

Smaller than Small, the Unique Eocene Louse!

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Abstract

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Some of the most spectacular fossil deposits of the European Tertiary are former maars located in old volcanic field areas. The Tertiary volcanic field of the High Eifel (THV) lies between the two Quaternary volcanic fields of the West and East Eifel and extends far into the West Eifel. The Eckfelder Maar lies on the south-western edge of the THV. The extraordinarily rich fossil record documents a species-rich terrestrial flora and fauna, ranging from algae and pollen grains to coherent mammal skeletons, some with soft tissue preservation and stomach contents. Among the most significant insect finds to date is the world's first record of a fossil bird louse (order Phthiraptera). The Eckfeld louse has survived in excellent quality and, despite its small size (length 6.7 mm), shows an abundance of detail, so that it has been possible to clarify the relationships of the find and thus also the probable host range. Their present-day relatives live on shorebirds and ducklings.

Keywords: Eocene, Eckfeld-Maar, Volcanism, First fossil bird louse, Visitor management, Geotourism, Geoeducation, Geoconservation.

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Introduction and Geological Setting

The volcanic Eckfeld-Maar, with its unique Middle Eocene flora and fauna, is part of the UNESCO Global Geopark Vulkaneifel. The Eckfeld-Maar was a volcanic crater inside the surface caused phreatomagmatic activities with a poorly ventilated groundwater lake and it has preserved a detailed snapshot of a subtropical ecosystem from 44.3 million years ago. An unexpected, but key, recent discovery has been a fossil bird louse.

A maar is a broad, shallow volcanic crater formed by the contact of rising lava meeting surface water and resulting in an explosion that mixes cooling lava with shattered surrounding country rock. The Eckfeld-Maar was formed in the valley floor of a small tributary called the Manderscheid Valley Basin, which existed at least since the Geiseltalium (Middle Eocene). The volcano penetrated the local country rock of Lower Devonian sandstones and siltstones, overlain by Triassic red sandstones (Buntsandstein, Trierer Bucht). The topographic relief was formed by geomorphological processes as seen today in a humid paratropical climates. A thick weathering mantle covers the land surface today.

The sediments filling the funnel-shaped Eckfeld Maar Crater belong to the Eckfeld Formation, comprising syneruptive diatreme breccias, tuffs and organic-rich laminites with intercalated sediments. These lake sediments today show the central pelitic facies (an oil shale or bituminous laminite) surrounded by coarse clastic marginal facies of primary air-fall pyroclastics. After the formation of the maar lake, it was covered by subaquatic volcanoclastics from the marginal tuff rim. Based on a cored, 123-m long sedimentary record the lithofacies succession characteristic for maars was described and defined. Numerous marker horizons - millimeter-thick turbidites to decimeter-thick debrites allow a high-resolution stratigraphic subdivision of the fossil-bearing laminites. The numerical age of the fossil deposit is 44.3 ± 0.4 Ma ($^{40}\text{Ar}/^{39}\text{Ar}$ date), corresponding to

the Middle Eocene.

Paleontology and the Bird Louse

The bituminous, varved laminites in the Eckfeld-Maar contain a wealth of excellently preserved fossils that document life in the lake and its surroundings (Lutz *et al.* 2010). The flora consists of algae, mosses, ferns, gymnosperms and both monocotyledonous and dicotyledonous angiosperms. The fauna comprises rhizopods, freshwater sponges, snails and mussels, ostracods, spiders, insects, fish, frogs, crocodiles and alligators, turtles, snakes, lizards, birds and mammals. The mammal fauna from Eckfeld site corresponds to Mammal zone MP 13.

Despite its tiny size, the “Eckfeld louse” (Wappler *et al.* 2004) is excellently preserved (Fig. 1). Laser scanning microscopy shows that even the remains of the last meal are preserved, as well as the setae and feather barbules within the gut. These feather barbules were ingested from the prey infested by the louse, namely birds. The louse is named as *Megamenopon rasnitsyni*, a member of Menoponidae, a family of chewing lice with about 650 living species that are ectoparasites of a wide range of birds including chickens. They attach themselves to the bases of feathers in different regions of the bird, and feed on both the feather as well as blood.

Extant genera of menoponids similar to *Megamenopon* are known primarily from birds that frequent aquatic environments. Presumably the Eckfeld louse had just finished its meal on the feathers of one of these water birds when it met its end. There are many possible hosts, including those represented in the fossil birds recovered from Eckfeld-Maar, but the louse was not found in association with any other organism. What is known of the biology of chewing lice suggests that menoponids are more likely to abandon a dead or dying bird than would a philopterid. Thus, it is entirely possible that the

