Stratigraphic meaning of the tetrapod fauna and ichnofauna from the Lower Permian Bromacker locality (Germany)

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Abstract

The Lower Permian Bromacker locality of central Germany (Tambach Formation) yielded one of the most abundant and diverse skeletal and footprint associations of this time interval. Tetrapod footprints, known since the 19th century, include long and exceptionally-preserved trackways as convex hyporelief on the bottom of sandstone beds. The ichnoassociation includes the anamniote ichnogenera *Ichniotherium* and *Amphisauropus*, the synapsid ichnogenus *Dimetropus*, the reptile ichnogenera *Notalacerta* and *Varanopus*, and the synapsid or reptile ichnogenus *Tambachichnium*. New research highlights the additional occurrences of the anamniote ichnogenera *Batrachichnus* and *Limnopus* and the synapsid or reptile ichnogenus *Dromopus*. This is an ichnoassociation typical of the Kasimovian-early Artinskian *Dromopus* footprint biochron. Tetrapod skeletons, known since the end of the 70, include a diverse association with several well-preserved, articulated and nearly complete skeletons. The anamniotes include the diadectids *Diadectes* and *Orobates*, the seymouriamorph *Seymouria*, the trematopids *Rotaryus* and *Tambachia* and the amphibamid *Georgenthalia*. The synapsids include the sphenacodont *Dimetrodon* and the caseid *Martensius*. The reptiles include the captorhinormorph *Thuringothyris* and the bolosaurid *Eudibamus*. The varanopids include *Tambacarnifex*. The nearby locality of Tambach-Dietharz, belonging to the same formation, yielded the ostodolepid recumbirostran *Tambaroter*. This is a typical association of the Seymouran Land Vertebrate Faunachron (LVF), based on the associations of the upper Archer City ('Nocona') and Petrolia formations of Texas. The lower part of the Petrolia Formation is laterally equivalent to the Elm Creek Limestone, dated with Wolfcampian conodonts as either middle Sakmarian or early Artinskian. Therefore, the combined tetrapod associations and ichnoassociations from the Tambach Formation suggest a Sakmarian to early Artinskian age for this unit.

This is also consistent with the insect association of the Tambach Formation, which includes the *Moravamylacris kukalovae* Assemblage Zone (late Sakmarian-Artinskian). The conchostracan association is generally assigned to the Wilhelmsthal Assemblage Zone, but some forms are similar to the underlying Oberhof Assemblage Zone. Waiting for a revision, a general Early Permian age can be hypothesised from conchostracan data. Radiometric dating on the Rotterode Formation, directly underlying the Tambach Formation, indicate a late Asselian age (295.8±0.4 Ma). So, the Sakmarian-early Artinskian age inferred from tetrapod faunas and ichnofaunas is consistent with invertebrate biostratigraphy and radioisotopic

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ages. The age of the Tambach Formation is thus relatively well constrained, and this is of the outmost importance for a correct evaluation of some key events in the tetrapod evolution registered in this unit.

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