Characterization of Mississippian Midale and Ratcliffe Reservoir Dolostones of Southeast Saskatchewan.

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Dolomicrites constitute the major reservoir lithologies of the Midale and Ratcliffe Beds of southeastern Saskatchewan (Table 1 page 2). They are productive in the Benson, Glen Ewen, Oungre, and Hummingbird fields where they have been sampled as part of a dolostone reservoir characterization project that will cover dolomicrites in Mississippian, Devonian and Ordovician rocks (Figure 1).

Figure 1: Location map with study area enlarged to show Mississippian Midale and Ratcliffe cores studied. Number of cores studied for each pool shown in brackets. (After Smith, 1980.)
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Table 1: Commonly accepted Mississippian stratigraphic nomenclature.

The Midale and Ratcliffe Beds are part of the Madison Group which represents shallowing upward cycles deposited in an epeiric sea. The Madison in general consists of deeper water carbonates at the base and shallow marine carbonates, tidal flat carbonates and evaporites in the upper portions. Dolomites in the Midale and Ratcliffe represent dolomitized lime muds deposited in restricted lagoonal to subtidal-intertidal environments.

Petrographically and petrophysically, two types of dolomites are recognized in these beds. Type 1 is cryptocrystalline (<4 µm) to very fine crystalline (4-16 µm) (Folk, 1962) dolomite associated with tidal flat sediments and evaporitic anhydrites. These dolomites generally have low porosity and permeability and occur in sections both above and below the current producing reservoirs. They are interpreted to have formed penecontemporaneously from evaporitic sea water (Smith, 1980). Type 2 is very finely crystalline to finely crystalline (16-62 µm) (Folk, 1962) with good intercrystalline porosity (~21%) and permeability (~12 md) and a microsucrosic to sucrosic texture. They are reservoir dolomites and are found in all four fields. Their effectiveness as reservoirs appears to depend on degree of dolomitization.

Stable isotope geochemistry, including Sr, C and O, will be used to determine the source and timing of dolomitization in the reservoir-quality rocks. The expected $^{87}\text{Sr}/^{86}\text{Sr}$ for Mississippian sea water falls in the range of 0.7076 to 0.7081 (Burke et al., 1982). Table 2 (next page) shows the geochemical results for Midale and Ratcliffe samples in the study area.
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Table 2  Results of geochemical analysis of Midale and Ratcliffe dolomite and limestone samples from study area.

<table>
<thead>
<tr>
<th>Bed/Lithology (# smpls)</th>
<th>$^{87}$Sr/$^{86}$Sr (average)</th>
<th>$\delta^{18}$O (PDB) (average)</th>
<th>$\delta^{13}$C (PDB) (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midale Beds Dolomite (17)</td>
<td>0.7081 to 0.7092 (0.70851)</td>
<td>-7.25 to 0.44 ‰ (-2.79 ‰)</td>
<td>2.46 to 4.51 ‰ (3.39 ‰)</td>
</tr>
<tr>
<td>Midale Beds Limestone (2)</td>
<td>-</td>
<td>-3.66 to -3.17 ‰ (3.42 ‰)</td>
<td>2.22 to 2.36 ‰ (2.29 ‰)</td>
</tr>
<tr>
<td>Ratcliffe Beds Dolomite (19)</td>
<td>0.7080 to 0.7103 (0.70856)</td>
<td>-3.84 to 0.89 ‰ (-0.50 ‰)</td>
<td>3.52 to 4.99 ‰ (4.31 ‰)</td>
</tr>
<tr>
<td>Ratcliffe Beds Limestone (2)</td>
<td>0.70792</td>
<td>-2.56 to –1.83 ‰ (-2.20 ‰)</td>
<td>3.59 to 3.78 ‰ (3.69 ‰)</td>
</tr>
</tbody>
</table>

This work will be included as part of Doug’s M.Sc. thesis, which will also include the characterization of some reservoir and potential reservoir dolostones from the Ordovician Red River and Devonian Birdbear and Duperow Formations.
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References


Biographical Note:

Doug Harvey graduated from the University of Regina in 1997 with a B.Sc. in Geology. Following graduation, he went on to work as a well-site geologist for five months, after which he was employed with Saskatchewan Energy and Mines in the Geology and Petroleum Lands Branch for a year and a half. Doug is currently pursuing a M.Sc. degree in Geology under co-supervisors Dr. Don M. Kent and Dr. Hairuo Qing at the University of Regina.