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Carbonate-Evaporite Cycles in the Upper Devonian Duperow Formation: A Geological Framework for Lithium Brine Resource Assessment in Southwestern Manitoba

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Summary

Interest in lithium brine resources has grown significantly in recent years due to the the growing demand for lithium in renewable energy. In southwestern Manitoba, the up to 220 m thick, Upper Devonian Duperow Formation is a key target for lithium-enriched brine exploration. Stratigraphically, the Duperow Formation is subdivided into the Saskatoon, Wymark (lower, middle, and upper units), and Seward members (Nicolas and Chow, 2018). These members consist of at least 12 regionally mappable, meter-scale carbonate-evaporite cycles, deposited in subtidal, intertidal, and supratidal environments, forming characteristic shallowing-upward sequences (e.g., Wilson, 1987; Cen and Hersi, 2006; Cen, 2009; Eggie et al., 2015; Bates et al., 2016; Nicolas and Chow, 2018). Although these depositional cycles have been extensively studied and correlated in parts of North Dakota and Saskatchewan, their spatial and temporal variability in Manitoba remains poorly characterized. This study integrates core data, routine core analyses, petrophysical well logs, and isopach mapping across townships 1–25 and ranges 13W1–29W1 to delineate the lateral and vertical distribution of carbonate-evaporite cycles within the Duperow Formation in southwestern Manitoba.

Preliminary isopach maps for each member suggests significant variation in carbonate-evaporite cycle thicknesses, with the thickest cycles deposited in townships 10-20 and ranges 20W1 – 29W1. Further, within these cycles, based on the integration of core analyses and well log interpretations, facies-dependent diagenetic alterations, such as dolomitization and subsequent dissolution plays a critical role in enhancing porosity and permeability. As a result, dolomite-rich intervals within subtidal and intertidal deposits are particularly favorable for brine aquifers due to their reservoir quality. These analyses provide insights into facies distribution within carbonate-evaporite cycles, depositional and diagenetic heterogeneity, which are critical for identifying reservoir intervals capable of hosting lithium-rich brines. Thus, provides a comprehensive geological framework for the development of a lithium brine resource model for the Duperow Formation in southwestern Manitoba.

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