Elucidating Diagenetic Impacts Upon Carbonate-Rich Organic Mudstones: The Cretaceous Eagle Ford Formation, SW Texas, USA

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ABSTRACT

The Eagle Ford Formation in southwest Texas has been a major focus of research given that it is a self- sourced oil and gas reservoir, and an economic producer of oil and gas. Furthermore, it was deposited at, or near, a period of marine anoxia at the Cenomanian-Turonian boundary and hence provides insights into geological processes during these important time intervals. However, although there have been many sedimentological and stratigraphic studies, the diagenetic pathways in these organic-rich mudstones are poorly constrained yet, as we demonstrate here through a combination of mineralogical and petrographic analysis on both core and outcrop material, these are an inherent control on the rocks composition and variability.

The dominant macroscopic features within the succession are carbonate beds and concretions, with both laterally persistent beds and isolated concretions present. These units are interbedded with argillaceous, organic-rich foramaniferal mudstones and wackestones. Calcite and kaolinite cements infill bioclasts and foraminifera chambers throughout the succession, significantly reducing intra-granular porosity. Micro-crystalline calcite pervasively cements concretions. Fine grained calcite cements the matrix in the organic-rich mudstones and wackestones, resulting in reduction in inter-granular porosity microscopy. Stable C and 0 isotope analysis indicates a significant bacterial organic matter oxidation contribution to early carbonate cements in concretions and beds, with a later cement sourced from the recrystallization of marine carbonate in the organic-rich foramaniferal mudstones and wackestones. Zonation within the calcite cements suggests evolution in pore water chemistry through burial. During late burial, authigenic quartz cement precipitated, further reducing inter-particle and inter-crystalline porosity. The source of this silica may have been clay mineral reactions or biogenic silica dissolution. Authigenic chlorite and kaolinite are present as late stage cements and replacements.

These observations place better constraints on the evolution of these, and similar, fine grained rocks and should lead to a greater appreciation that diagenesis plays in controlling rock properties.