Diagenetic Trends Affecting Carbon Dioxide Sequestration Potential in Mississippian Midale Carbonates; Weyburn Field, Saskatchewan

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Mississippian carbonate and evaporite strata of the Midale Beds, are progressively truncated in a north to northeastward direction by a pre-Mesozoic unconformity surface. The Triassic aged Lower Watrous formation overlies the unconformity and consists primarily of siltstones and shales. These low-permeability red beds partly contribute to hydrocarbon entrapment in the Weyburn Midale reservoir to the south. In the Weyburn field, the zone of diagenetic anhydritization and dolomitization occurs immediately adjacent to the unconformity, providing an effective up-dip seal for migrating fluids. The structural morphology of the Weyburn reservoir suggests that carbon dioxide from the PanCanadian EOR project will migrate up-dip and become sequestered beneath this zone of anhydritization and dolomitization at the Mississippian unconformity. It is therefore important to identify the mechanisms that controlled the extent and distribution of these diagenetic processes.

The gradual transition from highly anhydritized and dolomitized rocks at the unconformity to largely unaffected carbonates and primary dolomites in the reservoir suggests that secondary diagenesis occurred initially at the unconformity surface, and was progressively less active down-dip. Petrography of the secondary anhydrites and dolomites suggest that diagenetic fluids migrated along sub-horizontal microfractures at the unconformity surface with vertical fluid migration dependent upon the permeability of the carbonate protolith.

The origin of these fluids is uncertain, although they may have been derived during meteoric dissolution of the Frobisher or Midale Evaporites, which were exposed at the unconformity to the north and south, respectively.