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A new age model for the Late Ordovician bentonites in Oslo, Norway

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During the Late Ordovician, explosive volcanic eruptions led to the deposition of worldwide bentonites. Some of the largest of these eruptions took place in the Sandbian and produced the Milbrig and Deicke K-bentonites of North America and the Kinnekulle K-bentonite of Scandinavia. We have studied the classic locality of Hagemann and Spjeldnæs (1955) - one of the most complete sections of Ordovician bentonites in Europe. The bentonites are present in the Arnestad Formation comprising dark shale with carbonate nodule beds grading into an increasingly more carbonate rich environment.

Through a 50-meter interval we have identified 33 bentonites of which 10 have not previously been reported from this locality. The bentonites have an average thickness of 4.9 cm with a few exceptions such as the Kinnekulle K-bentonite (35 cm) and the Grimstorp B (13 cm).

We have measured magnetic susceptibility of two 2-3 meter intervals with a sampling distance of 5 cm, using a handheld magnetic susceptibility meter in the field. These data show significant periodicity peaks that correlate well with Milankovitch cycles and are suggested to represent astronomically forced changes in sediment supply.

This study further presents high-precision U-Pb zircon ages of five bentonites from the section, including the Kinnekulle K-bentonite and Grimstorp B. These two beds were previously dated by Svensen et al. (2015) from a locality south of Oslo. Our new data improves the precision of the ages of these two key beds, and constrain the duration of the entire interval and thus the onset and termination of the late Ordovician volcanic system that deposited these tephras.

We conclude that the Oslo section provides a high-resolution age model to understand one of the most intense volcanic periods of the Paleozoic by combining radiometric and cyclostratigraphic data.

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