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Synthesis on Quaternary aeolian research in the unglaciated eastern United States

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A B S T R A C T

Late-middle and late Pleistocene, and Holocene, inland aeolian sand and loess blanket >90,000 km^2 of the unglaciated eastern United States of America (USA). Deposits are most extensive in the Lower Mississippi Valley (LMV) and Atlantic Coastal Plain (ACP), areas presently lacking significant aeolian activity. They provide evidence of paleoclimate intervals when wind erosion and deposition were dominant land-altering processes. This study synthesizes available data for aeolian sand deposits in the LMV, the Eastern Gulf Coastal Plain (EGCP) and the ACP, and loess deposits in the Middle Atlantic Coastal Plain (MACP). Data indicate: (a) the most recent major aeolian activity occurred in response to and coincident with growth and decay of the Laurentide Ice Sheet (LIS); (b) by ~40 ka, aeolian processes greatly influenced landscape evolution in all three regions; (c) aeolian activity peaked in OIS2; (d) OIS3 and OIS2 aeolian records are in regional agreement with paleoecological records; and (e) limited aeolian activity occurred in the Holocene (EGCP and ACP). Paleoclimate and atmospheric-circulation models (PCMs/ACMs) for the last glacial maximum (LGM) show westerly winter winds for the unglaciated eastern USA, but do not resolve documented W and SW winds in the SEACP and WNW and N winds in the MACP. The minimum areal extent of aeolian deposits in the EGCP and ACP is ~10,000 km^2. For the LMV, it is >80,000 km^2. Based on these estimates, published PCMs/ACMs likely underrepresent the areal extent of LGM aeolian activity, as well as the extent and complexity of climatic changes during this interval.

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1. Introduction

Quaternary aeolian sand (predominantly sand-size, wind-deposited sediment) and loess (predominantly silt-size, wind-deposited sediment) blanket hundreds of thousands of square kilometers of the unglaciated land surface of the conterminous United States of America (USA). Numerous studies have focused on Pleistocene and Holocene inland aeolian deposits, and associated paleosols, in non-desert unglaciated regions of the country. Examples include loess studies in the northwestern USA (Busacca, 1991; McDonald and Busacca, 1992; Busacca and McDonald, 1994; Busacca et al., 2004; Sweeney et al. 2004); studies of sand and finer-grained aeolian sediment in the High Plains of the west-central USA (Muhs, 1985; Holliday, 1989, 2001; Muhs et al., 1999a; Muhs et al., 1999b; Arbogast and Muhs, 2000; Muhs and Holliday, 2001; Forman et al., 2001, 2008, 2009; Rawling et al., 2003; Miao et al., 2007; Muhs et al., 2008; Halfen et al., 2010, 2012), and loess studies in the eastern midcontinent (Fig. 1a) (Ruhe 1969, 1983; Barnhisel et al., 1971; Leigh and Knox, 1994; Follmer et al., 1986; Forman et al., 1992; Follmer, 1996; Grimley et al., 1998, 2003; Grimley, 2000; Hall and Anderson, 2000; Muhs and Bettis, 2000; Bettis et al., 2003a,b; Karathanasis and MacNeal, 2004). Most studies in the west-central and midcontinent areas of the country focused on inland aeolian deposits within the Mississippi River drainage basin (blue drainages on Index map for Fig. 1a), including loess deposits in the unglaciated Lower Mississippi Valley (LMV) (Figs. 1a and 2a). Studies of LMV loess date from Lyell (1847) and continue to the present (e.g., Russell, 1944; Wascher et al., 1948; Krinitzsky and Turnbull, 1967; Miller et al., 1985; Follmer, 1996; Rutledge et al., 1996; Rodbell et al., 1997; Markewich et al., 1998a,b; Grimley et al., 2003; Markewich et al., 2011b). Data from many studies of inland aeolian deposits in the unglaciated USA have been discussed and summarized in articles such as Lancaster (2000), Muhs and Zárate (2001), Bettis et al. (2003b), Busacca et al. (2004), Halfen

