Supplemental Article S1

Detailed information regarding the geological background, fossil site features, and collection history are available here to supplement the section of the article.

Geological background and fossil site features

Volcanic activity during the Paleogene to Neogene in Northern Bohemia (Czech Republic) and the Upper Lusatia in southeast Saxony (Germany) was caused by tectonic movements in the ENE–WSW trending Ohře (Eger) Graben, the eastern part of the European Cenozoic rift system (*Ziegler, 1992*; *Ziegler, 1994*). The Ohře Graben is characterized by volcanic complexes, wedged brown coal basins, and by the formation of marginal depressions (*Akhmetiev, Walther & Kvaček, 2009*). During the early Oligocene, such a local depression with a paleo-lake was formed between the localities of Seifhennersdorf (Saxony, Germany) and Varnsdorf (Ústí nad Labem Region, Czech Republic). The lake infilling is recorded by a up to 60 meters thick volcano-sedimentary sequence that contains interbeds of fossiliferous diatomite seams (*Ahrens, 1959*; *Walther & Kvaček, 2007*). The sequence ends with a potassium-argon-dated basaltic lava flow of 30.7 ± 0.7 million years (*Bellon et al., 1998*). Overall, five seams of lacustrine diatomite developed in temperate humid but seasonal paleoclimate (*Schiller, 2007*). Seams four and five, in the lowest part of the sequence, reached the highest thicknesses (four and 10 meters) and contained rich fossil fauna and the Seifhennersdorf flora (*Walther & Kvaček, 2007*). Toward the top of the sequence, volcanic activity increased, resulting in thinner diatomite seams. A thin coal seam was deposited above the last diatomite seam at the top of the sequence, representing the lake evolution's final stage. It is assumed that the Seifhennersdorf lake persisted only for a relatively short period (~ 100.000 years) till it was filled with sediments and finally covered by the lava flow (*Ahrens, 1959*).

Volcanism and tectonic movements controlled the lake's evolution and shaped the morphology of the lake's surroundings. That caused the development of various habitats inhabited by diverse plant communities at the shore of the Seifhennersdorf lake and within its proximity (*Walther & Kvaček, 2007*). Mixed mesophytic forest with, e.g., *Acer*, *Betula*, *Carpinus*, *Carya*, *Daphnogene*, *Dombeyopsis*, *Laurophyllum*, *Platanus, Rosa*, *Sloanea*, *Ulmus*, and *Zelkova* developed on hilly non-waterlogged sites whose soils derived from deeply weathered Lausitz Granodiorite. Flat and periodically flooded lake shores favored riparian forest development with, e.g., *Alnus*, *Carpinus*, *Carya*, *Eotrigonobalanus,* and *Populus* on fertile soils of alkaline volcanic rocks. Local rather permanently flooded depressions favored the colonization by a *Taxodium*-dominated swamp forest (*Walther & Kvaček, 2007*).

Besides the fossil flora, faunal elements are preserved in diatomite seams four and five. Fishes (*Böhme, 2007a*), amphibians (*Böhme, 2007b*), and several fossil insect species (*Prokop & Fikáček, 2007*) were described from Seifhennersdorf. Thirteen families of seven insect orders, represented by body or trace fossils, encompass the entomofauna (*Tietz, Berner & Mätting, 1998*; *Prokop & Fikáček, 2007*). Its composition resembles the entomofauna from the early Oligocene Czech site Kundratice (*Prokop, 2003*). The Seifhennersdorf insect fossil record is dominated by terrestrial insects, mainly beetles (Curculionidae). Aquatic species like caddis flies (mainly larval cases) and water beetles are only present as accessories (*Fikáček, Hájek & Prokop, 2008*). These aquatic insects imply the presence of a distinct littoral zone with rich submerged plant species and riparian vegetation, providing potential oviposition sites for semiaquatic insects. This implication follows the above-mentioned palaeobotanical reconstructions (*Walther & Kvaček, 2007*). Oviposition marks of a fossil damselfly (?Lestidae) on leaves of *Carpinus grandis* (Betulaceae) described by *Hellmund & Hellmund (1996)* represent the first study of insect damage types from Seifhennersdorf. The first extensive but not published analysis of insect damage types was conducted by *Koch (2011)*. The analysis is revised and extended in the present study.

