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Characterization of Chosen Ordovician Yeoman Dolostones of the Northern Williston Basin, Southeast Saskatchewan

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Dolostones make up the most important reservoir rock types in the Paleozoic rocks of the Williston Basin. These rocks are especially important in the Ordovician Yeoman (a.k.a. Red River in USA) Formation of the northern portion of the Basin (Figure 1), where exploration has been active since the Berkley Midale (4-2-7-11W2) discovery well in 1995. The productivity of these wells has varied for both vertical and horizontal wells, which calls for a better understanding of the factors influencing the reservoir quality of the rocks.

The work discussed herein is *part* of a M. Sc. thesis dealing with the characterization of dolostone reservoirs from various Paleozoic formations in the northern Williston Basin. This abstract centers on the Ordovician Yeoman dolostones.

The early portions of the research have dealt with determining the depositional setting and mechanisms of diagenetic alteration. This has been done through detailed description of seven core and ~50 thin sections from the Yeoman Formation. The Yeoman Formation consists of subtidal lime mudstones, skeletal wackestones and packstones that have undergone varying degrees of dolomitization. The most common feature of these rocks is the irregular mottled pattern which results from the selective dolomitization of worm or arthropod burrows. The degree of this dolomitization appears to be a major controlling factor in reservoir quality.

Based on core and thin section observations, there have been several mechanisms and stages proposed for dolomitization. The first mechanism was early (penecontemporaneous to deposition of sediments) and resulted from seepage-refluxion of Mg-rich brines associated with the precipitation of the Lake Alma or “C” Anhydrite. This particular mechanism effected the uppermost Yeoman strata.

Kent (1997) also described early dolomitization of the strata underlying the source rock (kukersite). He suggested that this mechanism of dolomitization occurred via the replacement of calcium carbonate sediment on the sea floor due to a high CO_3^{2-}/Ca^{2+} ratio in the sea water. The high ratio was brought on by the growth of the cyanobacteria *Gloeocapsomorpha prisca* - the main component of the source rocks. This mechanism created the best reservoir rocks and is represented by 10-15 µm planar-s to planar-e dolomites with good (~20%) intercrystalline porosity. The larger dolomite rhombs (~15 µm) are typically associated with the best reservoir characteristics as they had more space and time to grow.

Kent (1997, 1999) also proposed a mechanism for later dolomitization which involved the migration of magnesium-rich brines from the deep basin up through microfractures into the Red River rocks. The resulting dolomite is primarily observed as partial vug fill. Kent suggests that this later dolomitization is related to basement structures.

In thin section, the early reservoir quality dolomites typically show zonation in the form of a ‘dusty’ core and clear outer edges. The second stage of dolomite was aided by the previous permeability pathways created by the earlier phase of dolomitization. The later dolomites are larger, lack overgrowths and are porosity destructive.

Samples were also taken for carbon, oxygen and strontium isotope analysis. The isotope data will be used to further aid in determining the source of the dolomitizing fluids and timing of dolomitization. Cathodoluminescence will be used to determine the timing and number of stages of dolomitization. Scanning electron microscopy will also be used to aid in determining mineralogical composition and to give a graphical representation of the pores.

The goal of the research is to determine if certain geological and petrophysical features of chosen lower and mid-Paleozoic dolomicrites can be employed to characterize and predict their reservoir capabilities. The elements that will be considered include: depositional setting, stratigraphic distribution, mechanisms of diagenetic alteration and the nature of the pore systems in terms of porosity, permeability and pore geometry.

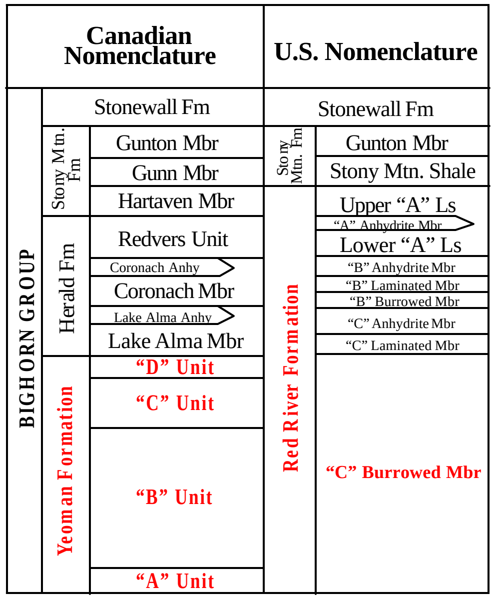

Fig. 1: Stratigraphic nomenclature of Ordovician strata in the Williston Basin.

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