Summary of the Geology of Konza Prairie

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The Konza Prairie lies in the Flint Hills of eastern Kansas, a region of stream-dissected hills eroded from flat-lying to gently dipping limestones and mudstones (shales) of Permian and Pennsylvanian age. The Konza Flint Hills are an erosional landscape produced during millions of years of exposure to weathering and removal of the weathered rock by streams tributary to the Kansas River. The bench and slope topography in the uplands was created by the erosion of contrasting bedrock units -- resistant limestone layers alternate with less-resistant mudstone layers in a layer-cake pattern.

The Florence Limestone Member of the Barneston Limestone underlies the highest hills on the Konza Prairie and contains a large volume of weathering-resistant chert (flint), so chert rubble mantles ridge tops and slopes. The Florence is the youngest bedrock layer on Konza, and forms the drainage divide between Kings Creek and the streams in the southern and southeastern parts of Konza. Two older limestone units, the Shroyer Limestone and Threemile Limestone Members of the Wreford Limestone, also contain abundant chert. The Shroyer Limestone forms a broad bench below the Florence Limestone, which includes the drainage divide between Kings Creek and Shane Creek.

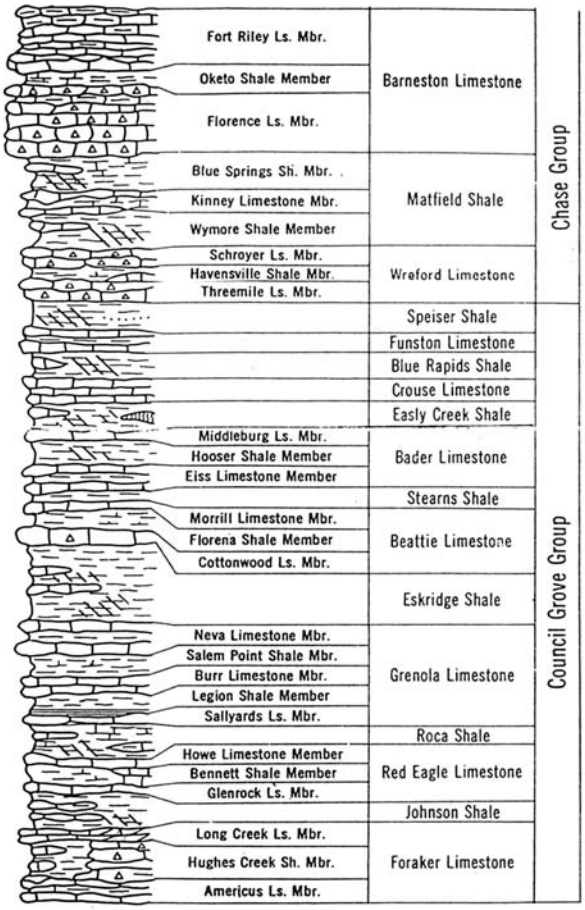
The lowest (oldest) bedrock unit exposed on the Konza is the Long Creek Limestone Member of the Foraker Limestone (one small outcrop in Shane Creek). The lowest prominent limestone is the Neva Limestone Member of the Grenola Limestone, which creates a shrub- and tree-covered shoulder at the base of the hills in the lower parts of Kings Creek valley. A number of springs issue from the Neva in the valley bottoms. Prominent bedrock units between the Neva and the Threemile include the Cottonwood Limestone, the Eiss Limestone, and the Crouse Limestone. The Cottonwood forms a conspicuous narrow bench colonized by numerous shrubs that take advantage of the groundwater that discharges from the fractured limestone and the protection from fire provided by the bare rock. The topographic bench formed by the Crouse Limestone is subtle in many places, but the Crouse weathers to distinctive flat plates and groundwater discharges from it in springs.

All the Permian limestone units were deposited almost 300 million years ago in, or near the margins of shallow interior seas, which fluctuated in depth and extent. Many of the mudstones, some of which contain ancient soils, were deposited during times when this region was not flooded by the sea. Some of the units that contain paleosols are: the Roca, Eskridge, Easly Creek, Blue Rapids, Speiser, and Blue Springs shales. Although no rocks of Cretaceous age are present at Konza, the sea finally retreated from the Kansas region by the end of the Cretaceous Period (65 million years ago). By about 5 million years ago, streams flowing eastward from the Rocky Mountains had beveled the gently dipping Permian rocks, from which the Flint Hills would later be carved. As the climate became drier and as glacial cycles began between about 3 and 2 million years ago, major rivers, such as the Kansas River, began downcutting, and their tributaries (including Kings Creek) dissected the rocks into hills and valleys. By approximately 700,000 year ago, when an enormous ice sheet covered all of Canada and the northern U.S. and extended into Kansas, the Flint Hills were beginning to look similar to the modern landscape.

