Diagenesis of the Upper Cretaceous Eagle Ford Group in South Texas and Its Relationships to Rock Properties and its Pore Networks

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Abstract

The Upper Cretaceous Eagle Ford (EF) Group is composed of massive, laminated, or burrowed chalky marl and marly chalk deposited on the drowned shelf below storm-wave base. An investigation of diagenesis relative to burial using five cores (depth ranges from 3,270 to 13,670 ft; BHT from 126 to 285°F) delineated a complex diagenetic history. This study focuses especially on the organic-rich Lower EF member deposited largely under anoxic-euxinic conditions. At deposition, total porosity was as high as 70 to 80% but with burial, porosity dropped to less than 10% because of diagenesis. The EF followed a diagenetic pathway from the deeper marine environment directly into the burial environment and was not affected by meteoric diagenesis. Compaction was the major porosity lost mechanism followed by cementation. Near-seafloor processes included the initiation of calcite cementation and pyrite formation (in matrix and biota tests). These early cementation of carbonate (some are microspar/pseudospar concretions) occurred prior to substantial compaction, which significantly impact the reservoir quality and petrophysical properties. Cementation of microcrystalline quartz is abundant. The appearance of glauconite grains and shards of volcanic glasses were evidence of active volcanism and were a source of silica. Another source of excess silica is from calcite-replaced radiolarians. Ankerite-rich marls and limestone/concretions were found in the OAE2 and MCE intervals and the limestone concretions show high unconfined compressive strength (USC) values as a result of significant porosity loss. Limestone beds can be packstone/grainstone or exhibit variable amount of cements. Organic matter (OM) thermal maturation generated

petroleum which migrated on a pore- to bed- level scale filling the primary mineral pores. Simultaneously, the process terminated cementation. Few of the limestone beds might act as flow barriers while the majority of them can contain small amount of migrated solid bitumen or can act as pathways for migration. Cementation of the coccolith hash in fecal pellets and matrix by calcite forms a rigid framework, retarding compaction. Feldspar diagenesis included the transformation of K-feldspar to kaolinite and albite with depth. Also, authigenic albite formed in biota tests and was deposited as grains within volcanic ashes. Clay diagenesis is complex with constant volcanic influences: smectite transforming to mixed layered I/S with burial, early authigenic kaolinite precipitating in biota tests and matrix, chlorite replacing kaolinite, and smectite and chlorite forming during alteration of volcanic ashes and then eroded and incorporated into the matrix. The paragenesis in the EF produced both vertical and lateral mechanical heterogeneity as well as variations in pore networks. On-going efforts involves attempting to correlate major diagenetic events across wells.