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# Microbiota and food residues including possible evidence of pre-mammalian hair in Upper Permian coprolites from Russia

Bajdek P., Qvarnström M., Owocki K., Sulej T., Sennikov A., Golubev V., Niedźwiedzki G.  
*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

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## Abstract

© 2015 Lethaia Foundation. Published by John Wiley & Sons Ltd Coprolites (fossil faeces) provide direct evidence on the diet of its producer and unique insights on ancient food webs and ecosystems. We describe the contents of seven coprolites, collected from the Late Permian Vyazniki site of the European part of Russia. Two coprolite morphotypes (A, B) contain remains of putative bacteria, cyanobacteria, fungi, protists, invertebrate eggs, arthropod elements, undigested bone and tooth fragments, fish scales and elongated hair-like structures with hollow interiors. Content, size and shape of the coprolites together with the associated body fossil record suggest that the most probable scat-producers were carnivorous tetrapods; the bone-rich morphotype A reveals short food retention time and a fast metabolism and is therefore assigned to therapsid carnivores whereas morphotype B with rarer and degraded bones are assigned to archosauromorphs or other non-therapsid carnivores. The general coprolite matrix contains abundant micron-sized spheres and thin-walled vesicles which are interpreted as oxide and phosphatic pseudomorphs after microbial cells. From analyses of the undigested bones, we infer that they represent remains of actinopterygian fish, a therapsid and unrecognizable parts of amphibians and/or reptiles. Additionally, hair-like structures found in one coprolite specimen occur as diagenetically altered (oxide-replaced) structures and moulds (or partly as pseudomorphs) in a microcrystalline carbonate-fluoride-bearing calcium phosphate. This suggests that the latest Permian therapsids probably were equipped with hair-like integument or hairsuit. If true, this is by far the oldest evidence of this mammalian character in the stem group of mammals.

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## Keywords

Coprolites, food residues, hair-like structures, Late Permian, microbial structures