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Palaeoenvironmental Interpretation of Yedoma Silt (Ice Complex) Deposition as Cold-Climate Loess, Duvanny Yar, Northeast Siberia

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ABSTRACT

Uncertainty about the geological processes that deposited syngenetically frozen ice-rich silt (*yedoma*) across hundreds of thousands of square kilometres in central and northern Siberia fundamentally limits our understanding of the Pleistocene geology and palaeoecology of western Beringia, the sedimentary processes that led to sequestration of hundreds of Pg of carbon within permafrost and whether yedoma provides a globally significant record of ice-age atmospheric conditions or just regional floodplain activity. Here, we test the hypotheses of aeolian versus waterlain deposition of yedoma silt, elucidate the palaeoenvironmental conditions during deposition and develop a conceptual model of silt deposition to clarify understanding of yedoma formation in northern circumpolar regions during the Late Pleistocene. This is based on a field study in 2009 of the Russian stratotype of the 'Yedoma Suite', at Duvanny Yar, in the lower Kolyma River, northern Yakutia, supplemented by observations that we have collected there and at other sites in the Kolyma Lowland since the 1970s. We reconstruct a cold-climate loess region in northern Siberia that forms part of a vast Late Pleistocene permafrost zone extending from northwest Europe across northern Asia to northwest North America, and that was characterised by intense aeolian activity.

Five litho- and cryostratigraphic units are identified in yedoma remnant 7E at Duvanny Yar, in ascending stratigraphic order: (1) massive silt, (2) peat, (3) stratified silt, (4) yedoma silt and (5) near-surface silt. The yedoma silt of unit 4 dominates the stratigraphy and is at least 34 m thick. It is characterised by horizontal to gently undulating subtle colour bands but typically lacks primary sedimentary stratification. Texturally, the yedoma silt has mean values of 65 ± 7 per cent silt, 15 ± 8 per cent sand and 21 ± 4 per cent clay. Particle size distributions are bi- to polymodal, with a primary mode of about 41 μm (coarse silt) and subsidiary modes are 0.3–0.7 μm (very fine clay to fine clay), 3–5 μm (coarse clay to very fine silt), 8–16 μm (fine silt) and 150–350 μm (fine sand to medium sand). Semidecomposed fine plant material is abundant and fine *in-situ* roots are pervasive. Syngenetic ice wedges, cryostructures and microcryostructures record

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