



## Research paper

## Dispersed plant mesofossils from the Middle Mississippian of eastern Germany: Bryophytes, pteridophytes and gymnosperms

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## ABSTRACT

Plant remains with organic-matter preservation are uncommon in the Mississippian due to the general rareness of Mississippian terrestrial deposits. Moreover, the fossils are often strongly affected by post-sedimentary processes. However, bulk-macerated samples of the upper Visean of Chemnitz-Glösa (Germany) contain several well-preserved dispersed organic remains including cuticle fragments. Even though it is difficult to assign these remains to specific taxa and they probably represent only part of the vegetation, they provide important information on Mississippian floras. The cuticles are assigned to sphenopsids and gymnosperms. In addition, several bryophyte remains were found; nine morphologically different types are recognised, which represent at least five different taxa. This is remarkable because only a few bryophytes have been recorded from the Carboniferous to date.

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## 1. Introduction

Mississippian floras are rather poorly known in comparison to Pennsylvanian floras, due to the relatively limited number of plant-bearing localities and the preservation of the material. Plants are mostly preserved as petrifications and as adpressions without organic matter. Reliable reconstructions of Mississippian plants are rare and natural affinities often remain unclear because they are based on limited data. Preservation of organic material, notably cuticles, is generally rare due to post-sedimentary processes such as high thermal alteration.

This contribution provides descriptions of several types of dispersed organic plant remains from a temporary outcrop in the upper Visean of Chemnitz-Glösa, Saxony, Germany. The mesofossils were obtained by bulk maceration of terrestrial shales containing recognisable remains of *Lyginopteris*, *Lepidodendron* and macroscopically unidentifiable plant debris. Although at present precise taxonomic assignments of these plant remains are not possible, the diversity and preservation are noteworthy. Apart from lycopsid cuticles (Hübers et al., 2011a), and sphenophyte and pteridosperm cuticles described here, the latter with leaf-colonizing fungi (Hübers et al., 2011b), several types of bryophyte remains, sporangia and megaspores have been found. Lycopsid and sphenopsid cuticles are generally not very common, except for sphenophylls. The occurrence of bryophyte remains, of which several types can be distinguished within the Glösa material, is remarkable, because only a single putative bryophyte taxon (Thomas, 1972) has

previously been reported from Mississippian rocks. Embryophytes evolved before the tracheophytes, probably in the Ordovician–Silurian (Kenrick and Crane, 1997), or maybe even earlier judging from the cryptospore record (Taylor and Strother, 2008, 2009). The different types of Mississippian bryophytes reported here may shed new light on this problem. Although most attention is given to bryophytes, a number of other mesofossils should not remain unnoticed. Several sphenophyte and pteridosperm cuticles are described as well as some remains that cannot be attributed yet. The bryophytes in particular contribute important information for reconstructing wetland ecosystems during the Mississippian, a time interval in which terrestrial biotas are still comparatively poorly known (Scott et al., 1984).

