Biogeosciences Discuss., 4, S1607–S1609, 2007
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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

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Received and published: 9 October 2007

I perfectly agree with Anonymous Referee # 3 that phylogenetic distance is not directly correlated with evolutionary time. I maintain, however, that phylogenetic distance, when it is complemented by evidence coming from other sources, can give useful indications as to the minimal age of the divergence between two given clades.

p. 3129, second paragraph. The paper by Butterfield, Knoll and Sweet (1994) about the fossils of the Svanbergfjellet Formation is one of the greatest achievements, I think, of the whole literature on the Precambrian field. The comparisons of Proterocladus with Cladophora and of Palaeastrum with Pediastrum and Coelastrum are particularly perspicacious. It would not be fair play to reproach Butterfield, Knoll and Sweet (1994)

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for not referring to papers that were published later than their own, especially that of Hanyuda and al. (2002) showing that Cladophora and Cladophoropsis are both polyphyletic, that of Buchheim and al. (2001) on the Sphaeropleales and that of Watanabe and al. (2000) demonstrating that the word “Chlorococcales” does not mean anything but a polyphyletic pseudo-clade. Nevertheless it is not illegitimate, using molecular phylogeny, to try to rectify afterwards the taxonomic position of Proterocladus and Palaeastrum on the grounds of these findings.

p.3134, line 7-8. When I write that the Pyramimonadales, albeit unicellular, are beyond any doubt genuine green algae, this is not an “overstatement” (as Anonymous Referee # 3 supposes), but it has been phylogenetically demonstrated. So you may doubt that Tasmanites is really akin to Pachysphaera or that Pterospermella is really akin to Pterosperma, and you may doubt that these fossils from Thule are really 1200 Ma old, but if all this is right, then you must necessarily conclude that the most ancient fossils of the green algae are not dated ca. 750 Ma, but that some green algae, namely some Pyramimonadales, were already present 1200 million years ago.

If molecular phylogeny shows that Proterocladus is deeply nested within the Ulvophyceae, that Palaeastrum is deeply nested between the Clorophyceae, that the Ulvophyceae and Chlorophyceae are both recent branches on the tree of the Chlolophyta and that these were preceded by a long series of paraphyletic lignes of “Prasinophycae”, then, unless you postulate that the radiation of the Ulvophyceae was explosive, that the radiation of the Chlorophyceae was explosive too, that both were simultaneous, and that the many lines of the “Prasinophyceae” diverged instantaneously from each other, it is reasonable to think (although it is not demonstrated) that the radiation of the Chlorophyta began LONG before 750 Ma instead of A SHORT TIME before 750 Ma.

In the same way, if molecular phylogeny shows that Tasmanites and Pterospermella are not basal Pyramimonadales, that Pyramimonadales are not basal Chlorophyta, that Spiromorpha (from Ruyang ca. 1200 Ma) is not a basal Streptophyta, then, unless you

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postulate that the differentiation of the Pyramimonadales was instantaneous, that the radiation of the Chlorophyta was explosive, that the radiation of the Streptophyta was explosive too and that all this was simultaneous, it is reasonable to think (although it is not demonstrated) that some Viridiplantae were already present LONG before 1200 Ma instead of only A SHORT TIME before 1200 Ma.

These indications of molecular phylogeny are strengthened by two data coming from other horizons: a) “Leiosphaeridia crassa” from Roper (ca. 1450 Ma) is coated by a “trilaminar structure” typical of the Chlorophyta; b) The envelope of some Schizofusa from Chuanlinggou (ca. 1730 Ma) bears the same semicircular splitting that characterizes the exkystment of the Pyramimonadales. So, if “Leiosphaeridia crassa” and Schizofusa were correctly interpreted, then the Viridiplantae must be separated from the Rhodophyta before 1730 Ma.

This hypothesis is corroborated by the observation that the recent Viridiplantae can easily be fossilized because their wall contains polymers like sporopollinins or algeanans that are highly resistant to HF maceration. Certainly, as Anonymous Referee # 3 points out, the Viridiplantae are by no means the sole Eukaryota capable of fossilizing. However the great majority of unicellular Eukaryota living today cannot do so because they lack a resistant wall. So it is not unreasonable to think (although it is not demonstrated) that some Viridiplantae may be found among the many microfossils preserved from sediments dating back to 1700-2000 Ma.

The aim of my paper was to refute the idea that the most ancient fossils of the green algae are not older than 750 Ma. I attempted, using a method that combines molecular phylogeny and palaeontology, to propose “a new interpretation of pre-existing data”, in order to suggest that the radiation of the Viridiplantae began certainly before 1200 Ma, that it may arguably have begun before 1730 Ma, and that the divergence of the Viridiplantae from the Rhodophyta is perhaps as old as 2000 Ma.

Interactive comment on Biogeosciences Discuss., 4, 3123, 2007.