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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.

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Comment from referee: "This is innovative, thorough and significant work addressing the biogenicity of the oldest known well preserved organic matter in the geological record and the biological affinities of its precursor organisms. The techniques involved have been applied rigorously but the interpretations are only as good as those techiques allow; I lack the expertise to judge them carefully so it is essential that this be done by well informed experts such as Roger Summons, Simon George and Jochen Brocks.

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Comment from referee: “There is a need to discuss the possibility that there could have been contamination by organic compounds derived from the 2.7-2.8 Ga Fortescue Group that overlies the Dresser Fm in the studied area. It is conceivable that a “hydrothermal pump” could have circulated fluids downwards into the older succession. There is a significant literature on the organic geochemistry of the Fortescue Group by George, Coffey, Summons and others. The same applies to the Strelley Pool Fm where there are abundant stromatolites and microfossils”.

Author’s response: The depositional age of the Dresser Formation is constrained to ca. 3481 $\pm$ 3.6 Ma (Van Kranendonk et al., 2008). An emplacement of organic material into the Dresser hydrothermal chert vein by fluids circulating during the deposition of stratigraphically younger units as e.g. the Strelley Pool Formation (ca. 3.43–3.35 Ga; Hickman, 2008) and Fortescue Group (ca. 2.7–2.6, see reviewer comment) is unlikely. Firstly, there is no petrographic evidence that the analysed Dresser hydrothermal chert vein has been affected by fluid-flow events that post-date the initial formation (e.g. brecciation textures, etc.). The kerogen exclusively occurs in form of fluffy aggregates and clots embedded within a very dense chert matrix which is, once solidified, highly impermeable to fluids. It does furthermore not occur along grain boundaries, cracks etc. which could indicate possible transport by later fluids. This has also been described for other hydrothermal chert veins of the Dresser Formation, where the kerogen has been interpreted as being syngeneic (i.e. formed prior to host rock lithification; Morag et al., 2016). A later transport of kerogen without fluids, as alternative scenario, can also be excluded as macromolecular organic matter is not mobile in solid, impermeable materials.

Author’s changes in manuscript: We tried to make this clearer (first paragraph of chapter 4.2 Syngeneity of the Dresser kerogen-derived compounds), now: “The kerogen of the Dresser Formation exclusively occurs in form of fluffy aggregates and clots embedded within a very dense chert matrix that is, once solidified, highly

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impermeable to fluids. The depositional age of the formation is constrained to 3481 ± 3.6 Ma (Van Kranendonk et al., 2008), and the investigated chert vein shows no evidence for disruption by post-depositional hydrothermal fluids. This has also been described for other hydrothermal chert veins of the Dresser Formation, where the kerogen has been interpreted as being syngenetic (i.e. formed prior to host rock lithification; Ueno et al., 2001, 2004; Morag et al., 2016). Furthermore, the maturity of the embedded kerogen is in good accordance with the thermal history of the host rock. An introduction of solid macromolecular organic matter from stratigraphically younger units in this region during later fluid flow phases, as proposed for the younger Apex chert (Olcott-Marshall et al., 2014), can therefore be excluded".

Comment from referee: "The manuscript would be enhanced by adding a paragraph outlining the evidence that indicates that the 3.5Ga environment was anoxic".

Author's response & changes in manuscript: We now provide information on existing evidence for reducing conditions during deposition of the Dresser Formation (widespread presence of pyrite, Fe-rich carbonates, trace element signatures) and cite the relevant studies (Van Kranendonk et al., 2003, 2008) (chapter 4.3 Origin of the Dresser kerogen: hydrothermal vs. biological origin).

Comment from referee: "It seems to me that the evidence from the Apex Chert needs to be at least briefly reviewed here as it would add significantly to the context of this new work".

Author's response & changes in manuscript: In contrast to the Dresser hydrothermal chert vein analyzed in our study, the younger Apex chert has been affected by multiple fluid flow events. Some of these events significantly post-date the initial formation time and also led to an emplacement of younger organic materials (Olcott-Marshall et al., 2014). Our hypothesis may be relevant for the Apex chert in that it explains the

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possible presence of organic matter during its initial formation. It cannot, however, help to pinpoint the formation pathways of distinct carbonaceous structures (e.g. Schopf, 1993, 2002; Brasier et al., 2002, 2005). We now explicitly state this problem in the manuscript (last paragraph of chapter 4.4 The "hydrothermal pump hypothesis").

Comment from referee: "The manuscript is well written and almost free of errors. P.11 l. 19 change to instantaneously".

Author's response & changes in manuscript: Done.

Comment from referee: "References to the published geological maps of the North Pole area should be added. There may be other publications by Hickman that should be cited". Author's response & changes in manuscript: We now provide information on published geological maps by Hickman (1983), Van Kranendonk (1999) and Hickman and Van Kranendonk (2012) (chapter 2.1). We also cite further publications by Hickman (1973, 1975, 2012) (chapters 1 Introduction and 4.1 Maturity of the kerogen).

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