst-cavern collapse.