

Dear Mr. Leins and co-authors:

First my apologies for the very slow processing of your revised paper. I have tried my best to obtain reviews but failed. This is exceptional and very unfortunate. It did never happen before in more than 50 years of cumulative associate editorships. One of the original referees was not interested to see it again, and the other did not respond, despite multiple system and three personal reminders. Other referees contacted also declined. I have therefore decided to have a more detailed look myself rather than further contacting referees.

Your revised paper has very much improved, the data are of high quality and quite interesting, but there is scope for further improvement.

Answer:

Dear Dr. Middleburg,

Thank you for taking the time to review the manuscript and for your feedback. We have addressed your suggestions and made the necessary adjustments to the manuscript.

1) Although the organization of the paper is better than before, I suggest re-organizing the results section so that the results referring to the inhibitor only and to the sample water (that contains the inhibitor) are better separated. This will improve the readability much. The reader is still somewhat lost in the results section.

Answer:

The main organization of the Results follows the methodology that was applied to the samples (Anion analyses, DOC and bulk fraction, FT-ICR-MS analyses). In our opinion it is not favorable to split the results into fluid and inhibitor sample for the first two since the data for the inhibitor in these subsections is minimal. However, we followed your suggestion for “3.3 Molecular composition of the DOM” and hope that this improves the readability. Due to the new structure we incorporated the mean DBE and AI_{mod} values in Table 3.

2) The abstract needs a major rewrite.

a. Write more active: For instance, the first sentence could Dissolved organic matter (DOM) and micro-organisms were characterized along.... The next sentence then Various analytical methods were used to differentiate...

b. The flow and logic: ‘the inhibitor’ suddenly appear in line 7 without prior explanation what type of inhibitor and why etc. This comes a few lines later.

c. Prevent abbreviation as much as possible. For instance, a sentence like using PICRUST2 is too cryptic. Write ...using amplicon sequence variants. (the precise pipeline used is not needed in the abstract).

Previous Abstract

The analysis of dissolved organic matter (DOM) and microorganisms was conducted along the flow path of a geothermal facility in Austria. Various analytical methods were used to characterize and differentiate between natural and synthetic organic matter, characterize the composition of the microbial community, and assess the implications of microorganisms in the operation of a geothermal site. Ion chromatography (IC), liquid chromatography — organic carbon detection (LC-OCD), and Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) in negative electrospray ionization (ESI(-)) and positive atmospheric pressure photoionization (APPI(+)) mode were applied to the fluid samples to characterize the composition of DOM and distinguish between the inhibitor and the natural DOM. The concentration of dissolved organic carbon (DOC) ranged from 8.5 to 10.4 mg C L⁻¹. To prevent carbonate scaling,

a chemical scaling inhibitor is injected into the production well at a depth of 500 m. The inhibitor adds approximately 1 mg C L⁻¹ DOC to the produced fluids. Depending on the applied ionization mode, the FT-ICR-MS results show that between 31 % and 65 % of the macromolecular formulas (150–1000 Da) detected in the fluid samples appear to originate from the inhibitor. However, the DOM primarily consists of low molecular weight acids (LMWA), especially acetate with up to 7.4 mg C L⁻¹. Targeted amplification of the 16S rRNA gene was performed to assess the bacterial diversity. Based on this, metabolic pathways related to the presence of acetate in the samples were predicted using PICRUSt2. The composition of the microbial community varied along the flow path, with Firmicutes Proteobacteria, and Thermotogae being the dominant phyla. Microorganisms may produce acetate through various fermentation processes, such as from lysine, pyruvate, and hexitol. Assessing the presence and interaction of organic compounds and microorganisms in geothermal fluids can provide a broader understanding of processes within the geothermal facility. This understanding could be beneficial for the efficient operation of a geothermal power plant.

New Abstract

Dissolved organic matter (DOM) and microorganisms were characterized along the flow path of a geothermal facility that produces water from a deep (2800 m) carbonate rock reservoir for energy provision. A variety of analytical techniques were employed to distinguish between natural and synthetic organic matter, determine the composition of the microbial community, and evaluate the role of microorganisms in the operation of the geothermal site in Bad Blumau, Austria. Ion chromatography (IC), liquid chromatography with organic carbon detection (LC-OCD), and Fourier-transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) in negative electrospray ionization (ESI(-)) and positive atmospheric pressure photoionization (APPI(+)) mode were applied to the fluid samples for the purpose of characterizing the composition of DOM and distinguishing natural DOM from a chemical inhibitor used to prevent scaling. The concentration of dissolved organic carbon (DOC) ranged from 8.5 to 10.4 mg C L⁻¹. The chemical scaling inhibitor contributes approximately 1 mg C L⁻¹ of DOC to the produced fluids. Depending on the applied ionization mode, the FT-ICR-MS results show that between 31 % and 65 % of the macromolecular formulas (150 – 1000 Da) detected in the fluid samples appear to originate from the inhibitor. However,

the DOM is primarily composed of low-molecular-weight acids (LMWA), with acetate being the most prevalent, reaching up to 7.4 mg C L⁻¹. To assess the diversity of the bacterial communities, targeted amplification of the 16S rRNA gene was conducted. The composition of the microbial community exhibited variation along the flow path, with Firmicutes, Proteobacteria, and Thermotogae representing the dominant bacterial phyla. Based on the community composition, metabolic pathways associated with the presence of acetate in the samples were predicted. Microorganisms may produce acetate through diverse fermentation processes, including those involving lysine, pyruvate, and hexitol. Assessing the presence and interaction of organic compounds and microorganisms in geothermal fluids can provide a broader understanding of processes within the geothermal facility. This understanding could be beneficial for the efficient operation of a geothermal power plant.

3) The introduction might sometimes give the impression that the chemical and molecular biology analyses are more important than the research question (this was communicated by the referees before). For line 42 states that IC was applied for information on... Wouldn't it be more interesting to present the problem that an inhibitor has been added and that its composition is not known because of commercial interest and that you have therefore analyzed the inhibitor and the fluids so that it can trace the relative contribution and transformation of the inhibitor.

Answer:

Part of the introduction was rewritten (start at line 43). It now presents the problem of having an inhibitor with unknown composition in the fluids and which techniques were applied to trace inhibitor and fluid DOM.

4) The use of Generally, in line 92 is unclear. Turn into However,

Answer: Done

5) The unit 5 L L⁻¹ needs more explanation: L L⁻¹ units are sometimes used for gases but then it should be less than one. Does the one volume refer to another phase than the other volume? This was identified by one of the referees before.

Answer:

This sentence was clarified (Line 102): The CO₂ concentration makes up 99 % of the gases and is estimated to be approximately 10 g L⁻¹, which correlates to approximately 5 L of CO₂ per L water.

6) The use of its in line 68 is unclear. Does it refer to natural and synthetic DOM?

Answer:

We restructured the sentence for clarity (Line 75): (2) determine the origin of DOM by distinguishing between natural and synthetic sources.

7) L. 85: at approximately

Answer: Corrected

8) Line 123: size exclusion chromatography in full rather than directly using SEC.

Answer: Corrected

9) Line 329: a strong influence of what?

Answer:

Rephrased the sentence for clarity (Line 360): The assigned signals from the fluid and inhibitor samples indicate a strong influence of the inhibitor on the production side sample, with contributions reaching up to 65 %.