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A 200,000-year record of late Quaternary Aeolian sedimentation on the Southern High Plains and nearby Pecos River Valley, USA

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ABSTRACT

Presently stabilized Southern High Plains (SHP) dune systems have been repeatedly re-activated during the past 200,000 years, providing an archive of environmental and related climatic change for the late Quaternary. Our data set of 38 optically dated samples from four different localities identifies eolian activity from late-middle Pleistocene to the historic period. Oldest eolian sediments are from the Blackwater Draw Formation and indicate accretion during late-middle to late Pleistocene. Younger sediments dating from the later Pleistocene through the Holocene are found in the Muleshoe, Lea-Yoakum, Mescalero, and Monahans dunes that overlie the Blackwater Draw Formation. Muleshoe dunes accreted during the Late Pleistocene between 31 ± 3 and 27 ± 2 ka, while Holocene deposition transpired 7.5 ± 0.4, 4.0 ± 0.7 ka through 3.6 ± 0.4 ka, and between 1.3 ± 0.2 and 1.1 ± 0.1 ka. A period of dune building for Lea-Yoakum dune sediments occurred during the late Pleistocene (48 ± 5 ka), and the later Holocene (3.6 ± 0.4 ka). Mescalero and Monahans dunes were accreting during the later Pleistocene between 29 ± 3 and 22 ± 2 ka followed by a sequence of eolian sand deposited ca. 15 ka. Holocene eolian sedimentation for the Mescalero and Monahans dunes occurred 7.5 ± 0.8, 5.1 ± 0.5, 4.3 ± 0.4, and 2.0 ± 0.3 ka. Historic eolian deposition is identifiable in the dune chronology with multiple optical age estimates overlapping established drought events recorded ca. 1890, 1910, 1920, and during the 1930's when the North American "Dust Bowl" transpired. These Quaternary eolian deposits mantling the Southern High Plains are an important component of the surficial material of the region and provide a rich archive of past climatic change.

1. Introduction

The late Quaternary landscape of the Southern High Plains (SHP) is primarily characterized by partially or completely stabilized eolian deposits (Gile, 1981; Holliday, 2001; Muhs and Holliday, 2001; Holliday and Rawling, 2006). These late Quaternary deposits, consisting of barchan, transverse, coppice and parabolic dunes, plus sandsheets, barchanoid ridges, and playa-fringing lunettes provide a terrestrial archive of episodes of aridity within this region and are an important element for understanding environmental change.

This paper extends both the spatial and temporal range of numeric data for eolian material blanketing the Southern High Plains plus portions of the nearby Pecos River Valley (Fig. 1) from the penultimate glaciation to the historic period. This chronology will assist in the reconstruction of the palaeo-environmental history of this region and also provide a basis from which previous approaches to relative age assessment and stratigraphic correlation can be evaluated.

Age control on Southern High Plains eolian deposits and adjacent Pecos River Valley dunes has primarily been determined from the ^{14}C dating of buried soils within the eolian deposits (e.g., Haynes, 1975, 1995; Hofman et al., 1990; Holliday, 1994, 2000; Holliday and Meltzer, 1996). This type of age control for eolian deposits based on radiocarbon dating has certain drawbacks. It is an indirect approach for estimating periods of soil formation within dunes and is limited to the last ca. 35 ka. The application of optical dating to eolian deposits provides a more robust approach for developing chronologies on Southern High Plains late Quaternary deposits and has previously yielded consistent age estimates on eolian sediments from this region and elsewhere (e.g., Feathers et al., 2006; Lian and Huntley, 1999; Mason et al., 2004; Hanson et al., 2009; Rich and Stokes, 2001; Rich et al., 2003; Stokes, 1992b, 1994; Stokes and Gaylord, 1993; Stokes et al., 1997; Stokes and Swinehart, 1997; Wolfe et al., 2002).

