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[PS]Intrastratal Dedolomite and Secondary Gypsum in the Prairie Evaporite Formation of Northeastern Alberta: Diagenesis in a Carbonate-Sulphate System*

Tyler E. Hauck[1], Hilary J. Corlett[2], Matthias Grobe[2], Erin L. Walton[3], and Pierre Sans-Jofre[4]

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[1]Alberta Geological Survey - Alberta Energy Regulator, Edmonton, Alberta, Canada (tyler.hauck@aer.ca)
[2]Alberta Geological Survey - Alberta Energy Regulator, Edmonton, Alberta, Canada
[3]Department of Physical Sciences, MacEwan University, Edmonton, Alberta, Canada
[4]Pierre Sans-Jofre, Université de Bretagne Occidentale, Institut Universitaire Européen de la Mer (IUEM), Laboratoire Domaines Océaniques, Place Copernic, 29280 Plouzane

Abstract

Mapping of the Prairie Evaporite Formation was undertaken as part of a regional assessment of Paleozoic strata in the oil sands regions of northeastern Alberta. Resting on the carbonates of the Keg River Formation, the Prairie Evaporite Formation was deposited as a thick succession of halite with lesser anhydrite, dolostone, and shale during a period of intense evaporitic drawdown in the Elk Point Basin. Within the Prairie Evaporite, pauses in evaporitic drawdown are marked by regionally mappable dolomudstone and anhydrite beds. During orogenic loading and the westward tilting of the Devonian succession, the Prairie Evaporite Formation was exposed along the eastern basin margin prior to and during Cretaceous deposition. Subaerial exposure resulted in intrastratal karst within the halite and anhydrite of the Prairie Evaporite through influx of water from the basin margin and the removal of significant volumes of halite. Removal of halite resulted in a northwest to southeast trending dissolution scarp through the study area. East of the dissolution scarp, net-pay mapping of anhydrite and gypsum in the Prairie Evaporite reveal that significant volumes of anhydrite have experienced gypsification. Gypsum here is considered to be secondary, in that it formed from the rehydration of anhydrite, or by solution-precipitation mechanisms, by near-surface groundwater. Whereas many of the thick gypsum intervals are located at the top of the remaining Prairie Evaporite interval, thin gypsum beds transitioning into anhydrite occur directly above and below mappable, partially to fully dedolomitized dolomudstone beds in the lower part of the interval. These dolomudstone beds are thought to be laterally continuous with the regionally mappable dolomudstone beds found west of the dissolution scarp. Rehydration of anhydrite to gypsum along with dedolomitization in the associated dolomudstone beds suggests the introduction of a common fluid that is undersaturated with respect to dolomite. The Prairie Evaporite Formation in northeast Alberta has experienced a complex history of evaporite karst and other diagenetic changes. Identification and mapping of the intrastratal dolomudstone beds and associated secondary gypsum, as well as the detailed investigation of the sequence of diagenetic changes helps to improve our understanding of the evolution of fluid composition and flow patterns within the Devonian beneath the Athabasca and Cold Lake Oil Sands areas.

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