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Origin of petroliferous dolomitic beds in the Uteland Butte Member, Lower Green River Formation, Uinta Basin, Utah

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The lacustrine Green River Formation is an important oil-producing formation in the Uinta Basin, Utah. Of particular interest for horizontal drilling are three beds with up to 100% dolomite in the Uteland Butte member (UBM) of the lower Green River Formation. These beds are 1.5 to 8 feet in thickness and interbedded with organic-rich limestones and shales. They have up to 30% porosity but only max 0.1 mD permeability, thus forming an unconventional reservoir. However, not all dolomitized layers, of which there are several more in the UBM, are of reservoir quality.

This study attempts to determine the role of dolomitization and other diagenetic processes in reservoir development, i.e., when and how were the abnormally high porosities paired with low permeabilities created? Furthermore, delineating the regional geometry of the dolomite layers is critical for understanding the unit's petroleum production potential. Methods of investigation include outcrop and core petrography, thin section microscopy, SEM, XRD, CL, and isotopic analyses.

Deposition of the middle UBM took place during three transgressive-regressive cycles that were driven by climate variations. The lake level was high during cooler and wetter periods that alternated with warmer and drier periods, which led to lower lake levels from reduced fluvial input and/or increased evaporation. The three reservoir layers were deposited during the first of these cycles as lime muds in lacustrine littoral to sublittoral environments as intraclastic, peloidal grainstones, and silty peloidal packstones, and in shallow littoral environments as peloidal, bioturbated mudstones and wackestones

The dolomite-bearing layers are greenish to beige in hand specimen and outcrop. Crystal sizes are <15 µm and porosity is mainly intercrystal. There is no discernible relationship between dolomitization and depositional environments. Permeability is low due to irregular and commonly disconnected pore throats. Also, post-dolomitization silicification commonly formed nodules and layers of length-slow chalcedony and equigranular quartz, as well as blocky ferroan calcite and equant to blocky calcite cement, which reduced secondary porosity and permeability.

Dolomitization took place very early, i.e., almost syndepositionally, from lake water that underwent moderate evaporation and probably also enriched in Mg during drier periods. Increased fresh water input during more humid climate periods stopped dolomitization and facilitated further deposition of lime mud layers that are now interbedded with the dolomitized beds. The origin of the microporosity - or lack thereof - is as yet undetermined.