Insights gained from resource and reserve estimates in brine deposits

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ABSTRACT
While Canadians have mined minerals from the earth for centuries, the concept of extracting minerals from brines is relatively new. Of particular interest for brine mining is the extraction of lithium for use in battery development (e.g., electrical vehicles, portable consumer devices). The first NI 43-101 report for lithium resources and reserves in a brine deposit (as required by the Toronto Stock Exchange) was published in 2012 and set the bar for estimation procedures and approaches.
For brine deposits, estimates of a mineral resource (i.e., how much is in the ground) requires detailed site characterization of geology (e.g. sequence stratigraphy consistent with depositional environment), hydrogeology (e.g., delineation of aquifer and aquitard units, drainable porosity) and the distribution of dissolved mineral grade concentration. A mineral reserve estimate (i.e., how much of the deposit can be extracted) requires a rigorous three-dimensional numerical model to simulate groundwater flow and brine transport at the level of detail incorporated within the characterization. Detailed modelling is required to design well networks that balance the number of extraction locations with total pumping requirements, while maintaining a high mineral grade; the total mass that is practically extractable defines the value of the application. Uncertainty analysis, facilitated through modelling, provides investors with a scientific basis to understand potential risks associated with a proposed mine.
Through case studies in North and South America, insights gained from evaluating brine deposits are presented. Case studies include the development of the first NI 43-101 report for reporting lithium resources and reserves in a brine deposit, as well as highlights from several similar applications in a variety of locations. While the primarily targeted sites are dried salt lakes (salars), where brine concentrations can be very high (>300,000 mg/L), the same principles for resource and reserve estimates can be applied to brine deposits in deeper geologic units.