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Arsenic transforming genes in a low arsenic hypersaline lake in southern British Columbia, Canada.

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Spotted Lake is located on the Okanagan First Nations territory, near the town of Osoyoos, British Columbia, Canada. The lake is comprised of hundreds separate brine pools, some of which disappear during dry periods or are flooded in the spring. Our previous study of deep gold mine brines, contaminated with arsenic, showed high copy numbers of arsenite oxidizing genes in comparison with arsenate reducing ones. The goal of this study was to measure chemical composition and the level of arsenic in the lake brine and sediment, and compare it with the deep mine high arsenic brines for genes involved in arsenic transformation. Chemical analysis of the muddy lake sediment up to 33 cm depth indicated very high concentrations of Sr (up to 2260 ppm), P (310ppm), Mg (2.32%), Ca (18%), Ba (40 ppm), with low concentration of arsenic (3 ppm). In water samples total arsenic was less than 0.05 mg/L. Other lake water element concentrations were as follows: Ca 589 mg/L, Mg 13000 mg/L, K 850 mg/L, Na 21200 mg/L, Sr 11.5 mg/L. Alkaline soils and sediments are known for producing very low microbial biomass that results in a low DNA yield, but Spotted Lake had microbial mats, and as most lakes in that region, the lake probably is formed by groundwater. Bottom waters of many saline lakes in British Columbia are oxygen-deficient for much of the year. To isolate DNA from the mud was a challenge, despite the obvious presence of organic matter in samples. Successful modifications of the common DNA extraction protocol that yielded amplifiable DNA from lake biomass will be described. Following DNA extraction, the AroA gene, responsible for arsenite oxidase, as well as the arsC arsenate reductase gene and the arrA respiratory arsenate reductase gene were quantified using several corresponding primers by the real-time qPCR method. The aroA genes were in the range 16000 to 645000 copy numbers per 1 ng DNA, while the arsC were not detectable with four different primer sets. The high numbers of gene involved in arsenic oxidation as determined in our analysis reveal intensive arsenic oxidation activity in this hypersaline lake, similar to that found in deep mine high arsenic brines.