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Discussions

Interactive comment on "Ideas and perspectives: Hydrothermally driven redistribution and sequestration of early Archaean biomass – the "hydrothermal pump hypothesis"" *by* Jan-Peter Duda et al.

M.A. van Zuilen (Referee)

vanzuilen@ipgp.fr

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This is a very interesting paper showing a potential key characteristic of kerogen in chert veins of the early Archean Dresser Fm. The origin of the kerogen in this chert vein (and other early Archean chert veins in the Pilbara) still remains debated. It could represent sedimentary biomass that was recirculated by hydrothermal fluids, or represent the abiogenic product of FTT synthesis that was generated during hydrothermal serpentinization of ultramafic crust. This paper therefore addresses a very relevant scientific question.

Based on HyPy extraction, GC-MS and compound-specific isotope analysis, the authors showed that the kerogen phase releases n-alkanes with a specific carbon-number distribution. The sharp decrease in n-alkane abundance above n-C18, is similar to the distribution of n-alkanes released during HyPy of cyanobacteria. This distribution is not observed, however, in n-alkane products of FTT synthesis. Based on these observations, the authors conclude that the kerogen in the chert vein of the Dresser Fm is derived from biomass (such as e.g. phototrophs, chemolithoautrophs), and not from FTT synthesis associated with hydrothermal circulation. In order to explain the presence of kerogen in deep feeder chert veins, the authors propose a 'hydrothermal pump' hypothesis, in which redistribution and sequestration of microbial biomass occurs through hydrothermal circulation. This is a very nice explanation, and would confirm that microbial life was abundantly present in the ancient oceans.

The paper is very well written, and experimental results support the conclusions. I have 3 issues that should be worked out better in this paper, which are listed below.

1) The conclusion of this paper strongly depends on the drop in >C18 n-alkanes in biologic materials. It should then be explained in detail why this happens. Is this drop observed in all biologic materials? Is it related to specific compounds that are present in cell membranes? There is now only a very short description about this (P10, line 10-11), stating that bacteria commonly (though not exclusively) form linear carbon chains <C18 (cf. Kaneda, 1991). I think it is important that this discussion is expanded here. Is there a chemical reason for this drop in abundance of n-alkanes beyond C18?

2) The HyPy products of kerogen of the Dresser Fm are compared with HyPy products of cyanobacteria, but – if I understand correctly – not with the HyPy products of FTT synthesized carbonaceous solids. Only the direct gaseous FTT synthesis products are compared. Were there any solid phases produced during FTT synthesis? It would have been important to see what kind of HyPy products this would have generated, in comparison with that of HyPy products of cyanobacteria and Dresser Fm kerogen. I think the authors should discuss this better, in order to make clear that a comparison

with a true abiogenic carbonaceous solid has not been made here.

3) The maturity of kerogen in the Dresser Fm is determined using Raman spectroscopy. I have several comments to the methods used here. The H/C ratio of the kerogen fractions is calculated following the method of Ferralis et al. (2016), using a D5-peak in the Raman spectrum. However, based on the example spectrum in Fig.2c I think it is quite difficult to convincingly fit a D5-peak. The authors should at least show how this fit was made. It may well be that the kerogen has reached a degree of alteration where the amount of H is too low to create a significant D5-peak. The other method used here is to check the S1 peak (2450 cm-1) in the second order spectrum. The absence of this peak is consistent with kerogen that has experienced prehnite-pumpellyite to lower-greenschist-facies metamorphism. However, I think there are more precise methods to determine the degree of alteration of the kerogen. For instance, the Raman-based geothermometer of Koketsu et al. (2014) could have been applied to the first-order spectrum. Or even better, the Raman-based indicator of Delarue et al. (2016) can be applied. This indicator has been specifically developed to compare kerogens in Precrambrian cherts.

Minor, technical issues:

- P3, Line 27: . . ..(GC-MS). Before. . ..

- P4, Line 7 and line 22: Why is the heating program for the cyanobacteria different than for the extracted kerogens?

- Section 2.8: It may be good for the reader if a little more information is given here on PAH's. What are they, and why are these ratios important? And how were these PAH's measured?

- Section 4.4: The way it is written, it is not clear whether the 'hydrothermal pump hypothesis' is an already existing term, or is here proposed for the first time. It should be more clearly stated that this is a new proposed model.

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