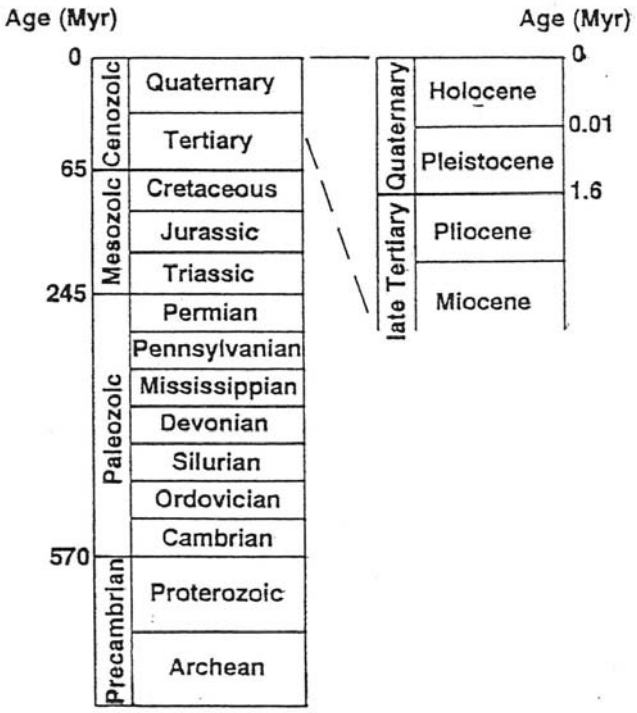
The southwestern limit of the ice sheet 700,000 years ago was about 15 miles northeast of the Konza Prairie, where the ice dammed the Kansas River, so glacial processes had no direct effect on the geologic evolution of the Konza landscape. During the 700,000-year-old glaciation, however, and possibly during the many other episodes of global glaciation during the last 2 million years when ice sheets advanced as far south as Nebraska and Iowa, processes associated with permafrost (permanently frozen ground), and extremely cold-dry conditions, were probably repeatedly active at the Konza Prairie.

Because the landscape is undergoing long-term erosion, surficial deposits are generally thin and relatively young, and accumulate in temporary storage sites, such as ridge tops and valley bottoms, before being transported away from the Konza to the Kansas River. The oldest known surficial deposits on the Konza Prairie are wind-blown silt deposits (loess) on upland ridges. The total thickness of loess is three or four feet, and it was dropped on the Konza during multiple episodes of dust deposition for at least the last 100,000 years.

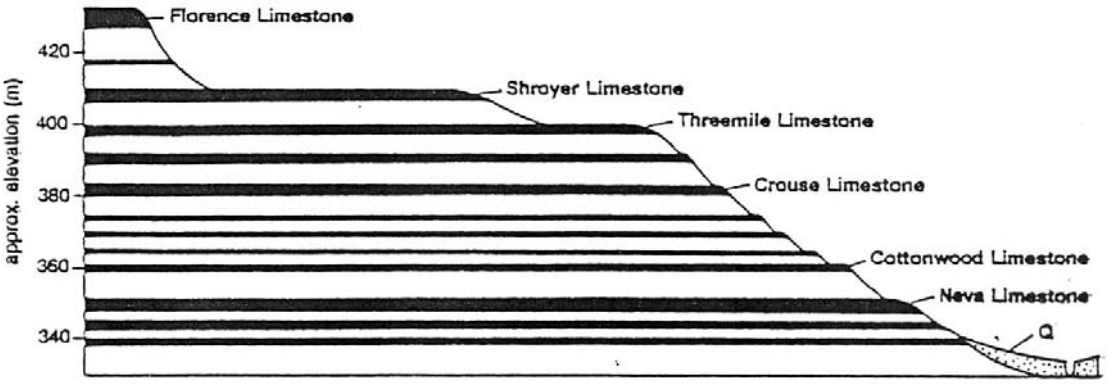
During the last 10,000 years, streams on the Konza have had a history of several periods of deposition and downcutting. Valley floors had been carved from bedrock to approximately their present levels prior to 10,000 years ago. Light-brown, fine-grained floodplain sediments that resemble reworked loess began accumulating in the Kings Creek valley by about 9,000 years ago and may have continued accumulating for several thousand years to fill in the valley floors to levels 15 to 20 feet higher than the modern stream. Soils formed in valley bottoms between 3,000 and 2,000 years ago, suggesting that at this time streams were not actively depositing sediment on their floodplains, and channels may have been entrenched and eroding. In lower Kings Creek the channel was entrenched about five meters below its former floodplain level, and by 1,800 years ago, more sediments had begun accumulating on the valley bottom. This second period of sediment accumulation was followed by another cycle of downcutting and accumulation (about 200 years ago) prior to the last downcutting event. Most streams are presently entrenched.



