

Core and Log-Based Carbonate-Evaporite Depositional Sequence Analysis, Late Ordovician Upper Red River Formation, Western North Dakota
Husinec, Antun¹; Marvinney, Kyle L.¹; Hoskinson, Katie¹ (1) Geology, St. Lawrence University, Canton, NY.

The Upper Ordovician Red River Formation is present throughout the Williston Basin, reaching a maximum thickness of slightly over 700 ft (215 m) in the central part of the basin in Dunn County, North Dakota. The Red River Formation consists primarily of shallow water limestone and dolomite, the latter forming major oil reservoirs. It has been traditionally subdivided into lower and upper unit; the latter having three porosity zones, in descending order, "A", "B", and "C". The studied upper unit is characterized by extensive evaporites capping depositional sequences consisting of the basal fossiliferous limestone grading-up into fine-grained dolomite and anhydrite.

By analyzing ~2,500 ft (760 m) of cores and combined neutron porosity-bulk density logs from 15 cores, three large, 25 to 80 ft thick third order depositional sequences are identified that can be traced regionally over western North Dakota. Each sequence is characterized by unique, regionally correlative lithologic properties, and neutron porosity and bulk density logs. Smaller scale component parasequences are 2 to 20 feet thick and are locally correlative. Within sequences, transgressive systems tracts (TST) are commonly thin and composed of subtidal, lagoonal facies of predominantly skeletal mudstone-wacke/packstone abundant burrow mottling. Highstand systems tracts (HST) are generally thicker than TSTs and composed of peritidal porous, laminated dolomites that grade into supratidal anhydrite capping sequences. Sequence boundaries on anhydrites on gamma ray logs are characterized by a slight positive excursion. The excursion is likely caused by a very thin shale bed overlying anhydrite; the shale was not recovered from any of the studied cores. Carbon and oxygen isotope samples obtained from carbonate mud matrix of burrow-mottled limestones and laminated dolomites from 3 cores sampled at 3 ft intervals to define any chemostratigraphic significance, better understand the dolomitization and diagenetic overprints.

The well documented 3rd-order sea level changes between the Late Ordovician Edenian-Richmondian have controlled sequence development and stacking patterns of reservoir facies in the Williston Basin, North Dakota. Sequences and reservoir facies are not simple shallowing-upward units, but are complicated by parasequence development likely related to moderate amplitude, high-frequency eustasy typical of this time period.