High-resolution Stratigraphy and Sedimentology of Khuff Carbonates (Central Saudi Arabia)

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ABSTRACT

The Khuff reservoirs are known for having complex heterogeneities and these were described to occur at inter-well and sub-seismic scale. We therefore studied the high-resolution stratigraphic framework of the Upper Khartam Member of the Khuff reservoirs in an outcrop analogue. Four outcrop localities were logged and about 600 representative samples were collected for microfacies analysis. Furthermore high-resolution photo-mosaics of the outcrops were made. Centimetre-thick beds are followed laterally and logged for detailed sedimentological and sequence stratigraphical analysis. Eighteen lithofacies were defined, with coarse-grained oolitic grainstone, interlaminated quartz-bearing recrystallized limestone, recrystallized limestone, interlaminated quartz-bearing fine-grained oolitic grainstone, and bioclastic grainstone/packstone making up the bulk of the successions. These lithofacies are occurring as sheet-like structures and channelized bodies. The former range in thicknesses from 2 to 40 cm and possess a lateral extension varying between 5 and 100 m, while channelized bodies have two anatomies, i.e. small tidal creeks (5m in width by 30cm in height) and large tidal channels (3m in width by 50cm in height). Accordingly, six depositional settings were distinguished, including: intertidal-subtidal flats, intertidal channels and creeks, shoal ridge, reef complex, and outer ramp settings. Seventeen high-frequency sequences were described, range in thickness from 1 to 5 m. The latter are traceable over about 1000 m and they are genetically correlatable over the studied outcrops (about 70 km). The defined high-frequency sequences likely represent fifth-order cycles and possibly relate to Milankovitch cycles (i.e. eccentricity = 100,000 year). At bed-level, about 20,000 beds are defined and traced laterally, ranging in thickness from 2 to 20 cm and extending between 5 and 50 m. The beds are dominantly back-stepping clinoforms (with minor occurrence of land-ward stepping clinoforms) and stacking into well-developed parasequences with relatively large lateral extension of about 300 m and complex internal amalgamation and stacks. The prograding clinoforms are separated by erosional surfaces, interpreted as regressive surfaces of marine erosion (RSME). The defined high-frequency sequences are interpreted to be deposited during gradual phases of marine regression and erosion following pulses of marine flooding events.