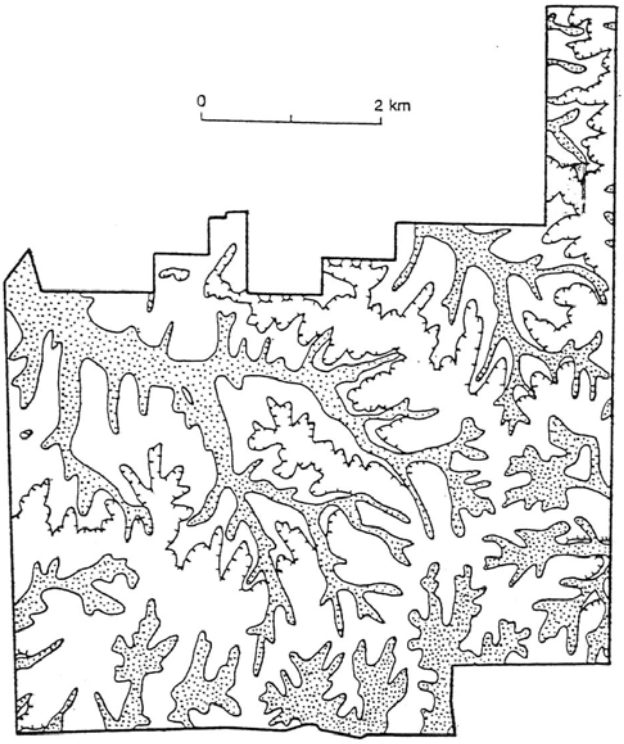
Permian and Pennsylvanian bedrock units on the Konza Prairie. The boundary between rocks of Pennsylvanian and Permian age (~300 million years) is at the base of the Bennett Shale.



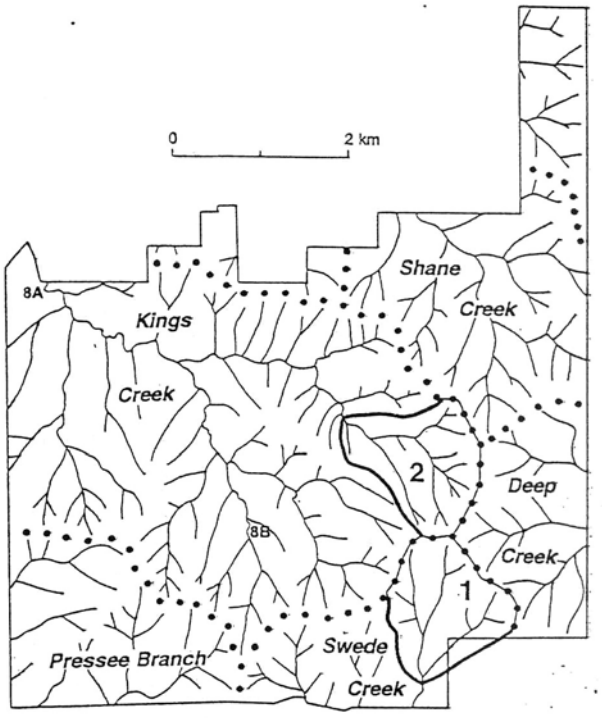
Geologic time scale, with ages given in millions of years (Myr). The Holocene is the last 10,000 years.



