Controls on stratigraphic development and reservoir distribution of shelf margin carbonates: Jurassic Atlantic margin - western Morocco

Duval-Arnould, A.[1], Habid, A.[1,2], Redfern, J.[1], Schröder, S.[1]

1: Basin Studies and Petroleum Geosciences Group, University of Manchester, Manchester, UK
2: Office National des Hydrocarbures et des Mines (ONHYM), 5 Avenue Moulay Hassan, Rabat, Morocco

Jurassic rocks reflect the initial post-rift phase of the central Atlantic margin. These strata constitute a proven hydrocarbon play offshore Morocco, and their potential is documented by discoveries in Upper Jurassic reefal carbonates in the Tarfaya Basin, southern Morocco (Juby Maritime discovery), as well as by the Panuke gas field on the conjugate margin in Canada. However, reservoir distribution and quality have proven to be unpredictable, which has resulted in some poor well results. While exploration activity is currently high offshore Morocco, in order to fully realize the potential of Jurassic reservoir and possible source rocks it is critical to develop a detailed chronostratigraphic and sequence stratigraphic framework for these strata. There is currently no published coherent model. Extensive outcrops in the Agadir Basin (Western High Atlas), as well as onshore wells from the Essaouira Basin in the north to the Tarfaya Basin in the south provide a wealth of information to construct such a framework.

Here we report on the initial results of a major new study on the Jurassic, being undertaken by NARG and in collaboration with ONHYM and our supporting sponsors, to integrate detailed outcrop observations with subsurface well and seismic data. The objective is a sequence stratigraphic framework that will be used to constrain possible Jurassic reservoir and source facies, and their spatial and temporal distribution. Of particular interest are the basal Jurassic strata in order to understand the tectonostratigraphic syn-rift to post-rift evolution, as well as the Jurassic-Cretaceous transition that can constrain why deposition changed from carbonates to siliciclastics; Cretaceous siliciclastics form another play along the same margin.

A reference section has been logged around the Anklout anticline, where the entire Jurassic succession is exposed. In outcrop, the Jurassic is represented by 2 large-scale transgressive-regressive cycles, from Pliensbachian to Bathonian, and Bathonian to Jurassic/Cretaceous.

The Liassic transgression resulted in establishment of peritidal environments characterized by peloidal and oolithic grainstones alternating with algal mats and breccias. These deposits are followed by oolithic fossiliferous packstones and grainstones, which mark the end of the transgression. The Liassic succession is disturbed by small-amplitude syn-sedimentary folding, which could result either from tectonic movements or from the formation of dissolution breccias. Regression during the Middle Jurassic led to deposition of fluvial siliciclastics in the proximal area, passing westward to shallow-marine carbonates.

A second transgressive phase, beginning in the Bathonian and culminating in the Oxfordian, established fully marine conditions across the Agadir Basin with widespread deposition of high-energy subtidal limestones rich in bivalves, gastropods, brachiopods and corals. Oxfordian reefal carbonates occur as lenticular biostromes with important lateral facies variation. The latter constitute offshore reservoirs, and constraining extension and facies variations within these reefs will be a key point of this study.

The uppermost Jurassic-Cretaceous regressive units begin with the transition from open-marine limestones to reddish subtidal marls including some bioclastic and oolithic limestones, thin breccias beds, and dolomites. This succession corresponds to the establishment of a peritidal environment. Uppermost Jurassic units contain small-scale syn-sedimentary folds and faults striking E-W, consistent with the axial orientation of the Anklout anticline. The transition to the Cretaceous is poorly defined in proximal locations, but marine carbonates persist into the Lower Cretaceous in more distal locations.