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### Title

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## Monitoring Microbial Chemotaxis and Sulfate-Reduction Using the Self-Potential Method

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There is increasing interest in the use of the self-potential (SP) method for non-invasively characterizing subsurface redox conditions. As variations in the redox state are indicative of conditions favorable to specific types of microbial activity, the ability to monitor spatiotemporal changes in the redox state of aquifer sediments would be of great value in evaluating stimulated bioremediation. We have used the self-potential method to track the onset and location of microbial sulfate-reduction in saturated sediments at the laboratory scale during conditions of organic carbon amendment. Anomalies of greater than  $-400$  mV were observed as sulfate-reduction coincided with the incomplete oxidation of lactate. The timing and location of the SP anomalies correlated with increases in the concentration of planktonic cells and decreases in sulfate. In the absence of chelating metals, the reduction of sulfate results in elevated concentrations of dissolved sulfide. The SP anomalies observed here are believed to result from electrochemical concentration gradients between regions of high and low dissolved sulfide. Temporal variations in the location of the SP anomaly corresponded to the location of active sulfate-reduction, which in turn was governed by microbial chemotaxis towards elevated lactate concentrations. Abiotic experiments in which sulfide concentration gradients were systematically varied showed a positive correlation between the magnitude of the measured SP anomaly and the difference in sulfide concentration. These results suggest the ability to measure the changes in the spatiotemporal location of sulfate-reduction during bioremediation and to perhaps quantify the ensuing sulfide concentration gradients.