Horizons with the Late Permian vertebrate coprolites from the Vyazniki and Gorokhovets, Vyatkian Gorizont, Russian Platform - preliminary report

Krzysztof Owocki (1), Grzegorz Niedźwiedzki (1,2) , Andrey G. Sennikov (3), Valeriy K. Golubev (3), Katarzyna Janiszewska (1), Kornel Biernacki (4) and Tomasz Sulej (1)

1 - Institute of Paleobiology, Polish Academy of Sciences, Warsaw, Poland
2 - Department of Biology, University of Warsaw, Poland
3 - Institute of Paleontology, Russian Academy of Sciences, Moscow, Russia
4 - Department of Geology, University of Warsaw, Poland

Figure 1 Location of Bykovka site in Russia and its position at Vyazniki town

INTRODUCTION

Permo-Triassic sections at Vyazniki (**Figure 1**) and Gorokhovets provide evidence on terrestrial ecosystem at, or close to, the Permo-Triassic boundary, the time of the supposed largest ever mass extinction (biotic change). The sedimentary succession records the overrun of a muddy playa–lacustrine depositional system by major channel belts transporting sand-grade sediments. Biostratigraphy (palynomorphs and conchostracans) of sections at Vyazniki and Gorokhovets (Zhukov Ravine) shows that this sites represent mainly the Upper Permian sections. In both sections sedimentary overturn occurred in the Permian part of exposed profiles. The timing and nature of this event, which records increased sediment flux from the Ural Mountains, is closely comparable with that from the Southern Uralian Foreland Basin. The Vyazniki and Gorokhovets sections are 800 km from the mountain (**see Figure 1**) front and in a separate depositional basin, which strengthens the case that increased sediment flux from the Urals at the Permo-Triassic boundary is related to devegetation of upland catchments (increasing sediment yield) and a switch toward low-frequency but high-magnitude discharge events (increasing sediment delivery).

Vyazniki (Bykovka Quarry - **Figure 2**) is located around 800 km west of the Ural Mountains on the southern limb of the Moscow Syncline and at the western extreme of the 'Perm' Facies Belt'. Within this facies belt, Tatarian continental deposits thin from around 600 m in the Perm' area adjacent to the Urals to around 100 m at Vyazniki, which lies close to the western limit of Permian sedimentation on the Russian Platform. Vyazniki remained an area of fine-grained sedimentation until the latest Permian and early Triassic, at which time there was an abrupt basinward shift of sandy fluvial facies into the former playa–lacustrine basin.

Figure 2 Fieldworks in Bykovka site, coprolite-bearing deposits were discovered in the uppermost part of exposed profile

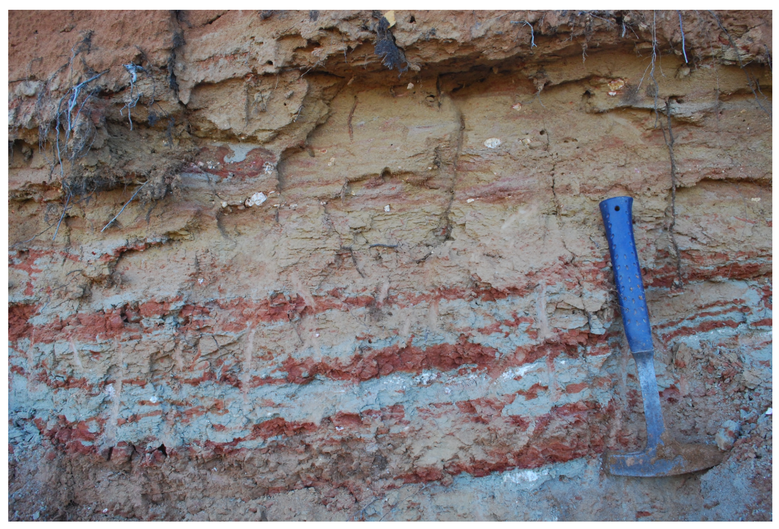

Figure 3 Close-up on coprolite-bearing deposits from the uppermost part of profile

Here we present for the first time a detailed study of coprolite material from the latst Permian sections in the Vyazniki town (Bykovka Quarry) and Zhukov Ravine. Vyazniki is historically important because Roderick Murchison first identified continental Permian in Russia here in 1841. The coprolites were gathered from a brown-greenish mudstone with coprolite 'breccia-like' layer and also from intra-sandstone conglomerates that were deposited in a floodplain environment probably during a sheet-flood events (**Figures 3,4**).

Coprolites provide information about the diets and feeding behaviors of ancient vertebrates, and serve as ichnological proxies for the presence of animals in paleoecosystems. The Vyazniki paleobiota is a diverse assemblage of the Late Permian (or possibly earliest Triassic) plants, insects, conchostracans, ostracods and vertebrate animals.

Figure 4 Coprolite accumulation preserved in red mudstone

Figure 5 Cross-section of elongated coprolite preserved in sandy mudstone

Figure 6 Selected elongated coprolites

DATA and RESULTS

Nearly 100 coprolites were collected and are referred to the three distinct ichnomorphotypes (**see Figures 5,6**). The coprolites were produced by a small and medium-sized carnivorous vertebrates and contain fish (sclaes) and small tetrapod remains. SEM images (both in scattered and backscattered electrons) show that coprolite matrix has its bulk mass made of abundant spheres and thin walled vesicles with diameters 0.5-4 μm, microbial in origin (**Figure 7**). Electron Micro Probe analyses of polished thin sections of coprolites show that the matrix is composed of microcrystalline carbonate-fluoride-bearing calcium phosphate with small amounts of calcium replaced in the crystal lattice by Na, Sr. The optical microscopy and EMP investigations show that iron and manganium oxides (**Figure 8**) are responsible for elevated iron (0,52-7,26 wt% Fe) and manganium (up to 1319 ppm) concentrations in the bulk mass of coprolite. Other metals (e.g.V, Ni) can be associated with oxides forming spheroids with diameters 3-10 μm. In one, large-sized coprolite a small fragment of amphibian bone was also found (**Figure 9**). It is suggests that was possibly produce by large therapsid or by early archosauromorph predator.

