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Editorial: Aeolian-fluvial surficial processes and paleoenvironmental archives: characteristics, mechanisms, and method

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Editorial on the Research Topic
Aeolian-fluvial surficial processes and Paleoenvironmental archives: characteristics, mechanisms, and method

Interactions between aeolian and fluvial (A-F) processes - the coupling of sediment transport by wind and water, play a fundamental role in shaping the geological, Quaternary and current surface of the Earth from local to regional scales. These processes have unique impacts upon landscape development, land degradation and hydrological patterns that in turn, since prehistoric times can sometimes postively or negatively impact human habitats (Magaritz and Enzel, 1990; Sankey and Draut, 2014; Vardi et al., 2018; Yu et al., 2015; Yu et al., 2022; An et al., 2020; Pang et al., 2023).

Aeolian-Fluvial (A-F) processes determine landform (Robins et al., 2022; Forman et al., 2023) and dunefield evolution (Yu et al., 2019; Yu et al., 2022) by scaling the ability of aeolian mass to overcome fluvial energy and *vice versa* (Williams, 2015). These processes are common in semi-arid to arid environments in both hemispheres, especially along dunefield margins (Loope et al., 1995; Bullard and McTainsh, 2003; Roskin et al., 2014; Al-Masrahy and Mountney, 2015; Liu and Coulthard, 2015; Mehl et al., 2018; Robins et al., 2022; Yu et al., 2022; Pang et al., 2023), where high-energy flows, generated at the upper reaches of basins, interact with dunefield sand (Al-Masrahy and Mountney, 2015). This process of dune-damming and deranging fluvial systems is a major A-F process whose outcome is the deposition of both fluvial sediments originating from upstream and local aeolian dunefield sediments in a variety of intrinsic mixtures and stratigraphic signatures (Loope et al., 1995; Robins et al., 2022).

A-F archives, by recording both aeolian and fluvial activity establish their dominating time sequences and spatial boundaries. Therefore, terrestrial A-F interactions (AFI's) are crucial for studies of climate change impacts, geological records (Fryberger et al., 2016), dunefield evolution, and palaeohydrology. Recent studies have demonstrated that A-F cycles respond to glacial inter-glacial cycles in cold deserts (Yu et al., 2019; Yu et al., 2020; Yu et al., 2022). They also provide analogues for similar planetary processes, recently reported in Mars

and Titan (Bahia R. et al., 2023; Bahia R. S. et al., 2023; Bohaceck et al., 2023). Research is necessary to acknowledge stratigraphic and morphological evidence of AFIs (Roskin et al., 2017; Robins et al., 2022; Robins et al., 2023), interpret and model the mechanisms of AFI's, and glean their paleoenvironmental and paleoclimatic information. As A-F processes have been sparsely studied but are recently attracting growing interest, we thought it was timely to produce a SI on the topic.

This SI entitled *Aeolian-fluvial surficial processes and Paleoenvironmental archives: characteristics, mechanisms, and Method* aimed to deepen the understanding of some fundamental questions about characteristics, processes, and mechanisms of AFI's. The main aspects that were called upon were: 1) sedimentological, stratigraphic and distribution characteristics of different types of AFI's records in dunefields under different environments and climates; 2) the dominant fluvial and aeolian properties controlling the range of A-F processes, e.g., formation, maintenance and decimation of dune-dammed water bodies; 3) A-F response to climatic and environmental changes in different time-scales, and 4) the role of AFIs and cycles upon dunefield and fluvial landscape evolution, and hydrological impacts like oases formation. The study of AFI's are also envisioned to broaden the scope of aeolian studies that are often perceived as secondary, at least in quantity, in relation to those in fluvial geomorphology (Stout et al., 2009). Furthermore, the understandings derived from A-F studies yield secondary derivatives such as an approach-oriented awareness that many geomorphic outcomes may be a combination of several different processes.

Following a rigorous selection, reviewing and editing process, the SI output in the form of six papers mainly reflects some of the goals of the SI. The papers dealt with a broad range of studies from a wide range of geomorphic environments that have a significant aeolian aspect. A majority of the papers relate to aeolian environments in northern China and in particular, the Tibetan Plateau (TP) margins, where long-term and largescale AFIs are common (Li et al., 2020) during the late Quaternary and to a lesser extent, are ongoing (Yu et al., 2019; Yu et al., 2020; Li et al., 2021; Yu et al., 2022).

Two papers in the SI display how aeolian, fluvial and lacustrine processes may influence geomorphic evolution and sedimentary record under climate change. Liu et al. attributed for the first time the formation of the Hetao paleo-lake to the AFIs controlled by glacial-interglacial scale climatic change. Here, the expanded Hobq dunefield dammed the Yellow River during glacial periods. Consequently, the dammed lake filled due to resumed precipitation and glacial meltwater from the northeastern TP at the early stage of interglacial periods (MIS7 and MIS5). Hu et al. revealed that the seasonal ice-covered lake on the TP may lead to spatial heterogeneity of aeolian sediment within a catchment, because cracks on the ice surface capture coarse grains.

The SI encompasses a wide range of field, remote and analytical research approaches and methods. Shi et al. applied rare Earth elements to fingerprint provenance of aeolian loess in the Menyuan Basin, northeastern TP, and found the dust was mainly sourced from the Qaidam Desert and Taklamakan Desert by the Westerlies, and from the Badain Jaran Desert by the East Asia Winter Monsoon as well. Wei et al. copes with the problem of poorly and variable solar resetting of quartz grains for ESR dating from outburst flood sediments in the southeastern TP. The residual ages ranged between ca. 283 and 1,400 ka, challenge the suitability of ESR for dating such sediments. Indeed, dune-dammed, loess-sourced A-F sediments have been found to have undergone partial and inconsistent solar resetting of luminescence signals during fluvial transport in the arid Negev desert (Kenworthy et al., 2014; Robins et al., 2022).

Two papers dealt with new GIS-based geomorphic mapping approaches at a dunefield level generating a framework for understanding process-based interactions between dunes and a wide range of landforms such as fluvial systems (Fischer et al.; Petrović et al.). These novel approaches are beneficial for dunefield mapping based on open-source imagery and datasets that attempt to delineate areas of AFI's. Fischer et al. using semi-automated geographic object-based image analysis demonstrates correlations between dune orientation, wind regime and the role of uplands as deflective barriers to longitudinal dune migration. The role of dune spacing and sediment supply upon the location of ephemeral and abandoned fluvial channels is also discussed. Using unsupervised machine-learning, Petrović et al. statistically evaluates the links between the contemporary low-energy climate and stabilized dune morphologies of the Karakum and Kyzylkum dunefields that reflect winds that most likely varied in strength, but not in direction.

Altogether this seems to be the first Research Topic dedicated to AFIs. Beyond its contribution to this sub-discipline that appears to be emerging in China, the SI also provides a lens into incorporating cryospheric oriented impacts upon conventional geomorphic processes (French and Shur, 2010). We look forward to seeing new scientists and studies engaging in A-F themes that in turn, are anticipated to result in broader and perhaps more complex understandings of the processes that shape significant proportions of the critical zone of Earth and several planets. The recent reports and preliminary modelling of planetary AFIs (Bahia et al., 2023; Bahia R. S. et al., 2023; Bohaceck et al., 2023) are exciting breakthroughs and are anticipated to generate a new and substantial sub-discipline of AFI studies that may in turn regenerate analogue-oriented field and modelling studies of terrestrial AFIs.

Author contributions

JR: Writing–original draft. LY: Writing–review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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