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Introduction

Introduction to special issue: loess environments: generation, transport, and deposition

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The International Union of Quaternary Research (INQUA) LoessFest, typically held once every four years, mainly concentrates on recent achievements and future work on the various aspects of aeolian studies, particularly focusing on loess, as well as reconstructions of paleoclimate and paleoenvironments. The thematic set of papers in this issue of *Quaternary Research* are associated with the 2022 INQUA LoessFest. Originally scheduled to take place in Yan'an, Shaanxi Province of China, this conference transitioned into a fully online meeting from August 20 to 23, due to the COVID-19 pandemic. The conference was organized by the INQUA Loess and Pedostratigraphy Working Group, the Key Laboratory of Cenozoic Geology and Environment of the Chinese Academy of Sciences, and the State Key Laboratory of Loess and Quaternary Geology of China. The LoessFest brought together 158 participants from 13 countries, who contributed 7 invited talks, as well as 57 oral and 32 poster presentations.

This thematic set showcases the diverse research topics presented at the 2022 INQUA LoessFest, with specific emphasis on loess transport dynamics (Schaetzl, 2024) and paleoenvironments in North America (Schaetzl, 2024), Central and Eastern Europe (Skurzyński et al., 2024; Taratunina et al., 2024), and East Asia (Cui et al., 2024; Fu et al., 2024; Gu et al., 2024; Li et al., 2024).

The investigation of periglacial permafrost in loess sequences bears significant practical implications for understanding future climate change. Taratunina et al. (2024) examined the morphology of cryogenic structures, the morphoscopy of quartz grains, and the micromorphology of subaerial sediments in the loess–paleosol sequences of the Lower Volga region of the East European Plain. They identified and interpreted four stages of cryogenesis during the last glacial–interglacial cycle, presenting unambiguous evidence of cryogenesis in the northern Caspian Lowland. These findings suggest that during the Late Quaternary, permafrost had repeatedly expanded to the southeast of the East European Plain, and to a much more southerly extent than had been previously reconstructed. This expansion may have occurred in response to precession-driven changes in summer insolation in the Northern Hemisphere.

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Through the study of loess deposits and their transport pathways in west-central Wisconsin, USA, Schaetzl (2024) demonstrated that these loess deposits were predominantly found (and thickest) in "protected" sites, that is, downwind from large topographic barriers. His research corroborated the model proposed by Mason et al. (1999) that saltating sands are effective agents for getting silt/dust into suspension and that the accumulation of loess deposits is thus optimized at sites downwind of topographic barriers, which halt the movement of saltating sand particles.

Fu et al. (2024) presented paired carbon isotope records of pedogenic carbonates ($\delta^{13}C_{Carb}$) and organic matter ($\delta^{13}C_{TOC}$) occluded within carbonate nodules from the Shaozhai section in the central Chinese Loess Plateau (CLP). Their findings suggest that the seasonality of C_4 plant growth and carbonate precipitation in the CLP could cause positive carbon isotope anomalies in pedogenic carbonates, highlighting the potential utility of $\delta^{13}C_{Carb}$ for quantitative C_4 vegetation reconstructions.

The environment of northern China is highly sensitive to the advance and retreat of the East Asian summer monsoon (EASM). Focusing on the northern margin of the EASM, Li et al. (2024) revealed fluctuations in lake level and dust activity over the past 11.5 ka through grain-size endmember analysis and the carbonate mineralogy record from sediments of Lake Bayanchagan. They identified a period of elevated lake levels and reduced dust activity during 10–5.8 ka, indicating the northward shift of the EASM rain belt. Gu et al. (2024) presented an alternative perspective on the Holocene evolution of the monsoon system. By analyzing radiocarbon and optically stimulated luminescence dating results from a loess–paleosol sequence on the northern CLP, they provided a high-resolution depositional record of East Asian monsoon variations over the past ~14 ka. Thus, they proposed a simultaneous strengthening of both the East Asian summer and winter monsoons during the Holocene climatic optimum (~7–5 ka BP).

Black soil, known as the "breadbasket of the world" due to its inherently high fertility, plays a crucial role in sustaining food production globally. A recent sedimentological study (Zhang et al., 2024) has demonstrated that the black soils of northeast China share a common origin with the loess deposits of the CLP — both are products of aeolian processes. In this thematic set, Cui et al. (2024) investigated the magnetic parameters, total organic carbon content, and stable carbon isotope composition of bulk organic matter in black soils formed on loess and non-

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loess sediments in northeastern China. Their results revealed that parent material significantly influences the spatial variability of black soil erodibility. Soils developed on loess parent materials exhibit lower erodibility potentials compared with those on non-loess materials. This difference was possibly attributed to the role of organic matter in stabilizing the soil against erosion. The study suggests implementing practices such as avoiding excessively deep plowing in summer and autumn and utilizing straw cover in winter and spring to protect black soils from erosion, thereby ensuring future food security.

Skurzyński et al. (2024) investigated chemical weathering in the youngest Polish loess (L1LL1 = MIS 2, ca. 26–15 ka). They observed some variations in weathering degree in southern and northern Poland loess, and yet the loess remains relatively fresh, thoroughly mixed during transportation and sedimentary recycling, and has not been significantly impacted by postdepositional processes or admixtures of local materials. The overall homogeneity of this Polish loess has facilitated the development of a new geochemical dataset known as the Polish median loess, which has value for comparative analyses of loess worldwide and may serve as a foundation for future research on a pan-European (or perhaps even global) reference dataset.

In summary, aeolian dust deposits preserved on land and in lakes serve as invaluable archives of paleoenvironmental conditions, and help to elucidate the processes governing dust production, transportation, and deposition and its postdepositional alteration. As such, the papers in this thematic set offer insights into comprehending past atmospheric dynamics and climate change.

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