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Soft-sediment deformation structures in Cambrian Series 2 tidal deposits (NW Estonia): implications for identifying endogenic triggering mechanisms in ancient sedimentary record

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Soft-sediment deformation structures (SSDS) are documented in several horizons within silt- and sandstones of the Cambrian Series 2 (Dominopolian Stage) Tiskre Formation, and some in the below-deposited argillaceous deposits of the Lükati Formation (northern part of the Baltoscandian Palaeobasin, NW Estonia). The aim of this study was to map, describe, and analyze these deformation features, discuss their deformation mechanism and possible triggers. Load structures (simple load casts, pillows, flame structures, convoluted lamination) with varying shapes and sizes occur in the Tiskre Fm in sedimentary interfaces within medium-bedded peritidal rhythmites (siltstone-argillaceous material) as well as within up to 3 m thick slightly seaward inclined stacked sandstone sequences. Homogenized beds, dish-and-pillar structures, and severely deformed bedding are also found within these stacked units and within a large tidal runoff channel infill. Autoclastic breccias and water-escape channels are rare and occur only in small-scale — always related to thin, horizontal tidal laminae. Profound sedimentary dykes, sand volcanoes, and thrust faults, which are often related to earthquake triggered soft sediment deformation, were not observed within the studied intervals. Deformation horizon or horizons with large flat-topped pillows often with elongated morphologies occur at or near the boundary between the Tiskre and Lükati formations. Deformation mechanisms identified in this study for the various deformation types are gravitationally unstable reversed density gradient (especially in case of load features that are related to profound sedimentary interfaces) and lateral shear stress due to sediment current drag (in case of deformation structures that not related to loading at any apparent sedimentary interface). Synsedimentary liquefaction was identified as the primary driving force in most of the observed deformation horizons. Clay thixotropy may have contributed in the formation of large sandstone pillows within the Tiskre-Lükati boundary interval at some localities. It is discussed here that the formation of the observed SSDS is genetically related to the restless dynamics of the storm-influenced open marine tidal depositional environment. The most obvious causes of deformation were rapid-deposition, shear and slumping caused by tidal surges, and storm-wave loading.