Sequence Stratigraphy of the Cretaceous Arabian Platform: Data Based Guidelines for Conceptual Models?

Philippe Razin[1], Carine Grelaud[1], Emmanuel Dujoncquoy[2]

[1]Bordeaux INP
[2]TotalEnergies

Abstract

An extensive carbonate platform covered the Arabian plate during the Cretaceous period. The combination of field work and seismic interpretation in Oman and UAE results in a multiscale reconstruction of the sequence stratigraphic organization of this carbonate system combining facies distribution and stratal geometries. This reconstruction provides several points that could be relevant for carbonate sequence stratigraphy conceptual models.

After a tectonically controlled exposure followed by the re-flooding of the platform during Late Tithonian, the Early Cretaceous carbonate systems were organized in successive prograding wedges without any major backstep nor drowning events disrupting the northward migration of the platform margin. The carbonate production was always equal or higher than the accommodation rate and this ratio was responsible for distinctive types of clinoforms. Eustatic sea level variations are clearly recorded from the architecture of these clinoforms, particularly the high amplitude ones, during the Berriasian and Valanginian (80 to 120 m).

Several generations of intrashelf basins and shallow troughs were created as a consequence of differential carbonate aggradation processes during periods of highest accommodation rate (Early Aptian, Cenomanian). The tectonic imprint on these stratigraphic structures is minor if not absent. Anoxic conditions in these basins favored the preservation of organic-rich deposits.

In such a carbonate system, most of the argillaceous facies intercalated within the carbonates are shallow marine inner platform deposits, even those containing some pelagic fauna. The shales come from exposed area (e.g. Arabian shield) and disappear towards the platform margin. Numerous stratigraphic misinterpretations are due to the occurrence of these argillaceous deposits that are classically considered as deep marine deposits indicating maximum flooding stages.

The inner platform deposits are extremely tabular and organized in thickening-up and “grainy-up” sequences that should not be interpreted as shallowing-up sequences but as the response to a progressive increase of the accommodation rate on the platform top. During maximum flooding periods, the increase of hydrodynamic processes on the platform domain is responsible for a tidal bar and channel complex of grainy composition that constitute the upper part of the sequences.

Numerous exposure surfaces bound these shallow marine sequences but are not conspicuous as karstic features did not extensively develop on this very flat and stable platform. Karsts generally developed during periods and in areas affected by structural deformation, particularly at the top of the Turonian platform at the time of incipient compressive movements.

The high-energy facies that characterize platform margin settings are mainly made up of oolitic-bioclastic grainstone, or occasionally corals and microbial boundstone. Rudist biostromes are found in back-barrier settings, but no rudist build-ups have been observed at outcrop in Early Cretaceous to Turonian platform margin setting, despite they have been interpreted on some seismic sections. Carbonate gravity-driven sedimentation occurred when the clinoforms were the steepest, i.e. when the aggradation rate of the platform, therefore the accommodation rate, was maximum.

Tectonic deformations only had a major impact at the times of platform initiation and demise: Late Tithonian, Late Aptian and Turonian.