Diagenesis and Geochemistry of the Carbonate Facies, The Middle-Late Triassic Al Aziziyah Formation, Jifarah Basin, Northwest Libya

Mohamed Moustafa[3], Mike Pope[1], Ethan Grossman[1], Ibrahim Mriheel[2], Mohamed A. El-Ghali[3]

[1]Texas A&M
[2]NOC
[3]Sultan Qaboos University

Abstract

This study offers the first petrographic and geochemical studies of the Middle-Late Triassic (Ladinian-Carnian) Al Aziziyah Formation at its exposure at the Jifarah Basin of northwest Libya. Eight sections were measured, and two sections with a total of ~260 m were studied for diagenesis along a depositional dip cross-section. Based on samples analyzed for petrography and geochemistry, three sequential stages of diagenesis have been identified: 1)syndepositional diagenesis including micritization, type one (D1) dolomite and isopachous fibrous cements, 2) Intermediate diagenesis characterized by dissolution, blocky calcite cement, neomorphism, physical compaction, and type two (D2) dolomite, and 3) Early burial diagenesis with pore-filling blocky dolomite cement (type three (D3) dolomite), silica cement, Anhydrite cement, stylolitization, and fracturing. Carbon isotope values of the late calcite cement and pore-filling dolomite cement (D3) range from -1.5 to -0.9‰ and -1.3 to +1.8‰ respectively, and oxygen isotope values of the calcite and pore-filling dolomite cements range from -6.2 to -4.3‰ and -7.6 to - 4.1‰ respectively. D1 is very fine- to fine-crystalline (≤50 μm crystal diameter) and preserves depositional fabric well. D2 is coarse crystalline dolomite (100 to 300 μm crystal diameter) that destroyed the depositional fabric, and some crystals have a clear outer rim surrounding a precursor cloudy coarse dolomite core. D3 is a course to very coarse dolomite that forms in a shallow burial environment. This diagenetic analysis indicates: 1) the Al Aziziyah Formation experienced early marine (syndepositional), meteoric, and early burial cements; 2) D1 cements were created by microbial processes in anoxic settings while D2 cements likely formed by seepage reflux soon after deposition and D3 cements formed as the last stage during early burial respectively; and 3) an arid climate as evidenced by the abundance of evaporite nodules, and dissolution and meteoric cement likely produced by the low rainfall patterns. This study describes the diagenetic processes and identifies the sequence of diagenetic events that affected the Middle-Late Triassic Al Aziziyah carbonate facies to understand the diagenesis setting and their distribution. This study also investigates the possible link between diagenesis and the monsoonal climate during the Middle-Late Triassic. This outcrop-based work could be an analogy for the offshore portion of the Jifarah Basin (Sabrath Basin).