

Isotopic biofractionation of perchlorate

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Perchlorate is a naturally occurring oxyanion that has become a widespread environmental contaminant through anthropogenic activity. Stable isotope analysis can be used as a forensic tool to determine the origin of perchlorate or evaluate the success of a bioremediation strategy. Here we present a new method for the purification of perchlorate for stable isotope analysis to track a novel lab scale oil reservoir souring strategy and evaluate parameters that influence perchlorate biofractionation. To assess the efficacy of perchlorate as an inhibitor of microbial sulfate reduction, we injected seawater amended with 3 mM perchlorate into sulfate reducing oil sand columns. Perchlorate successfully inhibited sulfate reduction and perchlorate was partially consumed within the column. Stable isotope analysis revealed that microbial perchlorate reduction was occurring in this system and inhibition of sulfidogenesis was through biocompetitive exclusion. To gain further insight into perchlorate biofractionation we assessed the impact of electron donor type, salinity, temperature and strain on perchlorate fractionation. The fractionation of perchlorate was conserved within the Proteobacteria suggesting that it is governed by the first step of the perchlorate reduction pathway. Overall, this work demonstrates the robustness of our new method that is more efficient (~80 % recovery) than existing procedures and practical for small biological and environmental samples.