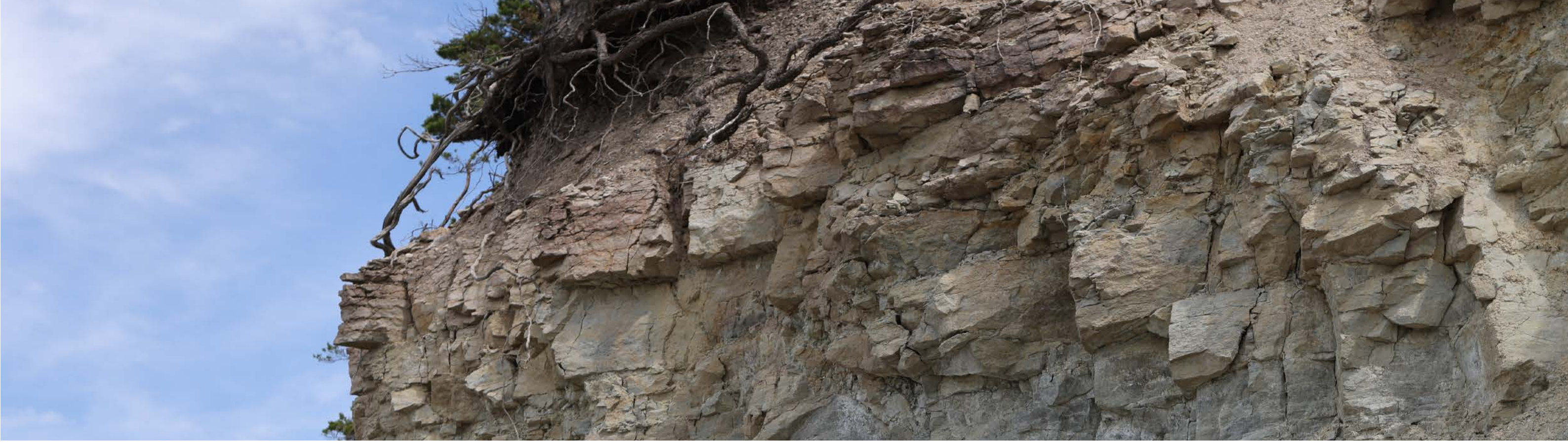

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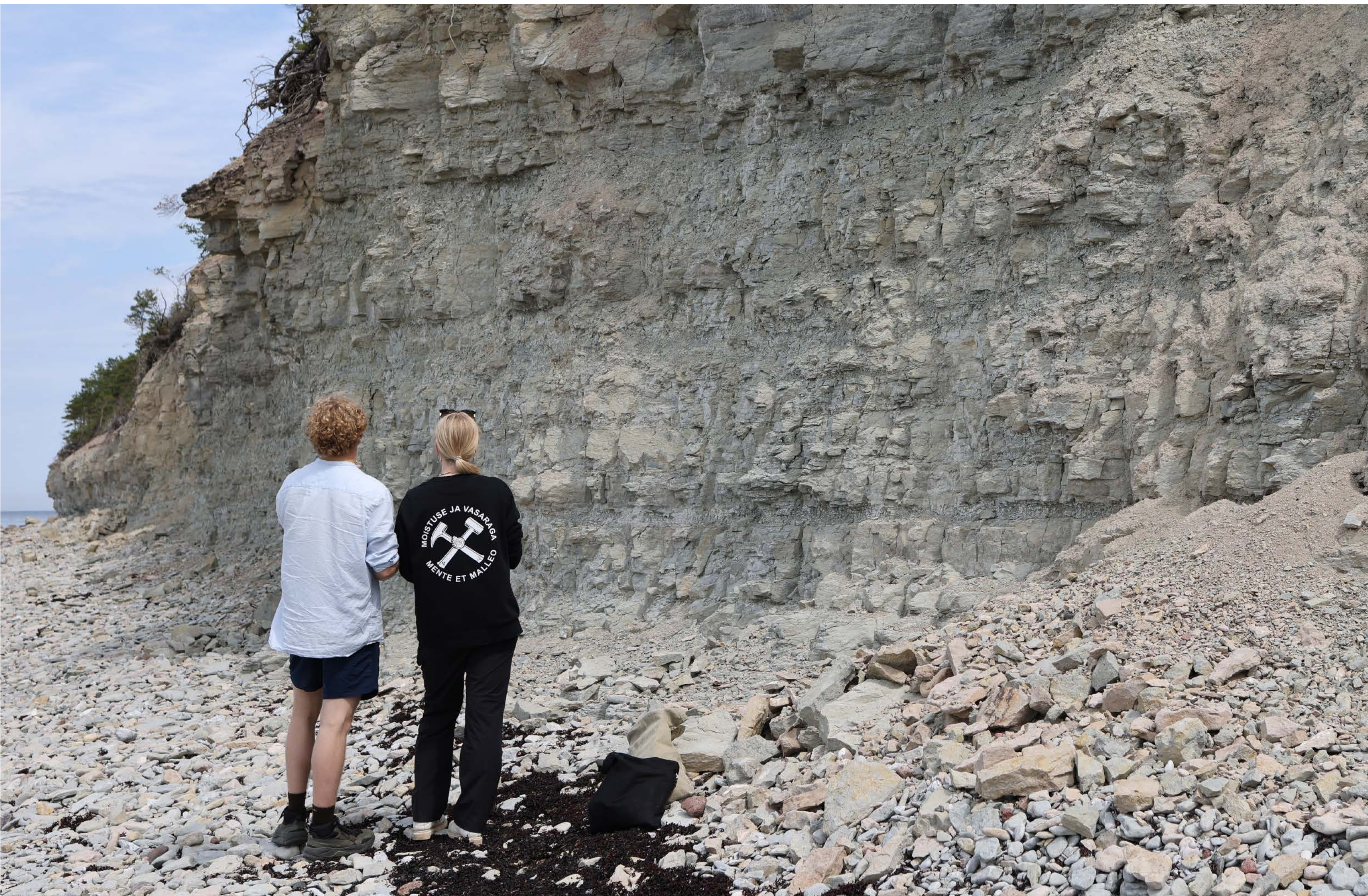

