Early Cretaceous deposition along the Moroccan Atlantic margin: implications of outcrop studies on the prediction and characterization of potential offshore petroleum systems

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Early Cretaceous clastic sequences are one of the main reservoir targets along the poorly drilled Moroccan Atlantic Passive Margin basin. Slope incision along the margin, together with the recognition of seismic attribute and reflector configurations in the deepwater licences, support the possibility of deep marine turbidites in this interval.

Subsidence and erosional history during the Early Cretaceous are controlled by tectonics driving continental exhumation and erosion, following the appearance of oceanic crust in the Central Atlantic (passive margin stage) and prior to the onset of Atlas shortening. Recent data documents Middle Jurassic to Early Cretaceous exhumation and erosion in the High Atlas, the anti-Atlas and, further to the S, on the Reguibate shield. The area experiencing exhumation was flanked to the West by a domain of continuous subsidence, part of which is exposed along the present day coastline and within the Essaouira-Agadir basin.

The tectonics driving continental exhumation and erosion are poorly known. Recent work by Bertotti and co-authors have used low temperature geochronology to document 2-3km of exhumation and erosion of the Moroccan Mesata (Bertotti and Gouiza 2012) during the late Jurassic to Early Cretaceous. The mechanism for the vertical movement is uncertain. Lithospheric thinning models predict only 50-60% of the observed subsidence by post-rift thermal relaxation and <30-40% of the observed exhumation can be explained by processes related to the evolution of the Central Atlantic rifted margin.

Ongoing studies are characterizing the variability of the depositional setting and lithofacies within the Early Cretaceous section along the Atlantic margin. Improved dating will refine often poorly controlled stratigraphic relationships. The significance of key surfaces within the Cretaceous section will be important to correlate offshore, some of which indicate significant base level drops and optimum times for sediment delivery.

The facies vary from gravelly bedload fluvial systems, to shallow marine shoreface and deltaic sequences. Locally stacked continental red beds are recorded, with braided fluvial to alluvial sequences. The presence of extensive shallow marine intervals correlate well with the limited offshore well control. Interpretation indicates deltaic systems with extensive shoreface deposits and the detailed facies analysis of the sections is allowing improved understanding of the distribution and temporal evolution. The new study is also addressing the petrography of the Early Cretaceous sections at outcrop, to aid characterization of the potential provenance and reservoir quality of sediments transported offshore into deepwater. The initial results suggest a potential for sand delivery into the basin from discrete locations and at specific time interval within the Early Cretaceous. Distribution offshore is less well constrained, but is likely to be constrained by the location of large feeder channels.

Understanding the controls on basin evolution, exhumation in the interior and drainage history, will help to reduce the risk in locating reservoirs offshore, and determining optimum location for best reservoir quality