

Author's responses to referee #1 (Sarah Hayes) comments on Cooper, et al (2017), 'Ferrihydrite associated organic matter (OM) stimulates reduction by *Shewanella oneidensis* MR-1 and a complex microbial consortia,' *Biogeosciences Discuss.*, doi.org/10.5194/bg-2017-270

Reviewer: Sarah Hayes

Summary: Cooper et al. is a thoughtfully designed and compares the rate of microbial iron reduction by *Shewanella oneidensis* MR-1 and a natural microbial isolate from an Fe-rich fen as a function of organic matter concentration and association with ferrihydrite (sorbed vs coprecipitated). The nature of mineral-organic matter interactions in the natural environment is an active area of research and the influence of nanoscale mineral and organic matter associations on microbial behavior is very timely, interesting, and well-suited for publications in Biogeosciences. The study is very clearly outlined and easy to understand with surprisingly similar rates of Fe reduction by the *Shewanella oneidensis* MR-1 and a fen microbial isolate. The manuscript is clearly written with a few typos that do not distract from the meaning.

We would like to thank referee #1, Sarah Hayes, for taking the time to review our manuscript and for her feedback and supportive comments. Your feedback will undoubtedly improve the quality of the manuscript. Below we provide answers to all comments.

General comments:

Overall, this is a lovely manuscript. The discussion section could use a little bit of streamlining to really highlight the important contributions a bit better.

Thanks for the positive feedback!

-It seems like the bulk of the section 4.0 could be redistributed into the other sections of the paper.

This section was reorganized/rewritten in a way that the information provided can now stand alone as an independent section instead of needing to be re-distributed to other sections of the manuscript. Please note, this is also addressed in our response to your comments regarding Line 329-345, 358-365 on the next page.

-Section 4.3 could probably be absorbed by the results section. And any mention in the discussion might be best integrated into another section.

Section 4.3 was removed from the discussion section. This information was integrated into the results section 3.4 as suggested.

-The conclusions section could also be streamlined to quickly revisit the key findings of the study.

We did some changes to the Summary and Conclusions (now section 4.3) to better streamline, however, we feel the way we presented our summary and overall conclusions in this section is effective in getting our message across and would prefer not to make significant changes to the text here.

Specific comments:

L11: should be "this study investigated to what extent"

Corrected (Line 11).

L14: should be "OM content" not "contents"

Corrected (line 14).

L48: should be "coprecipitation is the more common process"

Corrected (line 48).

L49-51: This sentence isn't super clear. Consider breaking it into two sentences or maybe just clarifying the end, something like "reducing agents potentially differ between ferrihydrite precipitated in the presence of OM and purely adsorbed OM."

This sentence was modified for clarity. The following sentence was added: 'The different properties of pure ferrihydrite and OM-ferrihydrite coprecipitates may lead to different behaviors during microbial reduction. Due to their smaller crystal size and more defective crystal structure, coprecipitates might faster dissolve. The associated organic material will change the mineral's surface properties, e.g., the

surface charge, with consequences for the accessibility of Fe(III) to microbes, redox-active shuttling compounds, or extracellular enzymes.’ (Line 49-52)

L61: Again, this sentence isn’t quite right. Consider something like: “dissolved humic acid and the mineral/humic acid ratios have been shown by some studies to increase Fe (III) reduction rates (ref) while other studies have not reproduced this result (ref).” But I’m not sure it keeps the meaning of what you are trying to communicate.

This line was modified as suggested (Line 65-66).

L85: Consider revising to: “Further, this study found that reduction rates by Shewanella were correlated...”

This sentence was revised as suggested (Line 90).

L86-97: This section could flow a bit better. All the pieces are there, but it feels disjointed.

Modifications to this section were included to improve the flow (Line 94-101)

L94-97: This is an excellent way to close this paragraph!

Thank you!

L105-7: I think this surprising result (which is way cool!) should be moved to later in the paper, maybe the results section. It doesn’t really fit here in the introduction.

