

SEG 2026 Conference in Salt Lake City, United States

Probabilistic Assessment of Undiscovered Potash in Stratabound Marine Salt Deposits: Example From Elk Point Basin, Canada and the United States

Mark Cocker¹

¹US Geological Survey, Tucson, United States

The stratabound Middle Devonian (Givetian) Prairie Evaporite is the world's largest source of the critical mineral potash and has produced 605 Mt of KCl from 1.5 Tt of ore since 1962. Total value of potash is on the order of \$70 trillion (CAD) from underground mines at depths ranging from 900 m to nearly 1,800 m. Known potash resources are approximately 22 Bt of K₂O equivalent. The Elk Point Basin is a large, intracratonic evaporite basin covering approximately 1,200,000 km² containing sylvinite and carnallite in four stratigraphic members (Esterhazy, White Bear, Belle Plaine, and Patience Lake) in the upper 100 m of the Prairie Evaporite. The members underlie about 188,000 km² with a total volume of about 2,690 km³ and total estimated mineralized rock tonnage of 5,000 Bt. Post burial salt dissolution and alteration of primary carnallite to sylvinite decreased member volumes and increased grades.

The USGS assessed undiscovered potash resources in this basin using Saskatchewan Geologic Survey's well data for probabilistic distributions of thickness, area, grade and mineralogy. Estimation parameters were: each member is at least 1 m thick, is less than 3 km from the surface, contains at least 4 percent equivalent K₂O, and contains the currently known potash resources and potash occurrences. Volumes for each stratigraphic member were modified by actual, estimated geologic loss owing to salt dissolution and extraction ratios, as well as estimated distribution of carnallite and sylvite. Monte Carlo simulations (n=5,000) combined volume estimates of the potash-bearing members with probability distributions for average grade and bulk density.

Mean potash grades (percentage K₂O equivalent) ranged from 10.66 to 17.76. Undiscovered K₂O resources for the Patience Lake, Belle Plaine, White Bear, and Esterhazy Members are 340, 220, 34, and 190 Bt, respectively, and estimated resources are 790 Bt for the entire Prairie Evaporite.