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Biogeosciences Discussions

Interactive comment on "Precambrian palaeontology in the light of molecular phylogeny – an example: the radiation of the green algae" *by* B. Teyssèdre

Anonymous Referee #3

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This manuscript attempts to integrate paleontological and phylogenetic data in order to reconstruct the evolutionary history of green algae or the Viridiplantae. The author discusses the phylogenetic assignment of several key fossils from the Proterozoic and concludes that the Chlorophycea and Ulvophycea diverged from each other long before 750 Ma, the Chlorophyta and Streptophyta diverged from each other long before 1200 Ma, and the last common ancestor of the Viridiplantae and Rhodophyta existed possibly two billion years ago.

The paleontological and phylogenetic data presented in this paper are not new. This would be acceptable if critical evaluation or new interpretation of pre-existing data is

presented. However, I am a bit disappointed that the review of paleontological and phylogenetic data is uncritical. In particular, the identification of “a great deal of microspheromorphs” as members of the Viridiplantae (p. 3128, line 8-15), on the basis of inferred presence of sporospollinins and algaenans, is problematic. Any kerogen would likely survive HF maceration, and many organic compounds other than sporospollinins and algaenans can be preserved as kerogen. So it is problematic to conclude taht “the envelope of acritarchs that withstand such a drastic treatment must possess some biopolymer like the sporopollinins or the algaenans, that are today almost exclusively typical of the Viridiplantae”. As a result, the conclusion that the Viridiplantae diverged at 2.0 Ga is insecure.

I also have some general problem about “molecular phylogeny as a heuristic tool for retracing the evolution of the Viridiplantae” (p. 3131). There is nothing wrong with the basic principles of the heuristic tool, and the biostratigraphic data have been used to infer phylogenetics (stratocladistics) based on similar principles. However, when we are dealing with the sparse Precambrian fossil record where reliable calibration points are few, one misinterpreted fossil could falsely lead to large range extension.

p. 3129, second paragraph: The comparison between Proterocladus and “Cladophora” was to show that the latter could serve as a good modern analog to guide the interpretation of Proterocladus. The later discovery of “Cladophora” being a polyphyletic taxon (but still within the Cladophorales) does not at all affect the original interpretation of Proterocladus as a cladophoran.

p. 3132, line 11-17: “A phylogenetic dendrogram shows that, starting from Palaeastrum or from Proterocladus, we must cross at least twelve nodal points in order to reach the last common ancestor of the Viridiplantae. So the fact that these two taxons were dated ca. 750Ma does not mean that the most ancient fossils of green algae are 750Ma old, as Knoll stated (2003). Instead their presence shows that the

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radiation of the multicellular green algae started LONG before 750 Ma, and that the radiation of the unicellular green algae is even MUCH older”. The conclusion is based on the assumption that the number of “nodal points” is correlated with evolutionary time. There is no empirical evidence to support this assumption. In addition, the number of “nodal points” really depends on how many taxa are represented in the cladogram (i.e., taxon sampling). The number of nodal points between Palaeastrum and Proterocladus would change significantly if you increase or decrease the number of taxa in your cladogram.

p. 3132-3133: “Therefore it is not amazing if it is represented among the most ancient fossils of Eukaryota, ca. 1450Ma at Roper or even ca. 1730–1700Ma at Chuanlinggou”. Are the Roper and Chuanlinggou fossils the most ancient eukaryotes? What about your interpretation of the 1800-2000 Ma microspheromorphs as eukaryotes (p. 3128)?

p. 3134, line 7-8: “However these fossils, albeit unicellular, are beyond any doubt genuine green algae”. Perhaps an overstatement?

p. 3134, line 22-27: “But if we try to determine the position that each of these fossils holds on the dendrogram of the Viridiplantae, we see that the Ulvophyceae and Chlorophyceae are both recent branches on this tree, that they were preceded by a long series of paraphyletic lines of “Prasinophyceae” and that the whole Chlorophyta must have diverged from the Streptophyta much earlier”. Again, phylogenetic distance (particularly measured here as number of number of nodal points) is not correlated with evolutionary time.

None of the figures are cited in the text.

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