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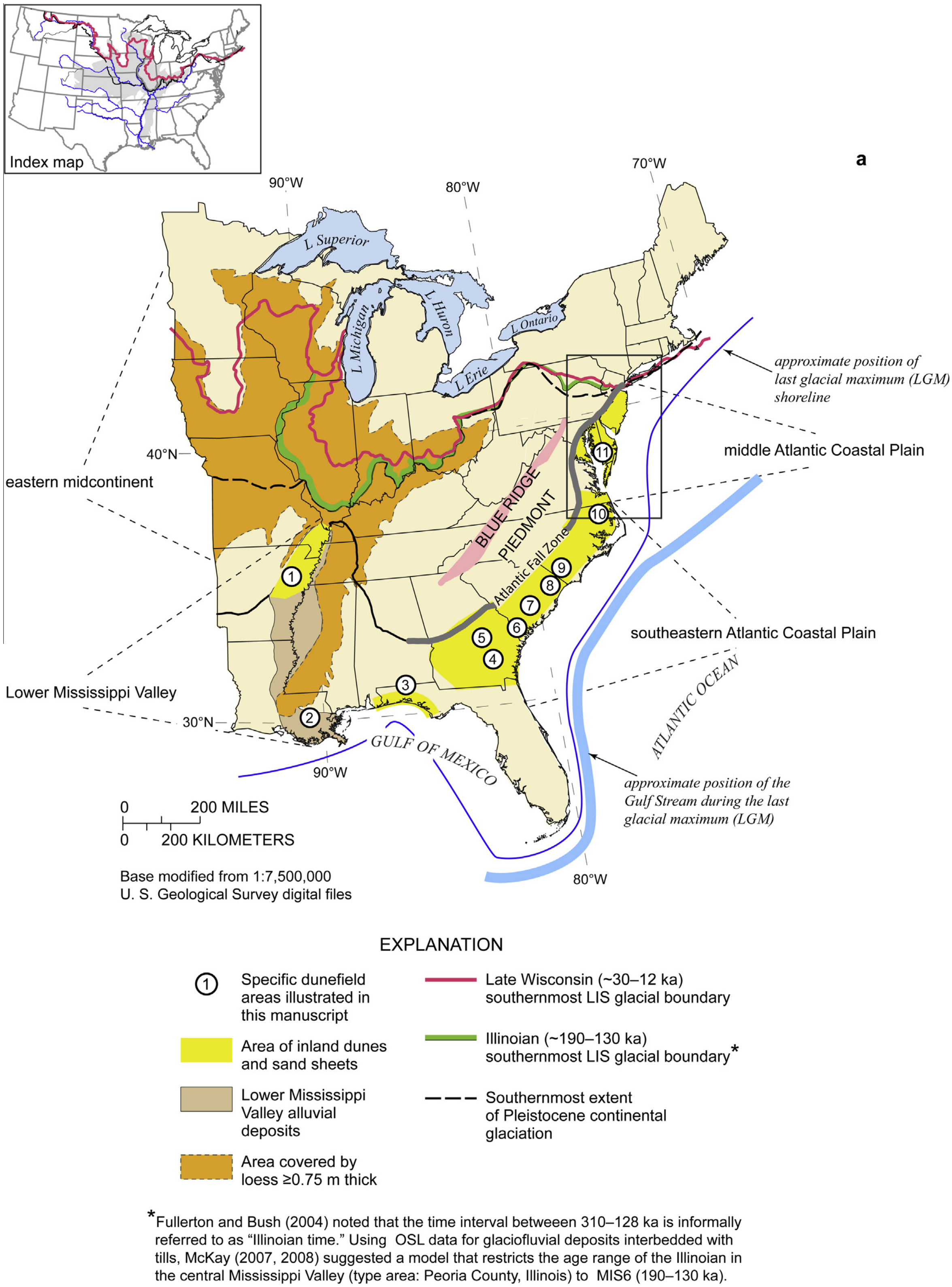

Fig. 1. Index map and location maps: (a) areas covered by loess (>0.75 m thick) and (or) aeolian sand dunes in the LMV and the eastern midcontinent, and aeolian deposits in the unglaciated eastern USA in relation to Pleistocene glacial maxima (extent), and the approximate position of the last glacial-maximum sea level; (b) enlargement of inset rectangle (the MACP) on (a); (c) enlargement of inset rectangle on (b); (d) named rivers in the eastern USA referred to in the paper (dark blue) or included for geographic reference (light blue). Rivers not included on (d) because of scale (e.g., Patapsco River, MD) are included on (b) and (c). Coastal Bays and Sounds are included on (b)–(d). Chesapeake Bay is the now-submerged Susquehanna River valley and its submerged tributary valleys (e.g., the Potomac River valley). The Atlantic Fall Zone on (a) marks the western boundary of ACP Cretaceous and younger unconsolidated sedimentary rocks with the crystalline metamorphic rocks of the Atlantic Piedmont. Place-name abbreviations on (b) and (c): BB, Butlers Bluff; BW, Brandywine; FL, Feldman loess; HP, High Point; HV, Hybla Valley; NW, Nottoway River. City abbreviations: ALEX, Alexandria, VA; ANN, Annapolis, MD; ARL, Arlington, VA; BAL, Baltimore, MD; D.C., Washington, District of Columbia. The Connecticut, Hudson, Delaware, and Susquehanna Rivers on (d) were meltwater conduits for the LIS. For state names, see Fig. 2b. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.) (See above-mentioned references for further information.)