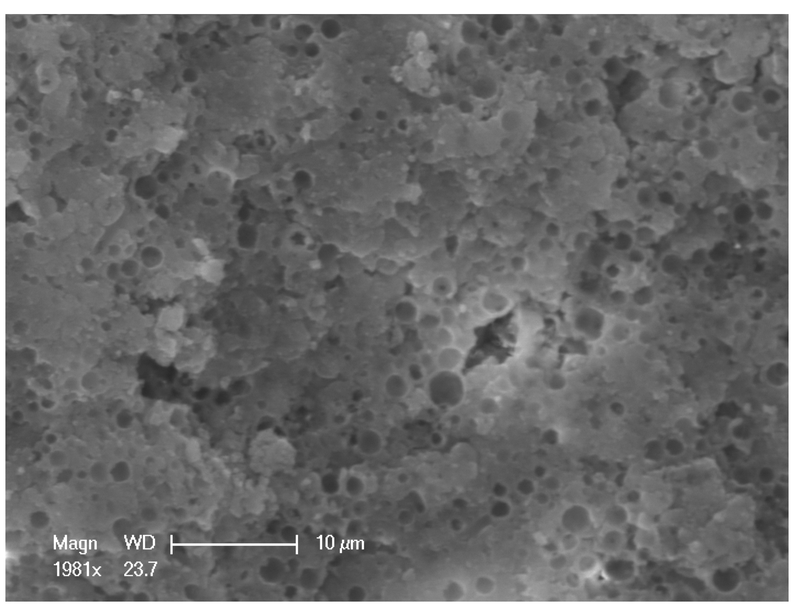

Figure 7 Microbial structures in coprolite

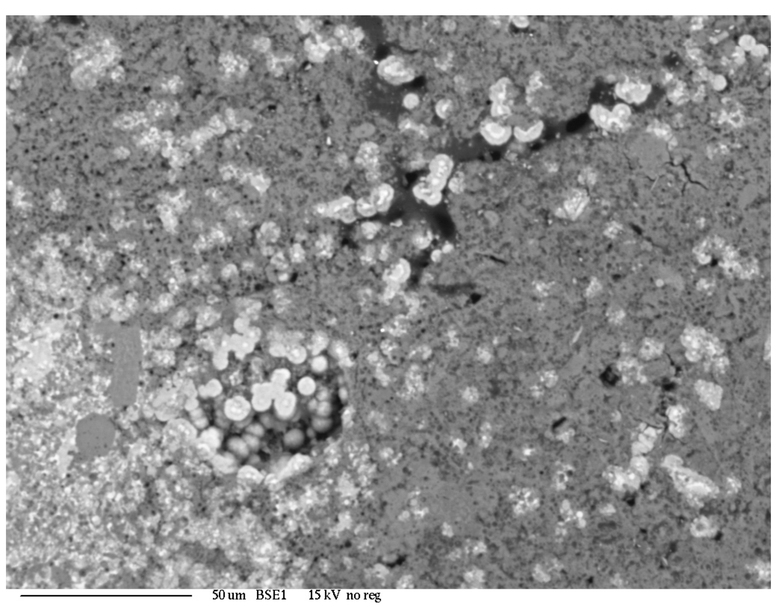

Figure 8 Iron- and manganium oxides in coprolite

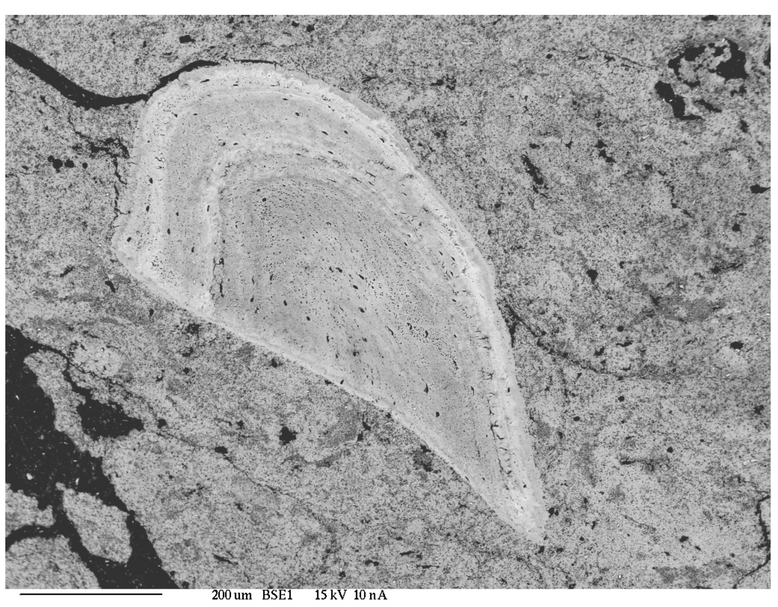

Figure 9 Fragment of bone from coprolite