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## Palaeobiogeography and diversification of Tournaisian–Viséan bryozoans (lower–middle Mississippian, Carboniferous) from Eurasia

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### ABSTRACT

The Mississippian represented the last diversification event of bryozoans in the Palaeozoic which affected all taxonomic levels. Within the borders of modern Eurasia Tournaisian–Viséan bryozoans are known from 24 areas, with a total of 878 species in 180 genera. Palaeobiogeographical analysis is here made according to the stages and substages of the Tournaisian and Viséan. Six characteristic species were identified for the lower Tournaisian which are distributed in more than one region of the continent, and for the upper Tournaisian there are two such species. Eleven species occur in the narrow stratigraphic interval of the lower Viséan that display a wide geographic distribution within Eurasia, in the upper Viséan there are 14 such species. Analysis of the generic composition showed the closest similarity between Tournaisian bryozoans of Kazakhstan, the Kuznetsk Basin and Eastern Transbaikalia. Significant similarity in the generic composition of Germany, Britain, Ireland and France is observed during the Viséan. Two centres of radiation bryozoans were identified: «Eastern» and «Western».

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### 1. Introduction

Bryozoans are benthic organisms playing important role in marine ecosystems from the Ordovician to the recent. Evolution of the phylum Bryozoa displays several significant diversification and succeeding extinction events, one falling in the Frasnian/Viséan interval. Rise in generic diversity is observed from the end of the Famennian reaching a maximum at the end of Viséan and followed by extinction of several taxa in the Serpukhovian (Ernst, 2013). During Famennian–Viséan ages bryozoans experienced crucial changes in their taxonomic composition (e.g., the rapid appearance of new families and suborders; extinction of Devonian genera and families; change of dominant order). The Mississippian represented the last diversification event of bryozoans in the Palaeozoic.

An analysis of the diversity of orders of Palaeozoic bryozoans, including those from the Carboniferous, was made by Gorjunova et al. (2004). They came to the conclusion that the diversity depends on the developmental phase of the higher taxon (bloom, decline, extinction or origination) under secondary influence of abiotic factors.

General biogeographical analyses have been provided for most of the Palaeozoic. Naimark et al. (1999) suggested that faunal radiations across different regions occurred diachronously, and that endemic species developed in areas that promoted bryozoan habitats rather

than in isolated basins. Buttler et al. (2013) have reported on Early Palaeozoic biogeography, and Ross (1982) and Ross and Ross (1985) provided a summary of Late Palaeozoic (Carboniferous–Permian) biogeography, while Ross and Ross (1982) discussed factors that influenced faunal distributional patterns. At the level of the geological period, a number of overviews of bryozoan biogeography throughout the Palaeozoic have been documented either globally or from a more restricted viewpoint geographically or temporally: Ordovician (Ross, 1982; Tuckey, 1990a), Silurian (Tuckey, 1990b; McCoy and Anstey, 2010), Devonian (Bigey, 1985; Tolokonnikova and Ernst, 2010), Carboniferous (discussed below), and Permian (Ross, 1978, 1979; Gilmour and Morozova, 1999).

The first overview of the palaeobiogeography of Carboniferous bryozoans was made by Ross (1981). She analysed generic diversity for 11 regions of the world according to stages of the Carboniferous and discussed changes in the composition of families and orders. Ross reasoned for continuity between Devonian, Carboniferous and Permian bryozoans, and inferred bryozoan diversification and radiation during the Viséan, which was apparently induced by such abiotic factors as fluctuating sea-levels driven by glaciations in Gondwana, and the loss of shallow-water environments due to the closure of the ocean between Euramerica and Gondwana (Ross, 1982). During the Late Carboniferous an increased number of new ecological niches developed due to a gradual warming of the climate that resulted in the origination of some new bryozoan lineages and a pronounced provincialism (Ross and Ross, 1985). However, the second half of the Carboniferous is generally marked by a reduction in taxonomic diversity (Ross, 1981). McKinney

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