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Evaporite Sedimentology in South-Central Alberta: Prairie Evaporite and Lotsberg Formations

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As the Middle Devonian halite deposits in southern Alberta have been defined by comparable adjacent stratigraphy, our research more directly characterizes the depositional model and facies shifts for the Prairie Evaporite and the Lotsberg formations of the Elk Point Group (Givetian to Frasnian) to the south. The formations studied are time equivalent to the black shales and carbonates to the west and the data collected provides key input for geomechanical analysis of salt caverns used for compressed air energy storage (CAES).

The Elk Point Group consists of sedimentary strata extending from the Canadian Northwest Territories to North Dakota, USA. We examined six drill cores and 120 well logs of the Prairie Evaporite and Lotsberg Formations from southern Alberta to determine formation thicknesses, correlate anhydrite interbeds, and assess halite purity.

The Prairie Evaporite is a Givetian salt deposit consisting of halite, sylvite, carnallite, trace anhydrite, and clay. It fills most of the Elk Point Basin, deepening to the southwest and maintaining a thickness of ~150 m throughout the study region. Cores studied contain primary depositional features such as chevron crystals and are dominated by redissolution truncation surfaces that mark flooding events. Cycles of increasing salinity are recorded by pure halite chevron and hopper crystal layers deposited in a lagoon environment succeeded by salt pan deposits of impure halite and potash rich beds. Secondary desiccation and bittern infilling of fractures occurred post-precipitation. This concentrated sylvite and carnallite in fractures at the distal ends of the core and sporadically throughout. The interbedded clay beds are commonly deposited on dissolution surfaces indicating a sediment rich fluid influx. These clay beds can be planes of weakness that may slip/cave and disturb brine mining or cavern operations. The Eifelian Lotsberg underlies the Prairie Evaporite Formation in an area restricted to the depositional center of the Elk Point Basin, and is 100 m thick on average. It is comprised of coarse, nearly pure halite with trace anhydrite impurities and at least one significant (~1 m) interbed of anhydrite. The lack of primary depositional fabrics in the formation is hypothesized to result from recrystallization of the halite.

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