

SUPPLEMENTARY MATERIAL

Fungal virulence at the time of the end-Permian biosphere crisis?

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This supplementary material contains brief explanatory notes on taxonomy, stratigraphic range, and chemical constitution of *Reduviasporonites*, as well as on applied methods.

TAXONOMY

Controversies surrounding the status of the palynomorph genus *Reduviasporonites* and included species are strengthened by conflicting taxonomic concepts. Pending further taxonomic analysis, for discussion purposes, we follow the concept of Elsik (1999), who grouped the major part of the *Reduviasporonites* assemblage from Tesero in the morphospecies *Reduviasporonites stoschianus*. Principal points of the taxonomic history of *Reduviasporonites* and included species are:

1. The (morpho)genus was established by Wilson (1962) on the basis of the type species *Reduviasporonites catenulatus*, described from the Flowerpot Formation (Middle Permian, Wordian) of Oklahoma, and considered to represent conidia-like fungal spores.
2. The fungal nature of *Reduviasporonites catenulatus* was accepted by other palynologists, e.g. Kalgutkar and Jansonius (2000), who also distinguished several other species of *Reduviasporonites*, particularly among Cenozoic fungal remains.
3. On the other hand, Kalgutkar and Jansonius (2000) and others did not accept the concept of Elsik (1999) who considered *Reduviasporonites* to be the correct name for the enigmatic Permian-Triassic palynomorphs later described as *Chordecystia* by Foster (1979), and *Tympanicysta* by Balme (1980).
4. Elsik (1999) transferred the type species of the last two genera, *Chordecystia chalasta* from Australia (Foster, 1979) and *Tympanicysta stoschiana* from Greenland (Balme, 1980) to *Reduviasporonites*.
5. Subsequently Foster et al. (2002) confirmed Elsik's concept that *Chordecystia* and *Tympanicysta* are synonyms of *Reduviasporonites*, but at the species level these authors argued that *Reduviasporonites chalastus* and *Reduviasporonites stoschianus* are conspecific, the former name having priority.
6. According to Foster et al. (2002) organic-geochemical and carbon-isotopic analysis indicates that the species *Reduviasporonites chalastus* is most likely of algal, rather than fungal origin. Because of morphological similarities with the type species *Reduviasporonites catenulatus*, the presumed algal identity has been extended to the genus.

It should be noted that the material from Tesero identified as *Reduviasporonites stoschianus* can be readily distinguished from the type material of *Tympanicysta stoschiana* described from Greenland by Balme (1980). Despite some overlap, particularly the size range of the type material is different (between 50 and 250 µm), while the cells usually have pronounced terminal rim structures. According to Foster et al. (2002) size differences are geographically determined. Long filament fragments or aggregates of large-sized cells are so far unknown. Particularly these large cells have been morphologically interpreted in terms of zygnematalean green algae (Afonin et al., 2001).

STRATIGRAPHIC RANGE

Although palynomorphs identified as *Reduviasporonites stoschianus* can be stratigraphically long ranging through much of the latest Permian Changhsingian Stage (Ouyang and Utting, 1990; Li et al., 2004), more common occurrences of the morphospecies are usually apparent towards the very end of the Permian. Pre-Changhsingian records need confirmation; particularly Pennsylvanian palynomorphs assigned to *Reduviasporonites stoschianus* by Wood and Elsik (1999) seem to be morphologically different from the late Permian forms.

Sometimes the remains are considered to characterize the earliest Triassic (Griesbachian) rather than the latest Permian, but most of the presumed Triassic occurrences can be related to obsolete conventions applied in recognizing the Permian-Triassic boundary. Records from marine deposits in the Boreal realm (Canada, Greenland, Barents Sea), for example, were previously regarded as Triassic, but are now known to pre-date the first appearance of the conodont *Hindeodus parvus* (e.g. Looy et al., 2001; Beauchamp et al., 2009), which formally defines the base of the Triassic.

Py-GC/MS SIGNATURES FOR REDUVIASPORONITES AND LEAF CUTICLES

In order to further confirm that post-burial polymerization commonly creates an algaenan-like signature in a wide variety of organic structures whose original composition was not aliphatic (e.g. Briggs, 1999; Stankiewicz et al., 2000; De Leeuw et al., 2006; Kodner et al., 2009), we compared pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS) data obtained from a concentrate of *Reduviasporonites stoschianus* from the Tesero section (Sephton et al., 2009) and leaf-cuticle material of *Lycopodium dezanchei*, a newly described subarborescent lycopod from the Middle Triassic (Anisian) of the Kühwiesenkopf/Monte Prà della Vacca section, Dolomite Mountains, northern Italy (Kustatscher et al., 2010; leaf material courtesy of Evelyn Kustatscher and Johanna van Konijnenburg-van Cittert, GC/MS analysis by Jonathan Watson).

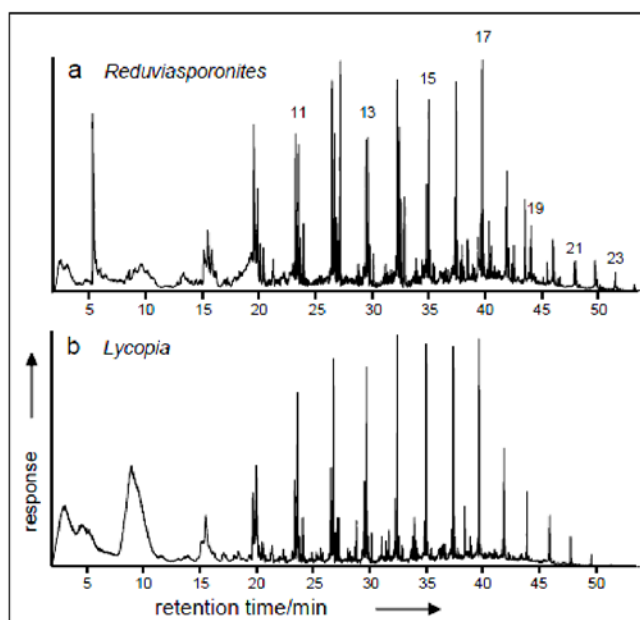


Figure DR1. Summed ion chromatograms (m/z 55+57) from Py-GC/MS data for **(a)** a concentrate of *Reduviasporonites stoschianus*, and **(b)** leaf cuticles of the Triassic lycopsid *Lycopodia dezanchei*, selectively displaying *n*-alkenes and *n*-alkanes.

With *n*-alkene/*n*-alkane doublets in the range C_8 to C_{22} and a maximum around n - C_{17} , the two signatures are remarkably similar (Fig. DR1). Comparable signatures also characterize fossilized chitin (e.g. Stankiewicz et al., 2000), substantiating that the regular occurrence of resistant aliphatic components in organically preserved fossils reflects *in situ* polymerization during diagenesis, rather than biological relationship.

METHODS

We used standard palynological procedures (Traverse, 2007), including treatment with 38% hydrochloric acid (HCl) and 40% hydrofluoric acid (HF) to remove carbonate and silicate mineral phases, respectively. In order to minimize mechanical destruction of filaments, gravity separation was applied, using a zinc-bromide ($ZnBr_2$) solution (density 2.1 g/cm^3), while fast centrifugation was avoided.

The applied Py-GC/MS analytical procedures are detailed in Sephton et al. (2009).

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