

Middle Ordovician in Estonia: litho- and chemo-stratigraphy of the Velise F97 drill-core

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During the Great Ordovician Bio-diversification Event (GOBE), the diversity of marine animals increased all in species, genus and family levels, together with individual size increase, particularly in the Middle Ordovician. Various unique geologic episodes occurred during the Middle Ordovician besides biological changes, e.g., sea-level, Sr-isotope ratio and carbon isotope ratios of seawater, large-scale volcanism, meteorite shower, geomagnetic polarity reversal etc; nonetheless, their mutual cause-effect relationships were not well explained. This study analyzed litho-and chemo-stratigraphy (bulk composition and isotope ratio of inorganic carbon) of a continuous drilled core of the Middle Ordovician (Velise-F97 core recovered from central Estonia by the Geol. Surv. Estonia). The Middle Ordovician of the core comprises the Volkhov unit, Kunda unit, Aseri unit, Lasnamagi unit, and Uhaku unit, in ascending order. The occurrence of glauconite, once abundant in the Volkhov unit, becomes rare upsection and absent in the upper Kunda unit and above. In contrast, the occurrence of oolite first started in the Kunda unit and continued into the overlying units. These recorded the overall sea-level changes in the shallow marine shelf setting from shelf edge to intertidal zone in central Baltica. The bulk geochemical composition (major and trace elements) of the fine-grained limestone clarified the occurrence of a unique interval of high silica content in the lowermost Kunda unit. This reflects a short-term, large flux of terrigenous clastics into the basin but does not necessarily synchronized with the above-mentioned sea-level drop. On the other hand, the isotope ratio of inorganic carbon increase for ca. 2 permil from the middle Kunda unit to Uhaku unit with the peak in the Aseri unit, which corresponds to the MDICE episode reported elsewhere. These records indicate that the major change in the shallow marine environment in central Baltica occurred mostly during the deposition of the Kunda unit. This study clarified for the first time in a single section that the Middle Ordovician change started from the onset of overall shallowing (episode 1), and followed by the increase of primary production (episode 2) in the shallow shelf domain. These may have linked to the GOBE, and further correlation with biostratigraphy of the core under analysis is necessary. The short-term influx of terrigenous clastics was likely a remnant of meteorite impact in the neighborhood.

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