We considered your suggestion to remove this sentence, but we prefer to leave this as the conclusion to the introduction.

L136: Add the information about the organic matter here (from lines L146-147 and from the discussion L379-82). Then maybe make the rest of the paragraph here with the information about the soil organic matter extraction first and then

Information about organic matter moved to Line 144.

L152: Should be “These cultures were...”

Corrected (Line 167).

L326: Add mineral formulas to the list of minerals observed.

Mineral formulas added to the list of minerals observed in XRD spectra (Line 360-361).

L331-4: This sentence is a little difficult to understand, please reword to improve clarity.

This section was modified to improve clarity. Please see section 3.4.

L352: I’m not sure of your exact meaning, please consider revising to something similar to these suggestions, depending on your meaning: “amendment with each of these substrates stimulates Fe(III) reduction...” or “amendment with all of these substrates stimulates Fe(III) reduction...”

Sentence modified as suggested (‘amendment with each of these substrates stimulates Fe(III) reduction...’) (Line 401-402).

L356: Consider “the substrate mixture used in these ferrihydrite...”

Sentence modified to reflect your suggestions (line 405-406).

L329-345: Would some or all of this material be better suited for introductory material? If not, try to make a stronger discussion point. L358-365: It seems like there is a topic change here that feels disjointed. The summary comments beginning on L 360 seem like they should precede the content earlier in the paragraph and are important to discuss in their own right.

Thanks for pointing out that this first section of the Discussion was a bit disjointed. We took some time to read through and decided the best way to address this was to rewrite/reorganize the information presented in an effort to better link the first paragraph with the overall outcome of our study. The ‘second paragraph’ is now divided into two separate paragraphs which, in our opinion, are easier and more clear to read and provide a better link to the first paragraph as well as the subsequent sections in the discussion (Line 397-420).

L367: Consider: “OM stimulates growth and Fe(III) reduction by S. oneidensis MR-1 and the microbial consortia.”

Sentence modified as suggested (line 442-443).

L373-4: Consider revising: “reducing conditions, which showed that *S. putrefaciens* was capable of using humic acids as an electron shuttle to enhance Fe(III) reduction. However, enhanced Fe reduction was only observed when the concentration of organic...”

Sentence modified as suggested. See lines 451-453.

L377: Consider revising: “which has lower aromatic moieties, and...

Sentence modified as suggested (Line 456).

L378: Consider revising: “electron shuttling capacity to...”

Sentence modified as suggested (Line 456-457).

L379-82: I think the info about the organic matter seems like it should be in the methods section.

Information removed from Section 4.1.

L383-386: seems like these details should also be in the methods, although they are also important here.

Sentence modified so that sufficient information remains here (Line 463), and more detailed information can be found in the methods (Section 2.2).

L394: The colon should probably be a period.

Corrected (Line 473).

L397: The comma between “directly” and “because” does not seem necessary.

Corrected (Line 476).

L405: Consider revising: “oxide surfaces: via direct contact...”

Sentence modified as suggested (line 484).

L406: The “or” should be an “and”

Corrected (line 485).

L428: Consider revising “Fe(III) oxides. However, ...”

Sentence modified as suggested (Line 508).

L429: “abundant” should be “abundance”

Corrected (Line 509).

L433: “inked” should be “linked”

Corrected (line 513).

L441: Should be “the question of whether”

Corrected (Line 521).

L441: consider revising: “bacteria remains unanswered.”

Sentence modified as suggested (Line 4521-522).

L442: the citation at the end of the sentence is redundant of in text citation.

Citation at the end of the sentence removed (Line 522).

L474: Should be “formation from pure...”

Corrected (Line 372). Note, information in section 4.3 incorporated into results section 3.4.

L480-482: This is kinda new information, which should be mentioned earlier (maybe with the other content in section 4.3). Further, you need a citation because this study does not provide any direct evidence to support this claim (which is likely the case).

This information is now introduced in Section 4.1 (Line 447-449). References were added to support this claim.