



## A Little Bit of Everything

### Evidence of Organic Carbon Control over Sulphate Reduction in a Saline Shallow Lake near a Gas Plant in Calgary, Alberta

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A gas plant adjacent to McDonald Lake, near Balzac, Alberta, was in operation for over 30 years by CNOOC. The plant ceased to operate in 2011 and from 2011 to 2024 it has been under remediation and restoration. High levels of sulphate concentrations, above statutory guidelines, have been registered historically at McDonald Lake. In general, these results of this investigation suggest that despite all the BGP operational licensed SO<sub>4</sub> discharges to the lake over the years, the effects on the water quality are considered nonmaterial due to the SO<sub>4</sub> sequestration via bacteria mediated reduction in the sediments and the significant climatic effects on the major ion chemistry of the lake.

The lake is a small, alkaline, shallow, saline Prairie evaporative water body with no perennial water courses flowing in or out of it. A previous water balance and a dissolved mass loadings balance suggest that the spring freshet contribution is critical to replenish the lake's water levels. Since the lake's sulphate concentrations have been relatively constant over the years and the inputs mass loadings are significantly higher than the outputs, the presence of a sulphate sink is assumed. This investigation was based on a detailed evaluation of McDonald Lake's chemistry, previous isotopic investigations of S<sup>34</sup> in the water and lake sediments, and lithological and dissolved major ions chemistry data from previous drilling programs. This information was assessed in combination with a mass transfer modelling with PHREEQC, the results of which reveal a sulphate reduction mechanism in presence of organic matter controlling the sulphate in the lake. Also, the high levels of sulphate in the lake during drought periods were assessed with PHREEQC modelling, the results of which suggest that gypsum and carbonates are the dominant minerals. Gypsum precipitation prediction in the lake sediments aligns with documented evidence of a drought occurring in southwestern Alberta lakes 9,800

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Francisco Castrillon Munoz is a Water Resources Manager with more than 20 years of experience in groundwater investigations in Canada and U.K. Francisco's hydrogeological experience has been acquired from projects in mining hydrogeology and water supply where he conducted drilling, testing dewatering plans, monitoring programs, deep injections, water balances, environmental impact assessments, aquifer characterizations and modelling. Francisco has experience in leading