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Dolomitization in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: Implications for Petroleum Production Potential

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The Eocene Green River Formation (GRF) has historically been an important oil producing formation in Utah's Uinta Basin. Recently, there has been increasing interest in GRF unconventional reservoirs, especially the Uteland Butte member (UBM), which has an estimated resource of 214 million barrels of oil and 329 billion cubic feet of associated/dissolved natural gas. Thin, high porosity dolomites (up to 30%) interbedded with organic-rich limestones and shales have become horizontal drilling targets. Determining how dolomitization is related to high porosity paired with low permeability and delineating the regional geometry of the dolomite layers are critical for understanding the reservoir's petroleum production potential. The results of this ongoing study are based on core and outcrop samples, thin section microscopy, SEM, XRD, CL, and isotopic analyses.

The dolomite layers, now identified as reservoir units in the UBM, were originally deposited in lacustrine littoral environments as lime grainstones and packstones and in shallow sublittoral environments as lime mudstones and wackestones. The dolomite layers alternate with limestones. Most dolomite crystals are green to beige, with crystal sizes <15 μm, and nonplanar A texture. Dolomite percentages range up to 76%. Dolomitization resulted in development of significant microporosity, currently ranging from 8 to 31%. However, there is no discernible relationship between dolomitization, microporosity development, and depositional environments. Permeabilities are low due to the microscopic, irregular, and commonly disconnected pore throats. Also, post-dolomitization silicification that commonly formed nodules and layers of length-slow chalcedony and equigranular quartz, as well as blocky ferroan calcite and equant to blocky calcite cement, reduced secondary porosity and permeability.

Our work suggests, cyclic evaporitic episodes resulting in lake water supersaturated in dolomite, which facilitated the replacement of carbonate sediment by microcrystalline dolomite. Increased fresh water input during more humid phases stopped dolomitization, which resulted in the preservation of lime mud layers during such periods.