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A CONOP9 quantitative stratigraphic model of Baltic Ordovician and Silurian chitinozoan distribution and K-bentonites

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The Baltic Ordovician-Silurian sedimentary succession is rich in well-preserved microfossils and contains numerous altered volcanic ash beds, both of which are valuable tools for regional stratigraphy. Over decades large amounts of data on the distribution of chitinozoans and conodonts have been collected in the Baltic region, and the corresponding biozonations are well established. Also, new methods have allowed much improved fingerprinting of individual K-bentonite layers. Such large integrated data sets can be efficiently analyzed and interpreted by the help of quantitative stratigraphic tools. One of these, CONOP9, has proved especially useful for automatic correlation as well as for high-resolution biodiversity analysis (Sadler 2012). We have previously applied CONOP9 to analyze diversification history of Ordovician and Silurian chitinozoans (Hints et al. 2011 and Paluveer et al. 2014). Here we extend these approaches by combing the Ordovician and Silurian data sets, including data from additional sections and incorporating the K-bentonite database in order to provide independent test for biostratigraphy and examine possible links between volcanic activity and chitinozoan diversity. The combined Ordovician-Silurian data set includes 80 sections from Baltoscandia, and 319 chitinozoan species and 50 geochemically fingerprinted K-bentonites (Kiipli et al. 2013). The composite model was created after several consecutive runs of CONOP9; good results were achieved using level penalty with ca 1200 steps and 6000 trials. Secondary penalty of TEASER and STACKER were applied to avoid placing an event in a section where it was not observed and to penalize taxon ranges from extending too far.

The CONOP9-derived diversity curve shows that chitinozoans thrived during the Darriwillian and Sandbian with standing diversity reaching 40 species in Baltoscandia. A small crisis coincided with the basal Katian, followed by a major late Katian-Hirnantian decline and extinction, with ca 10 species crossing the system boundary. The Silurian diversity peaks in the Telychian and late Sheinwoodian – early Homeric reached standing diversity of ca 30 species. The main Silurian biotic crises for chitinozoans correspond to the Ireviken and Mulde events and associated environmental changes. However, the Lau Event is not clearly expressed in the model suggesting that it might have been less severe for chitinozoans compared to the Hirnantian, Ireviken and Mulde events. A best-fit CONOP9 composite has strong local range support in the Ordovician, where the model revealed excellent or above-average fit of most conventional index species. In the Silurian the zonal taxa generally showed larger misfit values. Incorporation of K-bentonites did not alter chitinozoan succession, but helped to more precisely correlate the CONOP9 composite with regional stages.

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