2. Study site

2.1. Regional setting of the Southern High Plains and present climate

The Southern High Plains is a large (~80,000 km^2), isolated and relatively featureless plateau, located in Eastern New Mexico and

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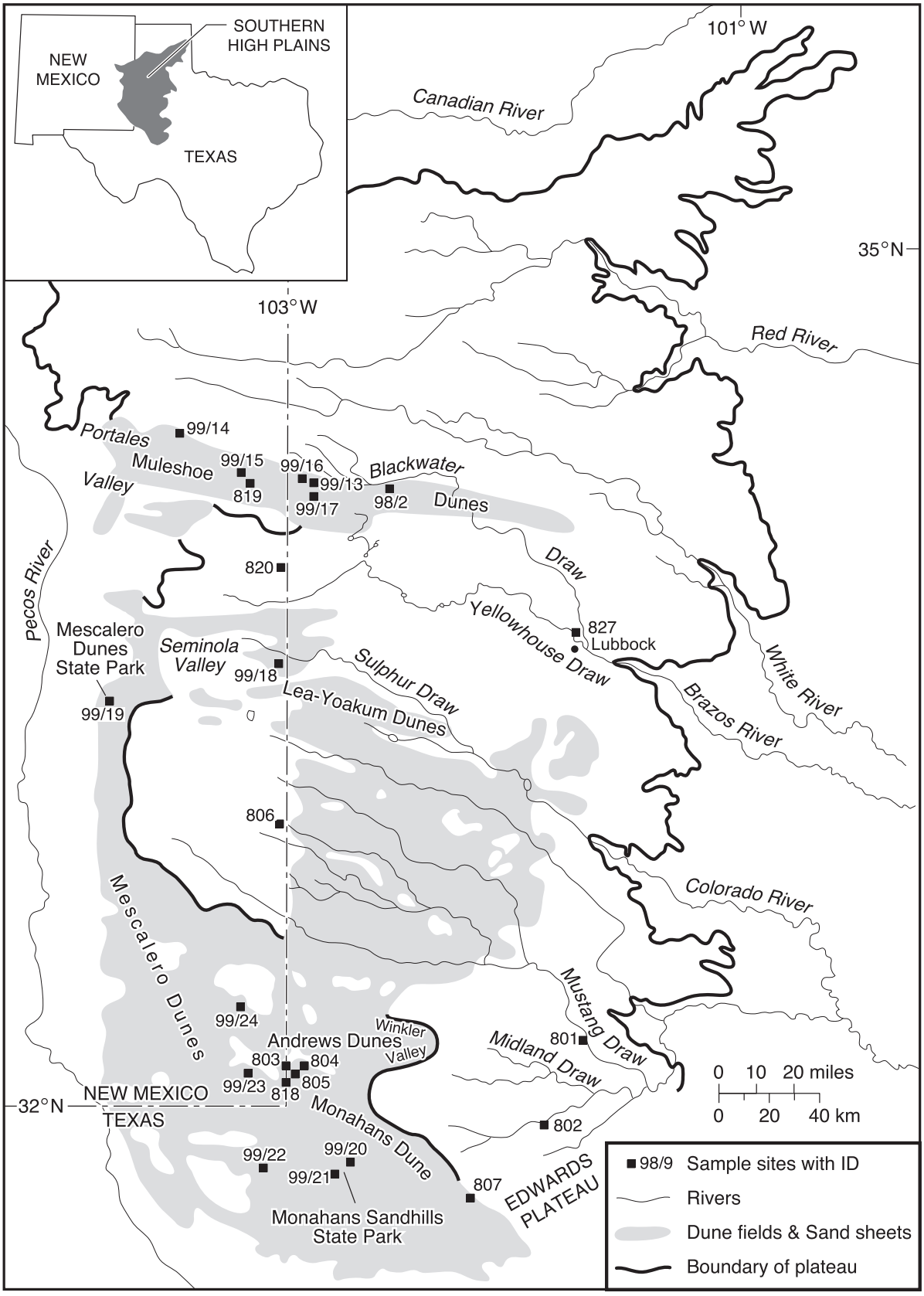

Fig. 1. The Southern High Plains. Aerial extent of recognized eolian systems is shaded (Modified from Holliday, 1995 and aerial photographs). Numbers represent sampling localities, which are described in detail within the text.

Northwest Texas (Fig. 1). The Southern High Plains surface is noted for its limited relief and topographic variation. On a NW–SE gradient, elevations range from 1700 to 750 m (1.8 m per km). This remarkably flat surface is interrupted only by playa basins, draws (dry valleys), and dunes with limited relief (~30 m maximum). The plateau is composed of sedimentary rocks and sediments of