Supporting Information

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SI Materials and Methods

Core Recovery and Logging. We first recovered 42 cores from the southern Everglades across water conservation areas (WCA)-3A and the Northeast Shark River Slough to obtain a general overview of the sediment stratigraphy of our study area (1). All cores were collected with a piston corer equipped with a polycarbonate core barrel (7.5 cm in diameter), which was able to recover the entire sedimentary sequence from the sediment/water interface to the underlying bedrock in a single drive (1). The soft near-surface sediment was first extruded vertically in 1-cm intervals from the top of the core barrel using a custom extruder described in the work by Glaser and Griffith (2). Each 1-cm slice of near-surface sediment was stored in a separate container. The remainder of the core containing the firmer sediment was next extruded horizontally, wrapped in plastic, and stored in PVC pipe for transport from the field.

All cores were scanned with a Geotek Multisensor Core Logger at the Limnological Research Center in Minneapolis, MN, to obtain values for wet bulk density by γ-ray attenuation. The cores were next split longitudinally into archive and sample sections and imaged with a color digital line scanner (RGB) at 300 dots per inch. Initial core descriptions were made on all of the cores using the methods described in the work by Glaser et al. (1). The general lithology of each core was initially determined by dispersing small samples of sediment with water in a Petri plate and identifying the major components with the aid of dissecting and compound microscopes.

On the basis of these initial core descriptions, we found evidence for paleodust indicators (e.g., large quartz grains) in many but not all of 42 cores recovered from our study area. We, therefore, selected the longest core with the most interesting stratigraphy for more detailed analysis (Fig. 1). This core also offered the best opportunity to obtain a reliable age model, despite the apparent problems caused by the hard water effect and contamination by fine rootlets (1). The core was recovered from a sawgrass (*Cladium*) ridge at 25.746° N and 80.583° W in the Northeast Shark River Slough of Everglades National Park.

Loss On Ignition and Pollen Analyses. Four complete sets of 1-cm^{-3} subsamples were collected from the Northeast Shark River Slough core for pollen analysis, loss on ignition (LOI), carbon elemental analysis, and analysis by X-ray diffraction (XRD) and X-ray fluorescence (XRF). All subsamples were extracted using a small open-mouthed plastic tube equipped with a graduated scale and a piston (1). The pollen samples were collected at 2- to 5-cm depth intervals and prepared by standard methods (3). Microscopic slides were prepared from these samples and counted under a compound microscope, and the results were plotted as percentages based on a sum of 300 pollen grains and spores. The LOI analysis followed the standard procedures first described in 1974 by Dean (4) to determine the relative fractions of organic matter, carbonates, and inorganic ash (remaining after ignition at 1,000 °C). The LOI samples were collected at 2-cm depth intervals and placed in glass vials before analysis. An analytical balance was used to determine the weight of (*i*) initial wet mass, (*ii*) dry mass after being left in a freeze-drier for 24 h to remove the water content, (*iii*) dry mass after ignition at 550 °C for 4 h to remove the organics, and (*iv*) dry mass after ignition at 1,000 °C for 2 h to remove the carbonates. All dry sample weights were determined after the samples had cooled in a desiccator and reached constant weight.

Elemental Carbon and Nitrogen Analyses. The third set of sediment samples was also collected at 2-cm depth intervals, dried for 24 h in a freeze-drier, weighed with an analytical balance, and then ground into a powder with a mortar and pestle for analysis of total carbon and nitrogen content using a Carlo Erba NC2500 elemental analyzer. Bulk samples were assayed in 5 × 9-mm tin capsules using an elemental analyzer and conventional methods (5, 6). Subsamples were assayed for total organic carbon in 5 × 9-mm silver capsules. Deionized water (50 μL) was dispensed into each capsule, and acid (HCl) was fumigated for 7.5 h in a sealed glass desiccators to decompose carbonates. Total inorganic carbon was calculated by difference, and total nitrogen was assumed to predominantly be in the form of total organic nitrogen. Concentration data were normalized to National Institute of Standards and Technology (NIST) 2710 and NIST 2711 soils (0.3 and 0.13 wt %N and 3.01 and 1.73 wt %C, respectively); fumigation efficiency was confirmed by spiking soil standards with pure CaCO$_3$. Precision was typically less than 0.5 and 1.0 wt % for N and C, respectively (5, 6).

