

Serpulid (Annelida, Polychaeta) Evolution and Ecological Diversification Patterns During Middle-Late Jurassic

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Tube-dwelling polychaetes of families Serpulidae, Spirorbidae and Sabellidae are extremely widespread, but poorly studied group of Mesozoic fossils. The main problems with serpulid study are:

1) Unclear and complicated systematics on tube features, which can not be easily coordinated and correlated with modern systematics based on soft body features;

2) Punctuated stratigraphical distribution, in most sections numerous serpulids occur only at one specific level;

3) Unequal paleontological study of the group at different territories, absence of any knowledge/systematic descriptions for some areas.

For the last decade the group attracts much attention of the researchers, and numerous papers are published not only in taxonomy, but also in tube microstructures. Thus, the study of serpulids gradually comes to a new level, and first aspects of evolution and paleoecology can be drawn by coarse dabs at the moment.

The fact is that total biodiversity rapidly grows during the Mesozoic (there are about only 15 nominal species described from the Triassic, about 150 – from the Jurassic, and more than 200 – from Cretaceous deposits), and the most remarkable radiation took place during Middle-Late Jurassic. The author has studied about 70 locations with Jurassic and Berriasian serpulids in Central Russia and Crimea. It was shown, that the main abiotic factor, which defines the appearance of serpulid community, is the character of substrate-live (usually sponges, corals) or stagnant (belemnite rostra, concretions, ammonite shells, etc.). Communities at the same substrate, but with different stratigraphic position, consist of close species. Second principal parameter is hydrodynamics, serpulid communities in high-energy and low-energy sedimentary conditions are different in species composition.

Comparison of similar sedimentary environment and substrate at different stratigraphic levels allows us to give some conclusions on evolution and ecology diversification in time, even when the fossil record is very scarce.

The highest biodiversity of serpulid communities was documented in upper Berriasian of Crimea on sponges (33 species), and analogous community in lower Oxfordian contains only 14 species. Furthermore, in almost the same sections upper Berriasian Crimean communities on stagnant substrate it counts 20 serpulid

species and in Jurassic (middle Callovian to lower Oxfordian, uncertain) – only 6 species. For Boreal sections of Central Russia this pattern is similar: Callovian complexes count about 8 species only, while in middle-upper Oxfordian there are about 12 species. Only few new generic taxa appeared in Berriasian and were absent in Jurassic. There is no significant diversification at the level of genera. However, studied Lower Jurassic locations do not yield numerous and variable serpulids, neither in the author's collection, nor in literature. Thus it can be deduced that generic diversification possibly took place during Middle Jurassic, when principal ecological and morphological types formed, while during Middle-Upper Jurassic diversification took place at specific level. Phylogenetic scheme at generic level is impossible to draw for the moment, since there is a "gap" in study for Lower Jurassic–lower Middle Jurassic serpulids.

Moreover, Upper Cretaceous serpulid faunas of Europe, detailed described in works of M. Jäger (1983, 2004, and others), also do not contain principally new morphotypes and genera of serpulid tubes comparing with Jurassic and Berriasian faunas, possibly except for numerous *Pyrgopolon* species.

The second fact is that tube morphotypes of different substrates are different, but in general features stable in time. The author has analysed all possible morphotypes of serpulid tubes and came to a conclusion that all tubes can be described with several parameters, all having morpho-functional interpretation: regular/irregular, large/average/small, attached/partly detached/free, fast growing/slowly growing. On live substrates and deposits of reefal tail predominate small compact attached forms with tube diameter not wider than several mm (*Metavermlia*, *Spiraserpula*, *Placostegus* and many others), while at stagnant and stable substrates substrate large irregular slowly growing serpulids (like *Propomatoceros*/*Parsimonia*) form the basis of the community. Of course, there are also several forms which can be found on any kind of substrate, like sabellid *Glomerula* of serpulid *Filigranula* spp.

The diversification during Middle-Late Jurassic, anyway, is marked by the first appearance of *Conorca* morphotype and most ancient of spirorbids – representatives of *Neomicrorbis* – on live substrates (sponges). Recently it was shown by Taylor and Vinn (2007) that Paleozoic spiral spirorbis-like tubes are not relatives of modern Spirorbidae, which appeared



somewhere around Jurassic-Cretaceous boundary. Our investigation shows that first Spirorbids were already small and compact. This group derived from Serpulidae (for the last years it is proven also from molecular phylogenetics), probably as an attempt to make tube small, which makes possible attachment to 1) flexible substrates like algae in the upper sub-littoral zone; 2) small free areas in densely inhabited biotopes and live substrates. This makes possible to effectively live in high-energy and rich in food shallow-water environment. It is interesting that *Conorca*-like tubes have the same basic morphological characteristics as spirorbids and can be considered as adapted to the similar environment, thus there were a parallel evolution of two independent and concurrent braches of tubicolous polychaetes.

Key words: Serpulidae; Spirorbidae; Jurassic;

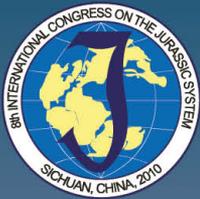
Evolution; Adaptation

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