



## **Holocene reactivation of the Willandra Lakes lunette dunes, semi-arid southeastern Australia**

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The Willandra Lakes system in semi-arid southeastern Australia provides one of the most continuous, and longest, combined palaeoenvironmental and archaeological records on the continent. The lakes are a relict overflow system which were fed by runoff from the temperate highlands 800 km distant. During this time, the lakes experienced sediment deposition onto their downwind margins, forming transverse shoreline, or lunette, dunes, within which both archaeological and palaeohydrological information is preserved. The lunette stratigraphy of the Willandra Lakes reflects the environmental conditions of the headwaters rather than locally.

Following final lake retreat c. 15 ka, the lunettes of the Willandra periodically reactivated, experiencing erosion, aeolian redeposition, and alluvial sheetwash onto the lake floors. These reworked sedimentary archives consequently reflect local environmental conditions in contrast to the underlying stratigraphy. Despite the opportunity provided by these reactivated lunette sediments to investigate local Holocene palaeoenvironmental and human history, the focus of study in the region to date has largely remained on the late Pleistocene. The general paucity of information about this later period has contributed to a perception that people largely abandoned the area in favour of the perennial Murray and Darling rivers to the south and west.

Our study seeks to address the knowledge gap about palaeoenvironmental conditions and how people lived in the Willandra Lakes area over the most recent 15 ky, subsequent to final lake retreat. We examine post-lake depositional history at the south-central Lake Mungo and adjacent Lake Durthong lunettes with respect to the nature and timing of sediment reactivation. We integrate this dataset with analysis of types of human activity traces preserved in sedimentary units of different age and depositional environments, and with analyses of stone artefact scatters preserved in the post-lake units. This provides a basis for reassessing published archaeological and palaeoenvironmental datasets relating to this later time period. Our data conclusively show that people did not abandon the area as previously assumed, but continued to live and adapt their subsistence strategies to the changed environmental conditions. We find that the nature of sedimentation in the area is broadly in tune with Australian inland climatic conditions over the Holocene; aeolian reactivation peaked during more arid phases, and alluvial sheetwash was widely deposited on the lake floors during the mid-Holocene climatic optimum. We observe a distinct anthropogenic signature in the most recent 150 years following pastoral activity by Europeans in the area in the form of increased aeolian reactivation, which appears to have been aggravated by the 1940s drought. Our study underscores the necessity of integrating geomorphological and archaeological investigations over landscape scales in order to optimise our understanding of interactions between people and their environment through time.