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Lithofacies-related changes of magnetic and radioactive rock characteristics along the Ordovician sequence in Lithuania

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The Ordovician succession of western Lithuania represents a rather continuous sedimentation, but still with recognised unconformities, in comparatively deeper shelf settings ascribed to the Livonian facies zone within the Baltoscandian palaeobasin. The Upper Ordovician sequence dominates over the Middle and Lower series. However, the Ordovician strata within the study area appear to be reduced in thickness towards the south, suggesting deposition on the slope of a topographic palaeohigh, the Lower Nemunas Elevation. This study aims to characterise trends in the magnetic and radioactive patterns of marine sedimentary facies spanning from the top of the Cambrian Deimena Series and Lower Ordovician to the lowermost part of the Silurian (Llandovery).

Along the studied profiles, magnetic susceptibility (MS) and spectral gamma-ray (GR) logs display similar shapes, i.e. both parameters increase within relatively more siliciclastic intervals (mudstones) and decrease in carbonate-rich intervals (limestones, carbonate concretions), pointing to common factors affecting the records. In general, the variability in MS and GR likely results from the introduction of siliciclastic detrital material to the basin, as well as locally associated authigenic and diagenetic fractions, which contain a higher portion of paramagnetic and/or ferromagnetic minerals and radioactive elements compared to the diamagnetic and low-radioactive 'pure' carbonates themselves. The siliciclastic component is well traced by spectral gamma Th and K contents, which serve as proxies for clastic material. In siliciclastic mudstone facies, carbonate minerals act as dilutants of bulk magnetic and radioactive signals. Although pyrite (paramagnetic) is abundant, it does not necessarily notably contribute to the MS record; instead, the MS signal in mudstones in the large portion may be controlled by paramagnetic Fe-chlorite content, implying the diagenetic origin of chlorite. Mudstones with a high content of organic matter (OM), marked by an elevated total GR due to authigenic U enrichment, often display decreased MS values, which could be linked to the diamagnetic nature of OM and its dilution effect resulting in suppressed bulk MS values. Very high total GR values are typical for the thin basal Lower Ordovician siliciclastic interval embracing *Obolus* sandstones (enriched in phosphatic shells of lingulate brachiopods) and overlying glauconite-rich sandstones.

In contrast to phosphate-bearing sandstone, characterised by low MS values and high GR mainly determined by uranium held in phosphatic constituent, glauconitic strata are marked by high values of MS due to the presence of paramagnetic glauconite mineral (evidenced by elevated K content). Beds of mudstone containing volcanic material or tephra show moderately elevated total GR due to higher K and Th contents. MS values are variable in those intervals, while tephra material itself appears to have low MS, thus this hints that the primary agent carrying the MS signal is siliciclastic detrital input. The reddish-brown colouration of beds in Middle and Upper Ordovician suggests the presence of hematite, possessing strong magnetic susceptibility properties. Despite this, the general trends of MS and GR remain similar along these 'red' sections, indicating detrital input as the primary controlling factor of MS signal, rather than diagenetic effects related to hematitisation, although its influence cannot be entirely neglected. Since there are evidences of dolomitisation throughout the Ordovician sequence, a local increase in MS could be linked to iron-bearing carbonates.

The strength of the MS and GR signals along the studied Ordovician succession, which represents the interaction of carbonate and siliciclastic environments, being diagenetically altered, can be mainly attributed to clastic terrigenous input to the basin, but with certain exceptions.

Keywords: magnetic susceptibility, spectral gamma-ray, Ordovician, sedimentary facies.

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