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Biogeosciences Discussions



# *Interactive comment on* "Integrative analysis of the interactions between *Geobacter* spp. and sulfate-reducing bacteria during uranium bioremediation" *by* M. Barlett et al.

**Anonymous Referee #1**

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The manuscript describes a study of the response of Geobacter-like microorganisms and Desulfobacter-like organisms in sediment columns responding to acetate addition. This laboratory experiment was initiated to mimic field amendments at a US Dept. of Energy study site. The field amendments with acetate indicate Geobacter populations bloom first followed by growth of the sulfate reducing populations. There is also concurrent uranium reduction and Fe II production at the site resulting from this acetate addition. The research was designed to elucidate the dynamic interplay between these groups of microorganisms during biostimulation.

Specific questions for the authors:

A. Is the title appropriate given the findings? The introduction states there is little direct interaction between Geobacter and SRB populations. Perhaps “Integrative modeling of Geobacter and SRB’s during uranium bioremediation” would be more accurate.

B. In figure 1A there are 2 peaks in cell numbers for Geobacter and SRBs during the first acetate addition. One peak is early in the experimental treatment (day 15) and corresponds to the increased acetate supply and decline. However, the second peak in cell numbers is around day 50 when most of the acetate has been utilized. Do the authors have any idea what may have caused this spike in SRBs and to a lesser extent the increase in Geobacter? What electron donor may be present in groundwater or their experimental system to account for this increase? It does not appear to be acetate.

C. In figure 2, the chemical models seem to do a very good job reproducing the concentrations of acetate, sulfate, and Fe II to a lesser extent. However, the cell abundance models are not as robust, showing results that overestimate the Geobacter fraction initially and then underestimate the population. The SRB model seems to miss the first 2 peaks in cell abundance completely and only captures the final peak. Conversely, the Geobacter model is only sensitive to the first peak in cell numbers and does not catch the last 2 peaks.

D. In figure 3, the model results indicate the acetate concentration does not seem to change in the presence of 100% Geobacter, suggesting the entire population of Geobacter is being supported by <1 mM acetate. Is this a reasonable prediction for 10ˆ9 cells per ml?

E. Other studies at the Rifle site indicate there are multiple microorganisms that take up acetate beyond Geobacter and SRBs. These microbes would not be assayed by the in situ fluorescence methods being used. Could these other acetate utilizers explain the lower than expected Geobacter fraction in the early stages of the acetate amendment?

F. Prior research using 57-Fe-goethite amendments with Rifle sediments also indicated the iron reducers and sulfate reducers are simultaneously active when acetate is added



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in millimolar concentrations. However in that study, the goethite was utilized in the beginning of the acetate addition casting some doubt on the “Difficult to use Fe” vs. the “Easy to use Fe” concept. Additionally, the goethite had little overall effect on Geobacter populations. This discrepancy in findings between the two studies could result from the different concentrations of the iron amendments. Can the authors comment?

Finally, efforts to model the response of microbial communities to field perturbations are tremendously important for predicting how bacterial populations react to bioremediation efforts. Ultimately, these discrepancies between field data and model results will help to elucidate where the models are inadequate and eventually lead to an improved understanding of how the microbiota respond to changing environments.

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Interactive comment on Biogeosciences Discuss., 8, 11337, 2011.