B28

Rock-Fabric Facies and Diagenetic Controls on Carbonate Reservoirs

H. Fakhfakh Bankemia* (ETAP)

SUMMARY

A Case Study from the Early Eocene El Garia Formation, Tunisia.

Early Eocene strata in Tunisia are characterized by widespread Nummulites-bearing limestone (El Garia Formation) extensively distributed in the Palaeogene Tethyan realm. The El Garia Formation developed through a narrow belt, roughly NW-SE trending, over a gentle ramp or shelf with a slope break controlled by normal blocks Cretaceous faulting. It occupies more than 20 km in width and reaches a maximum thickness of 300 meters in subsiding area. Including the largest number of oil occurrence among them Ashtart and the Giant El Bouri field, the oil-producing province, which extends from the Gulf of Gabes to the north-western margin of the Sirt Basin, encompasses the world's most prolific Cenozoic carbonate plays system. The exploration key play lies in the identification of facies change boundary from porous 'Nummulites accumulation' margin to deeper marine limestone (Bou Dabbous source rock). The producing interval, in Tunisia, has an average thickness 80 meters of which about 40 meters could be considered as net pay with porosity in range 5 to 18% and moderate to low permeability.

The El Garia Formation comprises northwardly prograding stacked sequences called 'Nummulites sequence' and occurring throughout high stand system tract, that have some porous intervals. Five types of sequences have been differentiated; each representing a different phase of ramp aggradation and progradation. All these sequences are unsorted muddy facies at the base that grades into a randomly oriented operculinids and A-form nummulites mud-supported facies and become well-sorted Nummulites-bearing grainstone.

The depositional setting controls the high intrinsic porosity and permeability of these carbonates reservoir. The principal reservoirs are Nummulites grainstones, the red algae and bryozoan-rich grainstones and the unsorted or randomly oriented Nummulites facies that contain significant porosity and are the main producing horizon.

The generalized diagenetic sequence includes early sub-marine cementation followed by a late carbonate cementation that preserves pore space. Marine cementation is as important as the primary depositional fabric in controlling the distribution of porosity within the El Garia Formation. The early lithification, commonly observed in grain-supported facies of high stand deposit induces during burial highest quality of secondary porosity generation. The compaction, as a highlighted diagenetic event in Early Eocene carbonates, is deeply affected by inherent rock characteristics (mud-supported or grain-supported), early diagenesis, permeability barrier and regional tectonics.

Significant enhancement of reservoir quality by diagenesis such as dissolution, hydrothermal dolomitization and later by fracturing is well observed. The corrosive migrating solutions originated from the thermal maturation of the deeper or lateral equivalent source rocks contribute to improve the leaching whereas, dolomitization in inner ramp was formed by the reflux of hypersaline fluid from closest sediments.

The stacking pattern of these 'Nummulites sequences' identified in Central Tunisia, is mainly controlled by tectonic subsidence and border rejuvenated fault zone, paleoecological environment and hydrodynamic setting (wave and storm process) These suggest that reservoir characteristics and its compartmentalization are complex yet predictable.

An integrate study of inter-digitization facies, rate of progradation, and structural history within the various areas in Central Tunisia serves to predict the lateral or vertical changes of rock properties. Delineation of reservoir distribution in the offshore therefore gains precision in the exploration process.