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Editorial: Environmental change in drylands: Past, present, future–volume II

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Editorial on the Research Topic
Environmental change in drylands: Past, present, future–volume II

Dryland environments—defined as landscapes spanning hyper-arid to sub-humid climates—cover 40% of the terrestrial surface, host 40% of the world's human population, and are characterized by considerable seasonal and inter-annual variations in precipitation. Climatic and environmental variability in drylands has been a key characteristic over a range of timescales from the Quaternary into the Anthropocene. The climatic oscillations of the Quaternary have influenced dryland landscapes, ecology, and hominin populations. Drivers include glacial to interglacial-paced impacts on temperature and hydroclimate, precessional-insolation forcing of global monsoon systems, and teleconnection with millennial-scale extreme climate events at the higher latitudes. More recently, human land use and anthropogenic climate change are causing desertification on dryland margins. The interpretation of aeolian, fluvial, lacustrine, and other dryland archives must consider complex and non-linear arid landscape dynamics and feedbacks in response to external forces. Dryland responses to climatic variation are recorded in landform morphology (geoproxies) and in sedimentary records.

This Research Topic showcases new innovative approaches to interpreting archives of environmental change in drylands. The development of new proxies, new interpretation of multi-proxies, and integration of data with numerical models is essential for improving the information which can be derived from geoproxies and for better understanding the history of environmental change in drylands. This Research Topic comprises eight papers, dealing with a range of geoproxy types, approaches, and geographical areas (Figure 1). Both hemispheres and four continents (Africa, Europe, Asia, and Australasia) are covered.

Wind is often the dominant sedimentary agent in drylands due to the scarcity of water and irregular precipitation. It is fitting, therefore, that four of the papers in this Research Topic deal with aeolian landforms in time and space. In Yang et al., vertical aeolian sequences from source-bordering dunes in the semi-arid alpine Qilian Shan mountains of China are interrogated to clarify the trajectory of moisture availability over the deglacial to late Holocene period. This study exploits the stratigraphic and sedimentological differences between primary aeolian and buried soil horizons to

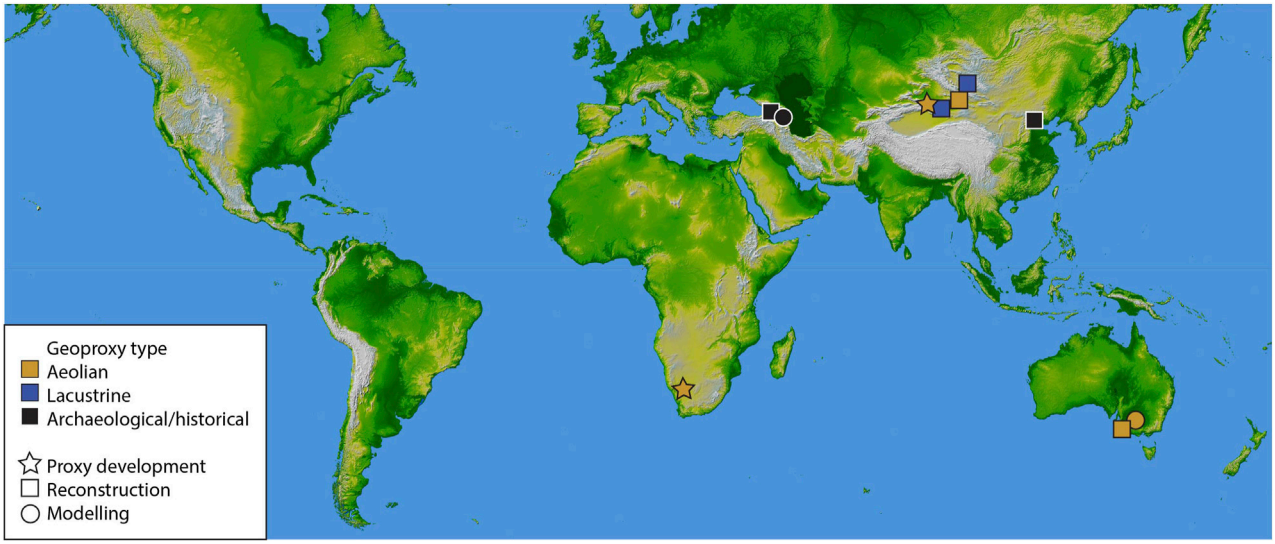

FIGURE 1
Overview of the geographic locations, geoproxy types, and approaches (proxy development, palaeoenvironmental reconstruction, and modeling) covered by this Research Topic. Base map: SRTM.