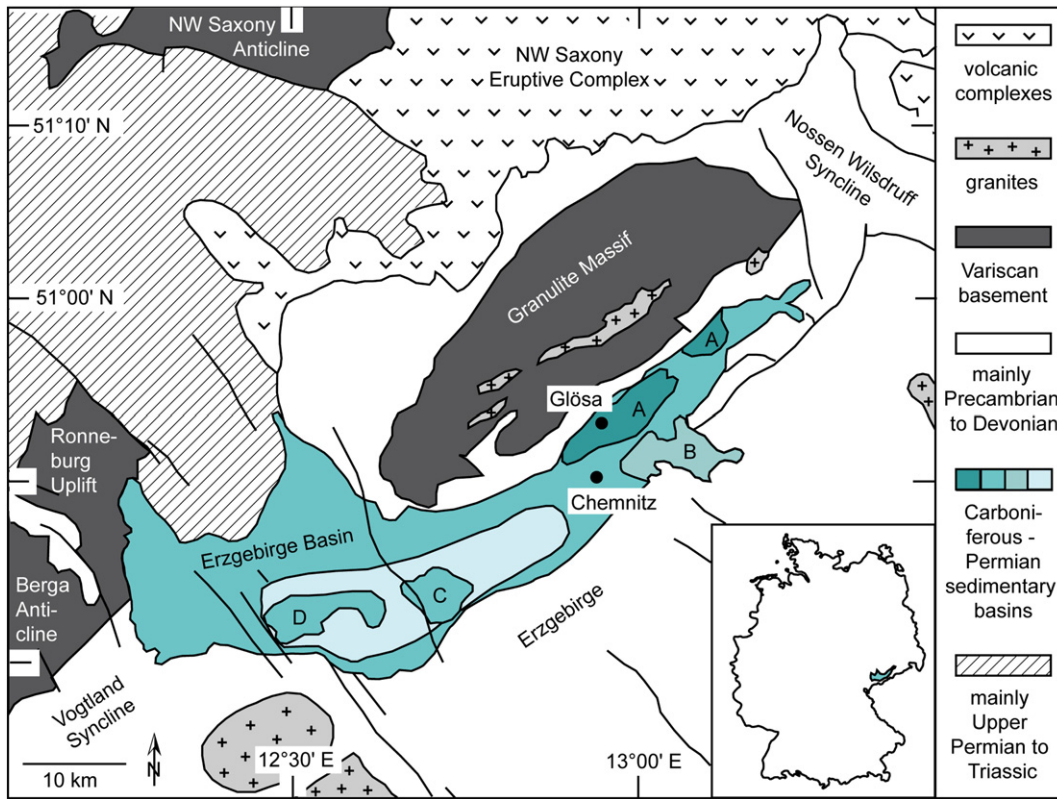
## 2. Locality and material

Eleven samples were collected in 1999 from a temporary roadcut exposure along the A4 motorway near the Chemnitz-Glösa exit, Saxony, Germany (50°52′34.67″ N; 12°54′38.73″ E). The rocks that represent the so-called “Early Molasses” facies of the Variscan Orogen belong to the Hainichen Subgroup of the Hainichen Basin (Fig. 1). The Hainichen Basin is dated as late Visean (Schneider et al., 2005; Gaitzsch et al., 2010). The relics of the Hainichen Basin are allochthonous, situated between Variscan high-grade metamorphic complexes of the Erzgebirge and the Saxonian Granulite Massif (Schneider et al., 2005).

The Hainichen Basin has yielded a comparatively rich macroflora that was described by Hartung (1938); for an updated overview of the so-called Borna-Hainichen flora we refer to Kerp et al. (2006). Glösa is located c. 1 km NW of the classical localities at Borna-Heinersdorf, in

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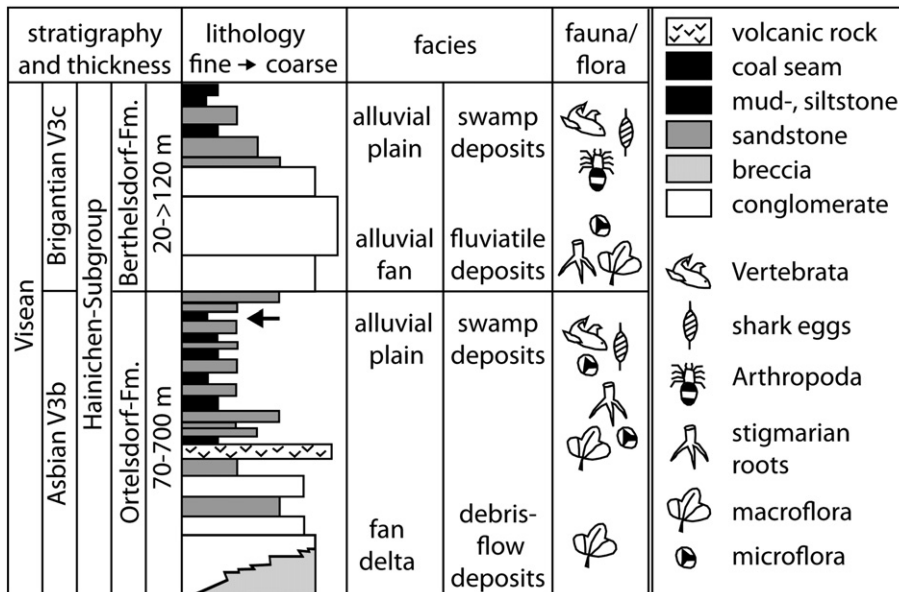


**Fig. 1.** Geological map of southern Saxony showing the positions of Carboniferous–Permian basins: A = Hainichen Basin, B = Flöha Basin, C = Oelsnitz Basin, D = Zwickau Basin (after Schneider et al., 2005).

the southwestern part of the basin. Hartung (1938) recorded over 30 taxa from Borna, including sphenopsids (*Archaeocalamites*, *Sphenophyllum*, *Bowmanites*, *Pothocites*, *Mesocalamites*), lycopsids (*Lepidodendron*, *Lepidophloios*, *Lepidostrobus*) and many pteridophylls (*Adiantites*, *Alloiopteris*, *Aneimites*, *Anisopteris*, *Cardiopteridium*, *Diplothmema*, *Fryopsis*, *Lyginopteris*, *Neuropteris*, *Pecopteris*, *Spathulopteris*, *Sphenopteris* and *Zeilleria*). This flora shows a clear differentiation into hygrophilous (coal-forming) associations and those growing on better drained soils. The most common macroscopically recognisable plant remains at Chemnitz–Glösa are *Lyginopteris bermudensisformis* (Schlotheim) Pateisky

and *Lepidodendron lossenii* Weiss; the latter can form monotypic stands. *Archaeocalamites* grew in monospecific stands along rivers and lake shores. A more detailed account on the Borna–Hainichen flora and a comparison with coeval floras from western and central Europe are currently in preparation.

The Hainichen Subgroup consists of two formations, the Ortelsdorf Formation (70–700 m) and the Berthelsdorf Formation (20–> 200 m). Both formations contain plant remains (Fig. 2). Rößler and Schneider (1997) recognised four plant communities in the Berthelsdorf Formation that was exposed in the sandpits of Borna and in the so-called



**Fig. 2.** Stratigraphy, lithology, facies and fossil content of the Hainichen Subgroup (after Gaitzsch et al., 2010). The arrow indicates the position of the samples.

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