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Towards a calibrated astronomical timescale for the Mid Ordovician

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The Ordovician Period is one of the most dynamic of the Phanerozoic Eon, notably with respect to greenhouse/icehouse transitions and associated biotic fluctuations. From the Mid Ordovician onwards, the Great Ordovician Biodiversification Event (GOBE) completely changed the mode of ecospace utilization [1] and by the latest Ordovician, a catastrophic mass extinction wiped out up to 85% of all species [2].

Due to these fundamental evolutionary events, the Ordovician bio- and chronostratigraphy have been studied for decades including a host of projects within the UNESCO/IUGS cooperative International Geoscience Programme (IGCP) [3,4]. Thus, a well-established global chronostratigraphy is now available for this period [5]. However, only a handful of radiometric dates are available for calibration against an absolute time scale.

This project aims at establishing a new holostratigraphy of the Middle Ordovician of Baltica through integration of various biozonations, chemostratigraphy, cyclostratigraphy and new U/Pb and ⁴⁰Ar/³⁹Ar ages. The study material is based on Scandinavian drill cores of Kårehamn-4, Tingskullen-1 and Albjära-1 which, together, expose a continuous succession through the Middle Ordovician (Dapingian–Darriwilian Global stages) in both carbonate and shale facies.

Preliminary data are presented here and comprise mm-scale trace and major element data obtained from a XRF-core scanner, bulk carbonate $\delta^{13}\text{C}$ data, gamma-ray logs and core colour spectra, thus offering a large spectrum of high-resolution data to test for the expression of Milankovitch cycles and establish an astronomical time-scale. A number of additional ash layers have been identified in the core thanks to the combined sedimentology and XRF data and will allow in the near future for the establishment of new radiometric dates. Taken all together, the integration of all those proxies will hopefully provide the first synchronized geologic time scale over the ca. 11.5-myrr long interval of the mid-Ordovician. This framework will then be used to assess the rate of biotic and environmental change across this critical period of Earth history.

References:

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