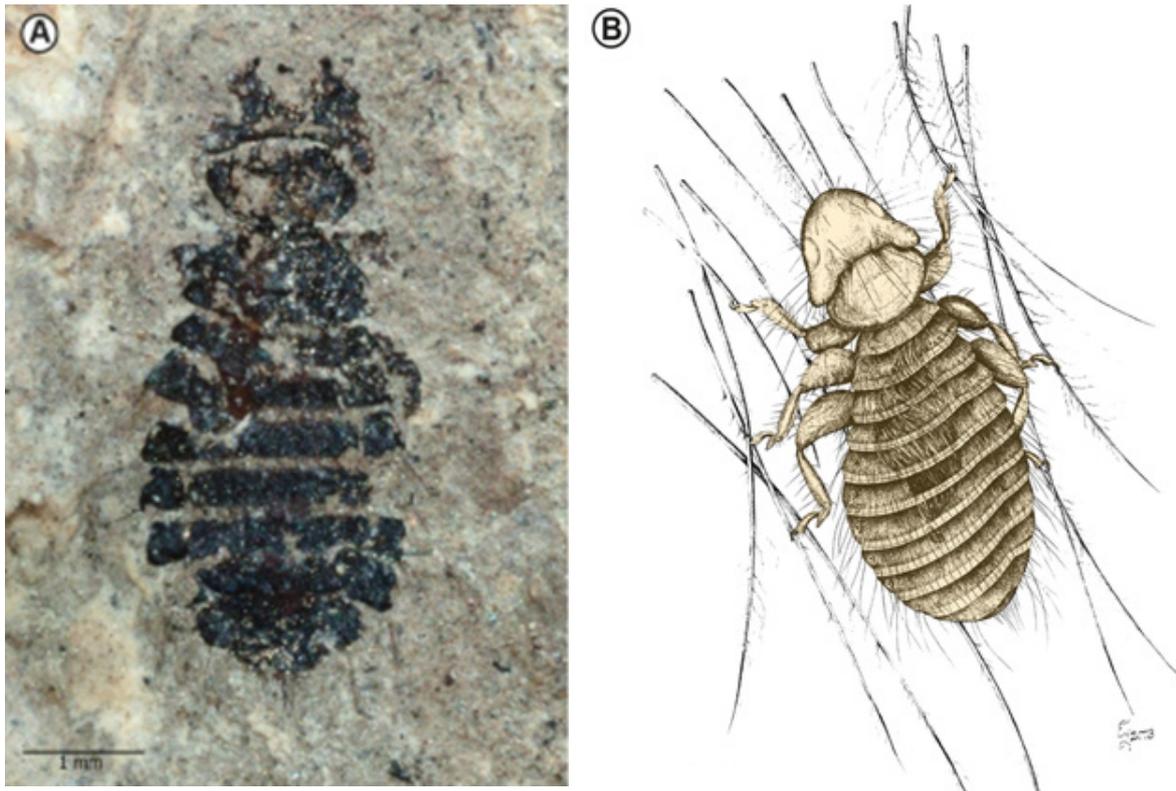


Figure 1. The Eckfeld louse, *Megamenopon rasnitsyni*, showing (A) the complete preserved specimen (NHMMZ PE 1997/33-LS), body length 6.74 mm, and (B) an artist's impression of the louse when alive, by E. Gröning.

louse left the bird and died independently of its host.

The excellent preservation of the Eckfeld louse allows confident reconstruction of its phylogenetic relationships. Its present-day relatives live on shorebirds and ducks. The 44-million-year-old find from Eckfeld sets for the first time a reliable geological date in the phylogeny of lice, which allows calibration of the molecular phylogeny of lice, and suggests that the origins of lice as a whole must go back far into the Mesozoic. Probably, the first bird-lice already lived on feathered dinosaurs and not only on their descendants, the “real” birds.

Geotourism

The Geo-Route “Volcano-Eifel around Manderscheid” (Koziol & Röhl 2002) as part of the UNESCO Global Geopark Vulkaneifel, is a tour through the area with a focus on regional geology, and it has existed around the town of Manderscheid since the 1990s. On this hiking route of 140 km, 50 geologically particularly interesting geotopes,

showing the history of the last 400 million years of the West Eifel, are explained clearly and scientifically. Colored information boards, which include scientific research results, introduce visitors to the geology of the landscape around Manderscheid. The Geo-Route consists of three sections, each dealing with a different geological focus: 1. Devonian-Route; 2. Triassic-Route; 3. Volcano-Route

One of the most important geotopes on the Geo-Route is the Eckfeld-Maar with its famous Eocene fossils. The clear layout of the paths helps to protect the environment. The Maarmuseum Manderscheid (MMM: www.maarmuseum.de), which opened in 1999, is responsible for visitor management, geotourism and geoeducation. It works closely with the Natural History Collection of the federal state of Rhineland-Palatinate which is maintained by the Natural History Museum of Mainz (NHMMZ: www.naturhistorisches-museum.mainz.de). The latter conducts excavations at the site, houses the fossil collection from the

site and coordinates scientific work on site and fossils. In the exhibition of the Maarmuseum you can see original fossils. Georangers of the museum offer guided geo-excursions for all kinds of groups, mostly for school classes. The offers (museum-tours and geo-excursions) can be booked through the museum or the youth hostels.

Since 1986, the fossils and evidence of geological history have been protected under a Monument Protection Act in Rhineland-Palatinate. Delineated areas such as Eckfeld-Maar can be declared to be Excavation Protection Areas by ordinance if there is a reasonable assumption that they contain cultural monuments. The Eckfeld-Maar is one of these protected areas. Unauthorized digging at the site is strictly forbidden, and excavations may only be carried out with an official permit. The Eckfeld fossils are the exclusive property of the federal state of the Rhineland-Palatinate. The Maarmuseum Manderscheid presents these spectacular fossils for the public on site and thus creates a direct link to the nearby fossil deposit.

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References

- Koziol M & Röhl S (2002). Geotope auf der Georoute Vulkaneifel um Manderscheid. *Scriptum*, Krefeld 9: 61–69.
- Lutz H, Kaulfuss U, Wappler T, Löhnertz W, Wilde V, Mertz DF, Mingram J, Franzen JL, Frankenhäuser H & Koziol M (2010). Eckfeld Maar: window into an Eocene terrestrial habitat in Central Europe. *Acta Geologica Sinica*. 84: 984–1009.
- Wappler T, Smith VS & Dalgleish RC (2004). Scratching an ancient itch: an Eocene bird louse fossil. *Proceedings of the Royal Society B*. 271: 255–258.