The fossil site of Berand near the village of Suletice, called Suletice-Berand, is situated in the east of Ústí nad Labem in Northern Bohemia (Czech Republic) within the České středohoří Mountain's volcano-sedimentary complex (ČsMts. complex). The ČsMts. Complex, as a geological unit of the Ohře Graben, is characterized by a lithostratigraphy showing a polygenetic assemblage of alkaline superficial and intrusive volcanism, pyroclastics, and accompanying sedimentary intercalations (*Cajz, 2000*; *Akhmetiev, Walther & Kvaček, 2009*). The fossil flora of Suletice-Berand is preserved in freshwater diatomite embedded in a sequence of basaltoid pyroclastics of the Ústí Formation (*Cajz, 2000*). Contrary to Seifhennersdorf, knowledge about local geology, stratigraphic position, and the structure of the paleo-lake, most probably the infilling of a volcano-tectonic depression, are limited and only partly clarified by studies of core drillings and in test pits (*Kvaček & Walther, 1995*; *Walther, 2004*). Paleobotanical investigations indicate the lack of swampy and riparian habitats like in Seifhennersdorf. Non-waterlogged areas were inhabited by a mixed mesophytic forest characterized by fossil-species of, e.g., *Acer*, *Daphnogene, Engelhardia*, *Laurophyllum, Leguminosites*, *Platanus*, *Sloanea,* and *Zelkova* (*Kvaček & Walther, 1995*; *Akhmetiev, Walther & Kvaček, 2009*).

According to their embedding in volcano-sedimentary sequences (e.g., infillings of volcano-tectonic depressions, maar, or crater lakes), fossil floras, like Seifhennersdorf and Suletice-Berand, have been denominated as 'volcanic floras' (*Walther, 2004*; *Akhmetiev, Walther & Kvaček (2009*). This kind of vegetation is controlled by volcanic activity and tectonics that cause a heterogeneous landscape with uplands and depressions and, thus, diverse microclimate conditions. Additionally, the edaphic factors of volcanogenic paleosoils might have been essential for the vegetation composition (*Kvaček & Walther, 2001*). However, it could not be demonstrated that fossil vegetation colonized such paleo-soils. Compared to leaf assemblages from central and eastern German Paleogene sites of the coastal lowland plains, these sites provide a higher diversity in fossil-species (e.g., *Kunzmann & Walther, 2012*; *Kunzmann et al., 2016*) and consist predominantly of zonal (hinterland) vegetation elements (*Kvaček & Walther, 2001*). Based on the Integrated Plant Record Vegetation Analysis, the floras of Seifhennersdorf and Suletice-Berand are assigned to a vegetation type defined as an ecotone between broad-leaved evergreen forest and mixed mesophytic forest (*Teodoridis & Kvaček, 2015*).

Collections – history and collecting process

As mentioned above, the specimens in the Seifhennersdorf collection come from a localized area between Seifhennersdorf and Varnsdorf. The small lagerstätte of coal and lacustrine diatomite was excavated in two mining periods. Between 1837 and 1856, small coal deposits were mined near the surface. After World War II, from 1951 to 1957, the Geological State Office of Saxony reopened the pit as an exploratory mine for resources (e.g., *Walther, 1996*; *Walther & Kvaček, 2007*). Seifhennersdorf specimens were first collected and described by H. Engelhardt in the late 1860ies (*Engelhardt, 1870*) from dumps of a mine that excavated the small near-surface lignite seam and underlying first diatomite. In the 1950s – 1990s, several paleobotanists and private collectors collected the most significant part of the Seifhennersdorf collection from the mining dump of an exploitation mine (*Walther, 1964*; *Walther, 1984*). The government of the former German Democratic Republic (GDR) kept geological prospecting of resources secret so that publications of geological data, theses, and direct sampling in the underground mine were restricted (*Walther, 1996*). The later accessibility of unpublished reports and theses revealed essential details about the geological background. Most of the fossil material excavated by the exploratory mine and deposited in dumps coming from the deeper and thicker diatomite seams four and five. Seams 2 and 3 of the section are thin and without fossils (*Ahrens, 1959*; *Walther & Kvaček, 2007*). Since no significant floristic difference between the diatomite layers was detected, we consider the collected Seifhennersdorf specimens as a unit (*Walther & Kvaček, 2007*). According to catalog numbers, the Seifhennersdorf collection at the Senckenberg Natural History Collections Dresden, Museum of Mineralogy and Geology (MMG) includes >5000 hand-sized specimens with fossil plant remains. Since most of the collection was obtained through intensive and systematic sampling (including fragments) of mining dumps during 1951-1994, we assume that sampling biases did not strongly influence the diversity of leaf morphotypes.

Suletice-Berand specimens were collected from a few cubic meters of rocks from a well shaft during a single fieldwork campaign in 1896 by the paleobotanists J. Deichmüller and P. Menzel (*Engelhardt, 1898*; *Kvaček & Walther, 1995*). The differently hand-sized specimens and leaf fragments suggest that the collectors took as much material as possible and did not pre-select better-preserved fossils in the field. According to catalog numbers, the Suletice-Berand collection at the MMG includes 918 hand-sized specimens with fossil plant remains representing all material from the well shaft.

In summary, we assume that specimen sampling generating the two historical collections was conducted to capture the fossil-species diversity of the sites and was not focused on insect damage types or leaf specimen attractiveness.

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