distinguish between arid and wetter phases, carefully decoupled by high-resolution luminescence dating. This paper serves to highlight the utility of high-frequency dating of sedimentary deposits, particularly for areas where there may be abrupt or gradational transitions between dry and wet phases. By contrast, Fitzsimmons and Gromov, working in the comparatively sediment-poor landscapes of southeastern Australia, investigate evidence for intensified westerly aeolian transport over large scales during the Last Glacial Maximum (LGM). These authors use a novel combination of sedimentology and stratigraphy, geochronology, and climate modeling—the latter involving particle trajectory analysis for both the present-day and LGM time slices—to argue for an extended LGM period with northward expansion of the westerly air masses over southern Australia. The paper by Liang et al. works with aeolian features but from a very different perspective. They investigate the physical characteristics of the iconic yardangs within the UNESCO Dunhuang Geopark in northwest China. Yardangs are features created by aeolian erosion of stratified sedimentary deposits in hyperarid regions. Minimal attention has so far been paid to the nature of the original sedimentary rocks which have been eroded with respect to their depositional environment and implications for subsequent aeolian erosion and yardang morphology. This study sheds light on the different facies preserved within yarding stratigraphy by means of multi-proxies, including chromaticity. Stone et al. provide the fourth paper, focusing on aeolian deposits. This study uses the dunes of the Kalahari Desert in southern Africa as a test case for investigating the potential of an exciting new approach to reconstructing rainfall based on depth profiles of evaporative enrichment of meteoric chloride, with varying degrees of success.

Two studies, both from dryland northwest China, interrogate lacustrine deposits as archives of hydroclimatic change. Wang et al. address the Holocene timescale also identified by Yang et al. which has yielded contradictory records of moisture availability in previous studies. Wang et al. focus on an archive at Lake Qinghai, approximately 100 km south of the Qilian Shan dunefield. Both the lacustrine and aeolian chronostratigraphies and integrated multi-proxies corroborate with each other and indicate very dry deglacial conditions, shifting to a moist period dominated by Asian summer monsoon rainfall in the early to mid-Holocene, followed by a late Holocene drying trend. Working within a lacustrine deposit within the Badain Jaran dunefield c. 250 km north-northeast of the Qilian Shan, Wang et al. investigate plant phytolith assemblages as a novel means of quantifying temperature and inferring hydroclimatic conditions. Their work yields a similar chronology to the two above, albeit with a slightly later onset of late Holocene drying conditions. The hydroclimate reconstruction alludes to the complex interplay between temperature, rainfall, and evaporation in dryland lake environments and complements the two other studies from the region.

Despite the challenges of living in drylands, some 40% of the world's human population lives in these environments, and there is substantial archaeological evidence of human occupation in drylands since prehistory times. Two papers in this Research Topic volume investigate the human-environmental nexus in drylands. Von Suchodoletz et al. elucidate the substantial interplay between changing climatic conditions and human land use on landscape in the Shiraki Plain of the southeastern Caucasus during the late Bronze and early Iron Ages, highlighting a complex history made possible only through the combined application of multiple proxies, geochronology, and hydrologic modeling. Feng et al. focus on natural disasters, in particular locust plagues, over the last c. 1,400 years in semi-arid

northeastern China. This region hosts one of the longest written records of natural disasters and meteorological information, and the study identifies the spatio-temporal links between water resources, weather patterns, and locust plague outbreaks and their impact on people there.

This volume of the Research Topic "Environmental Change in Drylands" is the second and final in our Research Topic highlighting the diversity of novel approaches and insights which can now be obtained from dryland records.

Author contributions

KF: Writing–original draft, Writing–review and editing; ZL: Writing–review and editing; ZX: 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.

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