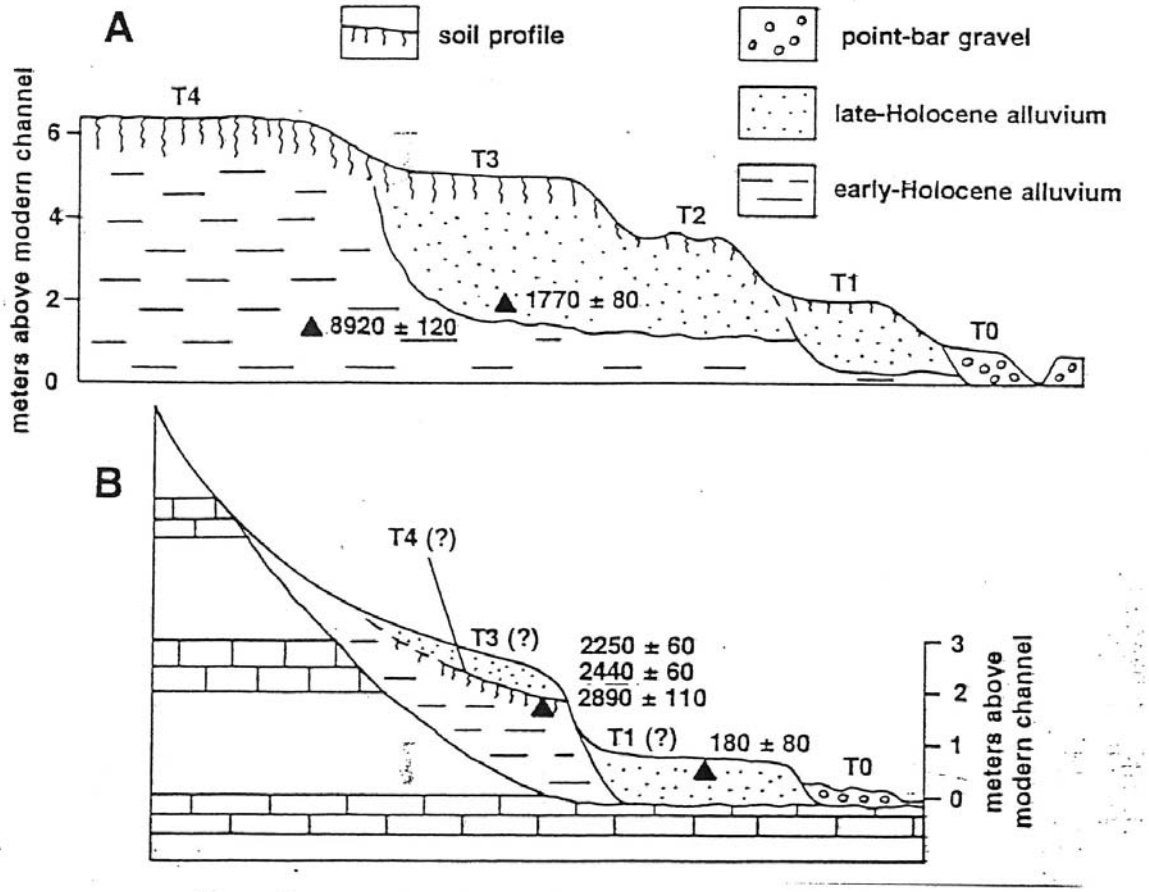
Cross section through a typical hill on the Konza Prairie. The limestones (in black) form benches, and the mudstones form slopes. Q marks valley-fill alluvium (stream deposits).



Simplified geologic map of the Konza. Stippled areas are Quaternary alluvium; white areas are Permian bedrock. The hachured line marks the outcrop of the Threemile Limestone.



Drainage networks on the Konza Prairie. Dotted lines represent major drainage divides.



Schematic cross sections showing alluvium and terraces in Kings Creek valley. A. Lower Kings Creek Valley. B. Upper Kings Creek (N4D watershed). Triangles mark radiocarbon ages.

Cross sections of alluvium (stream deposits) and terraces in Kings Creek valley. The locations of the cross sections (A and B) are shown on the map of drainage networks (labeled 8A and 8B). Terraces are labeled in order of increasing age (T0 is youngest, T4 is oldest). Triangles mark samples dated by radiocarbon, and the ages are given in years before the present.

some references:

Smith, G.N. 1991. Geomorphology and geomorphic history of the Konza Prairie Research Natural Area, Riley and Geary Counties, Kansas. MS thesis, Kansas State University. 121 pp.

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