XRD and XRF Analyses. Samples for mineralogy were freeze-dried for 24 h and then heated at 550 °C for 4 h to remove organic matter but preserve carbonate minerals. The samples were powdered and pressed as a 0.2-mm layer onto briquettes composed of Chemplex X-Ray Mix. The identical briquettes were analyzed for both quantitative mineralogy by XRD (Panalytical Xpert Pro) and elemental composition by XRF (Phillips PW-1480). By convention, elemental results were reported as normative oxides summing to 100% of the inorganic fraction excluding carbonate C (carbon is not detected by XRF): MnO, CaO, K$_2$O, SO$_2$, P$_2$O$_5$, Al$_2$O$_3$, SiO$_2$, Fe$_2$O$_3$, Na$_2$O, MgO, and TiO$_2$. Mineralogy was interpreted as mass percentages of the total crystalline fraction (both excluding and including XRF-estimated amorphous Fe and Al oxides) using search-match and reference-intensity ratios from the PDF-2 database (International Center for Diffraction Data); results were validated by the elemental concentrations. Selected splits of the same samples were gold-sputtered and examined with a Hitachi S-4000 scanning electron microscope, and energy-dispersive spectra were observed qualitatively, identifying C, O, Fe, Na, Al, Si, S, Cl, P, Mg, and Ca. The results of all analytical methods were corroboratory. The age model was based on eight accelerator mass spectrometry-14C dates of gastropod shells obtained from the Center for Mass Spectrometry at the Lawrence Livermore National Laboratory. A more complete description of the dating methods was presented in the work by Glaser et al. (1).

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SI Results

Pollen Zonation. The pollen stratigraphy has four distinct zones characterized by changes in the relative abundance of the principal local and regional pollen types (Figs. 5 and 6). The most important pollen boundary at 66 cm (between zones 2 and 3) coincides with the major change in lithology from calcite to organic matter (between Units II and III), whereas the other stratigraphic divisions are offset. Pollen zone 1 represents the cultural horizon with the post-World War II era (zone 1a) marked by the sharp rise in *Ambrosia* and other anthropogenic or disturbance indicators, such as *Eugenia*/*Melaleuca*, *Myrica*/*Casuarina*, *Rhus*/Anacardiaceae, and *Urtica*. Both zone 1a and 1b are

also distinguished by the decline in pine, which declines from 70% of the pollen sum at the base of zone 1b (29–13 cm) to 29% to the top of zone 1a (13–6 cm).

Pollen zone 2 (29–67 cm) is marked by the dominance of *Pinus* pollen (50–75%), with significantly lower concentrations of Amaranthaceae (<30%). This zone is also distinguished by the rise of *Myrica*, *Alnus*, and *Juniperus/Taxodium* pollen and the consistent occurrence of *Iva frutescens* and Tubilflorae. *Cladium jamacense* (sawgrass) and *Sagitaria* with lower abundances for *Nymphaea* and *Sparganium* are also consistently abundant.

In contrast, pollen zone 3 (66–85 cm) is marked by much lower values for *Pinus*, which range from 10% to 35% (except for a spike of 85% at 83-cm depth), and also, the dominance of Amaranthaceae, which is between 40% and 80% of the pollen sum. The local pollen is dominated by *Nymphaea* (water lily), with the consistent occurrence of *Cladium*, *Utricularia*, *Sparganium*, and *Sagitaria*. In pollen zone 4 (85–99 cm), *Pinus* is very low (<10%), whereas Amaranthaceae is the dominant regional pollen type, generally accounting for more than 80% of the pollen sum. *Juniperus/Taxodium*, *Celtis*, *Rhizophora*, and Arecaceae are present to the base of the core, and there is a significant increase in Poaceae. The local pollen types are dominated by sedges (Cyperacease), including *Cladium* and aquatic macrophytes (*Nymphaea*, *Utricularia*, *Sparganium*, and *Sagittaria*).

Microbially Enhanced Dissolution of Silicate Minerals in Peat. Silicate minerals may be subject to microbially enhanced dissolution in peat pore waters under certain conditions. Bennett et al. (7) first reported evidence for the in situ weathering of aeolian silt grains within a raised bog in northern Minnesota. The silicate minerals

had apparently blown in from the adjacent Great Plains and become embedded within the accumulating peat profile over several thousand years. Contrary to expectations, the greatest degree of weathering was observed in pore waters with a pH that exceeded 7 and had high concentrations of dissolved organic matter. A general model of mineral weathering in peat profiles was then developed with respect to calcite, aluminosilicates, and quartz for this peatland site (8). Both high pH and high concentrations of labile dissolved carbon compounds were considered necessary to enhance the in situ weathering of silicate minerals, even quartz. Bennett et al. (9) later extended this model by assuming that dissolution was driven by microbial communities scavenging for sparse nutrients, such as P or K. In addition, Welch et al. (10) showed that microbes enhanced the dissolution of apatite by several orders of magnitude when incubated in circumneutral waters with labile carbon substrates. These conditions would be expected in the southern and central Everglades, and the apparent preservation of the quartz may be a function of the size of the grains, their protective coatings of Al and Fe oxides (which would also obscure weathering patterns), or their lower P and K contents.

Although the C and N data have been processed successfully on a computer system at the US Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data on any other system, or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. The USGS shall not be held liable for improper or incorrect use of the data described and/or contained herein.

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Other Supporting Information Files

Dataset S1 (XLS)
Dataset S2 (XLS)