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Correlation of Upper Ordovician K-bentonites in the East Baltic – A combined approach of chitinozoan biostratigraphy and sanidine geochemistry

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Ordovician K-bentonite beds have a long history of investigation and by now have been reported on most major paleocontinents. As the corresponding volcanic eruptions represent instantaneous events in the geological record, the K-bentonites are invaluable for local and regional correlations as well as for radiometric dating and for building up a global numeric time scale. About a hundred K-bentonites have been identified in the Upper Ordovician mudstones in Scania, southern Sweden. However a vast majority of these are thin (less than 1 cm) and are difficult to identify in the coeval carbonate-dominated successions of the Baltoscandian basin, which obviously limits the usage of K-bentonites in regional chronostratigraphy. In this study we analyse the potential of chitinozoan biostratigraphy combined with fingerprinting sanidine phenocryst composition to aid correlation of Sandbian and Katian K-bentonites in the Paleobaltic basin. The high evolution rate of chitinozoans and their planktic behavior makes them a valuable correlation tool for Lower Paleozoic rocks. They are among the most useful microfossils in the Upper Ordovician strata of Baltoscandia, providing biostratigraphic resolution which far exceeds of that of conodonts.

The Kukruse K-bentonite (more appropriately termed as a feldspathic tuff) is encountered in drillcores of Central Estonia can be confidently traced outside of oil shale accumulation area in the Paleobaltic basin by the presence of *Conochitina tigrina*. Up to 17 thin K-bentonites (Grefsen and Sinsen K-bentonite complexes) have been recorded in the variably argillaceous wackestones of the Haljala Stage, although the usual number encountered in a single drill core is three to seven ones. The Grefsen and Sinsen K-bentonite complexes, erected in Norway, can not be reliably separated in the East Baltic sections neither by chitinozoans nor by conodonts. The Kinnekulle K-bentonite at the base of the Keila Stage is the thickest and the most widely studied Upper Ordovician K-bentonite in Baltoscandia. As for chitinozoan biostratigraphy, this bed is located just below the findings of extremely short-ranged *Angochitina multiplex* encountered at least in 10 East Baltic and 2 Swedish drillcore sections. Five Katian K-bentonites of Pirgu age have been distinguished in the East Baltic sections. The lower two occur in the *Tanuchitina bergstroemi* Zone, while three others can be found in the overlying *Conochitina rugata* Zone. *Bursachitina umbilicata* is another chitinozoan key species which occurrence is strictly restricted to the *Conochitina rugata* Zone.

The Institute of Geology at Tallinn University of Technology has successfully applied a little used XRD method to determine the (Na+Ca) component in sanidine phenocrysts that can be useful for discriminating individual K-bentonite beds. The Na+Ca content in sanidine $(K,Na,Ca)AlSi_3O_8$ solid solution was calculated using a linear relationship between K-sanidine (d = 4.233 Å) and albite (d = 4.033 Å). In favourable cases (a sharp sanidine 201 reflection and a low content of authigenic potassium feldspar) the precision of the method is ± 1%, in less favourable cases – the precision is ± 2%. The studies accomplished in recent years have shown a good potential of this method for discriminating the Katian K-bentonites of Pirgu age in the East Baltic with the following results: BIV – 47–48; BIII – 34-36; BII – 42–44, BI – 37–38, BI – 25 mol%. The corresponding values for the Kinnekulle K-bentonite of Sandbian age range between 24–26 mol%. The same method has been successfully applied for discrimination of Silurian K-bentonites in the East Baltic sections.

Detailed chitinozoan biostratigraphic studies, combined with XRD fingerprinting of sanidine composition, could be a promising cost-effective and time-wise supplementary method in discriminating individual K-bentonite beds in other Lower Paleozoic paleobasins as well.