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Chondrites from the Hirnantian-Rhuddanian carbonates of Baltica

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The Baltic region has a prolific carbonate succession deposited during the Ordovician and Silurian periods. Studies have been ongoing on these rocks to understand the environments and events of the early Paleozoic, and ichnology has emerged as a valuable proxy for this. A focus on the latest Ordovician (Hirnantian) to earliest Silurian (Rhuddanian) pinpoints the study to a significant event during which environmental changes culminated in the first of the "Big Five" mass extinctions. Trace fossils from this interval have been documented from a few locations, including Baltica, and the effects of the palaeoenvironmental conditions are observed to be reflected in the abundance, ethology, diversity, and disparity of the traces. However, in this study, the specimens of the trace fossil *Chondrites* are highlighted as indicators of some environmental changes, chiefly oxygenation conditions, based on their morphology and abundance.

Sampled from the Reinu Quarry in northern Estonia, *Chondrites* specimens from three lithostratigraphic units in the Hirnantian-Rhuddanian interval exhibit characteristics probably reflecting varying oxygenation levels during the trace-making process. *Chondrites* specimens from the Hirnantian Kamariku Member are depauperate, occurring in scarce patches on thin mud layers between thicker sandy limestone beds. Trace-making occurred in oxygenated conditions, which hindered the preservation of organics that support deposit feeding. In the overlying Koigi Member, a predominantly carbonate mudstone unit, *Chondrites* specimens show a variety of well-expressed morphologies that may indicate different species or morphotypes. These specimens are confined to bedding planes, though shafts connected to some of the specimens suggest conduits through which the trace makers moved to access layers containing food. Trace-making in this unit was under dysoxic conditions, where deposit feeding occurred due to the preservation of organic matter, though concentrated in thin layers. The lower part of the Varbola Formation, above the Koigi Member, is most likely of the Rhuddanian age and characterised by pervasive *Chondrites*, fluctuating in abundance in the alternating marly and bioclastic layers. Morphology is observed as circular to elliptical spots and short bars (sometimes with branches). Oxygenation levels remained low during this part of the Varbola

Formation deposition. However, the intermittent occurrence of bioclastic layers suggests oxygenation episodes.

Keywords: *Chondrites; palaeoenvironmental reconstructions; ichnology; Baltica; Paleozoic.*