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Taphonomy and anatomy of the Ediacarans

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Early diagenetic iron sulphide cementation was the main mechanism enabling reproduction of anatomical structures of the Ediacaran soft-bodied organisms in the rock (sandstone or limestone). That way isolated organic membraneous skeletons may be cast in detail within the rock. The cemented sole of an overlying rock bed may reproduce dorsal surface of a dead body. Depth of such imprint depends on the resistence of particular organs to collapse at various stages of their decay under the sediment load. Also impressions left by animals resting on the microbial mat may be replicated on the lower surface of the bed. This offers evidence on their external morphology. The bed sole replicates also fractures in the microbial mat that allowed fluidized sand to penetrate the underlying clay layer or fill organic membranes covering the mat. This means that the sand remained loose and the basement membrane intact, long after the imprint was fixed by sulphide cementation at their contact.

In the Ediacarian (Vendian) strata at Zimnie Gory in northern Russia, series of positive resting imprints on the microbial mat frequently terminate with a negative imprint of a cadaver of the trace maker. Such associations are extremely rare in the post-Ediacarian fossil record. In time averaged fossil assemblages, the frequency of trace fossils in proportion to dead bodies should reflect the whole life activity of the animals. No doubt thus that the Ediacaran associations of this kind are catastrophic in origin. Probably the animals were killed by deposition of suspeded sediment. To produce the observed pattern, this should have occurred immediately after colonization of the microbial mat surface, before its surface was completely bioturbated. Fossilized mat with numerous laminae contradicts this, by proving its prolonged stable growth. The taphonomic role of deposition and cementation of the sand was apparently restricted to

fixation of the assemblage of already dead bodies covering the mat. Notably, similar spiral traces of activity with a cadaver at their end are known from the Jurassic of Solnhofen, where the associated bivalve *Solemya* indicates hydrogen sulphide as the killing factor. The same mechanism may apply to the Ediacarian assemblages.

Soft tissue imprints have allowed to restore the body plan of the main inhabitants of the Ediacaran microbial mats. These were the rangeid petalonameans, rooted with their basal discs in the mat and having elevated fronds of tetraradial or biradial symmetry. There were no openings in their smooth external surface and the complex organs pennately arranged along the central canal of the frond were internal. Their reliance on chemoautotrophic symbionts seems thus likely. There is at least remote similarity of their body plan to the Cambrian ctenophores.

The next in abundance radially symmetrical Ediacarans are the triradial pteridiniid petalonameans, known mostly from isolated sets of basement membranes lining serial chambers within the body. Triradial symmetry characterizes also the Ediacaran soft-bodied *Tribrachidium* and aragonitic skeletons of the anabaritids. Yet no convincing interpretation of their relationships has been offered.

The most diverse bilateral Ediacarans are dipleurozoans, with their body plan composed of serial dorsally disposed chambers, intestinal caeca, and gonads. Some aspects of such a groundplan can be found among nemerteans and chordates, but these may be just plesiomorphic bilaterian traits.

A molluscan affinity has been proposed for *Kimberella*, which is known to produce scratches over the mat, perhaps by a ventrally located mouth apparatus. As shown by various stages of its contractile body collapse, the dorsal surface was covered with papillae, the intestine was filled with mud and surrounded by a collapsing cavity, except for the rectum. Somewhat similar papillae, but regularly distributed, cover the organic membrane of the Namibian *Ausia*. Their similarity to calcified papillae of the Cambrian halkieriids may support molluscan affinities of *Kimberella* and the concept of coeloscleritophorans.