

PLANT-ARTHROPOD INTERACTIONS FROM THE PIESBERG QUARRY NEAR OSNABRÜCK, GERMANY (MIDDLE PENNSYLVANIAN)

Laaß, M.¹, Leipner, A.², Hauschke, N.³ & Rößler, R.^{4,5}

¹Technische Universität München, Heinz Maier-Leibnitz Centre and Faculty of Physics E21, Garching, Germany, michael.laass@gmx.de

²Museum am Schölerberg, Osnabrück, Germany

³Martin-Luther-Universität Halle-Wittenberg, Institut für Geowissenschaften und Geographie, Halle (Saale), Germany

⁴Museum für Naturkunde Chemnitz, Chemnitz, Germany

⁵Technische Universität Bergakademie Freiberg, Geological Institute, Freiberg, Germany

In the last years, the Piesberg quarry became one of the most important fossil Lagerstätten of Middle Pennsylvanian insects. Nevertheless, bearing in mind the vast material provided here, little is known about relations between arthropods and plants. Intensive collecting revealed a range of plant-arthropod interactions. As a result, at least 14 damage types (DT's) belonging to five Functional Feeding Groups (FFG's) were distinguished. We recognised margin and surface feeding (DT12, DT30), oviposition damage (DT72, DT101? and six new DT's), seed/stem boring, galling (two DT's) and leaf-mining (two DT's). The diversity and abundance of oviposition damage were significant and quite comparable to extant organisms. We recognised three oviposition types on seed-fern fronds (*Macroneuropteris scheuchzeri*, *Sphenopteris* cf. *crepini*) and four types associated with calamitalean stems. Further possible oviposition damage occurred on a fern axis. For comparison, longitudinal borings in the pith of calamitaleans were studied. Coprolite evidence in the boring casts of another specimen from the Late Pennsylvanian of the Saale Basin revealed that small millipedes likely produced the tunnels, which were visited by oribatid mites. Moreover, we found circular borings in *Trigonocarpus* – medullosan seeds. The record of plant-arthropod interactions comprises the first galling evidence from the Piesberg: Small, ca. 2 mm long, lenticular galls and one single, ca. 20 mm long, ovoidal gall were recognised on a sphenophyte axis. The existence of leaf mines before the Permo-Triassic extinction event is debated. Remarkably, we found the earliest evidence of leaf mines on *Neuropteris* seed-fern pinnules from the Variscan Foreland Basin. The mines resemble digitate or star mines of modern Diptera and Lepidoptera lineages and have implications on current evolutionary concepts. Furthermore, putative undulating leaf mines were recognised. Our findings reveal that the ecosystem of the Piesberg was more complex than previously thought and offer potential for further palaeoecological studies on Carboniferous wetland environments.