The Evolution of Stream Valleys in the Flint Hills

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Kansas Geological Survey

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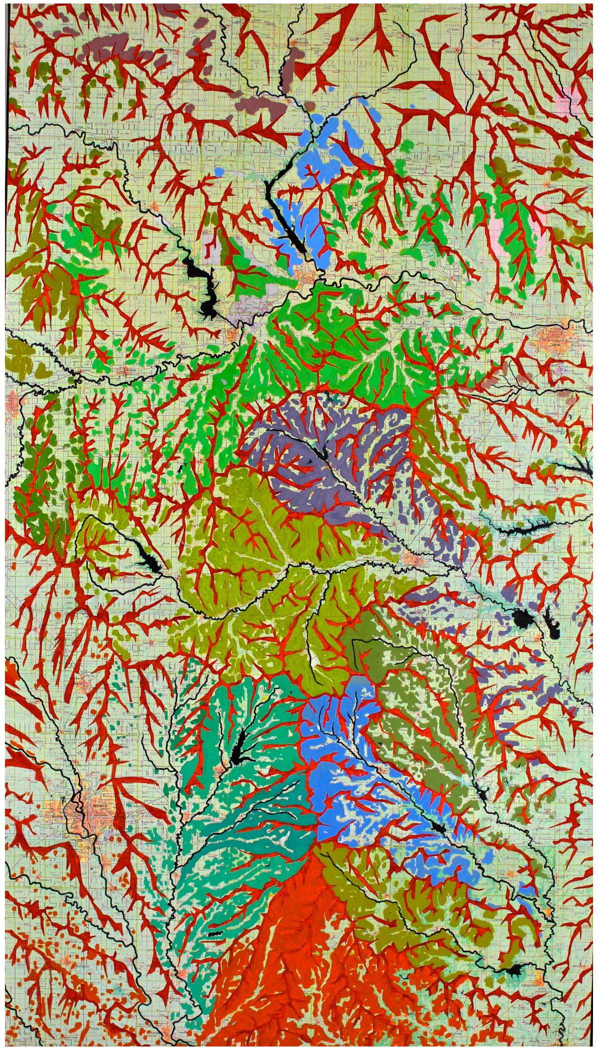


Flint Hills - grass, ridges, watersheds
Bill McBride

THE EVOLUTION OF STREAM VALLEYS IN THE FLINT HILLS

One of my favorite books is Norman Maclean's semi-autobiographical novel, *A River Runs Through It.*

Maclean was fascinated with Montana's Big Blackfoot River and streams in general, and he was masterful at weaving them into metaphors:

> *Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great flood and runs over rocks from the basement of time. On some of those rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs. I am haunted by waters.*

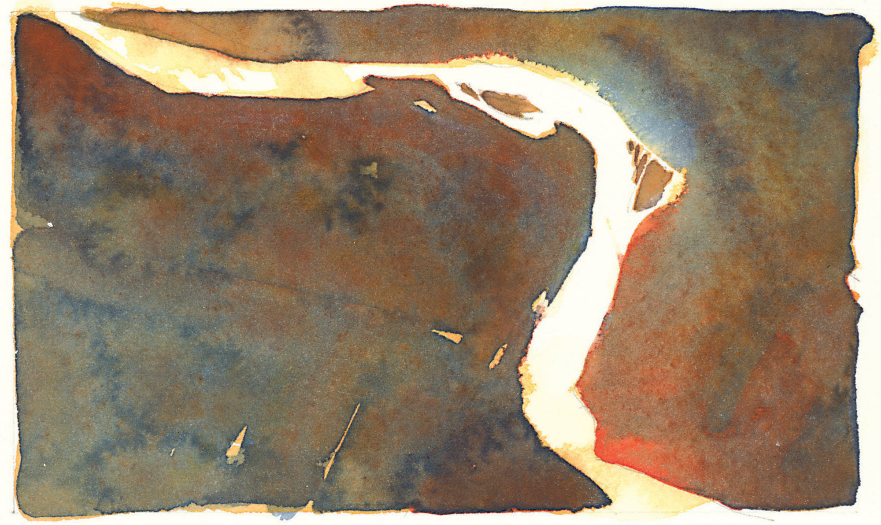
I am also fascinated with rivers but in a different way. For the past forty years I have studied the evolution of individual stream valleys, as well as entire drainage basins, and much of my research has focused on rivers and creeks in the Flint Hills. I am especially interested in how stream valleys evolved in response to climate change since the end of the Ice Age (Pleistocene) about 12,000 years ago, and the effects of landscape evolution on the oldest part of the archaeological record. Stone tools, hearths, and animal bones left by the first Native Americans to inhabit the Flint Hills are often deeply buried in stream valleys.

The Flint Hills have a long history of water. During the Permian period, which lasted from about 299 to 251 million years ago, the region was a shallow, tropical ocean. The rocks that comprise the Flint Hills, mostly limestone and shale, are products of deposits that accumulated at the bottom of the ocean. The rocks form the prominent stair-step topography that is a signature of the Flint Hills landscape. Water continued to be an important part of the story of how that landscape, and particularly the stream valleys, evolved long after the ocean receded.

Ten major rivers – the Smoky Hill, Kansas, Big Blue, Little Blue, Verdigris, Neosho, Cottonwood, Elk, Caney, and Walnut – flow through portions of the Flint Hills. Hundreds of creeks feed these rivers, and springs and seeps emanating from the bedrock are important sources of water in the creeks and rivers.

So how have I been able to unravel the evolutionary history of stream valleys? I am a geomorphologist, so I have taken a geological approach to assembling the pieces of the puzzle. My field investigations have mostly involved studying tall cutbanks, also known as river cliffs. Cutbanks are formed by erosion as a meandering stream channel collides with its banks. The cutbanks are my windows into the past; they expose deposits beneath floodplains and stream terraces. The latter are created when stream channels cut deeply into their valley floor, leaving remnants of older floodplain surfaces as step-like benches along the margins of the valley.

I typically use a hand shovel to clean the face of a cutbank from top to bottom, a process that can take a day to complete. Then I describe the soils and stratigraphy of the stream deposits (alluvium). Thick, dark layers are common in the alluvium and often represent buried soils. The buried soils, which are important stratigraphic markers, formed when sedimentation temporarily ceased on the valley floors. Also, carbon extracted from the buried soils can be radiocarbon dated, thereby allowing me to reconstruct the timing of landscape stability. If I am lucky, organic mats containing plant remains are preserved at the bottom of the cutbanks. Even luckier if charcoal lenses or ancient animal bones occur in the overlying alluvium. The organic mats and charcoal lenses are evidence of previous logjams and prairie fires, respectively. Sometimes human artifacts and archaeological features, such as hearths, are exposed in the cutbanks. The hearths often contain wood charcoal and burned bone, as well as the charred remains of plants that were cooked by Native Americans. I send



Kaw-Overhead
Lisa Grossman

plant remains, bone, and charcoal to a laboratory to determine the radiocarbon age of the material. The resulting suite of radiocarbon ages provides a chronology that forms the basis for reconstructing the evolutionary history of stream valleys in the Flint Hills.

To gain access to the cutbanks, I knock on the doors of many ranchers and farmers in the Flint Hills and explain my mission. Although some seem puzzled about my interest in the development of these stream valleys, and a few are slightly suspicious of a stranger asking for permission to walk up and down streams on their property, all generously allow access to their land. In fact, some of the landowners became engaged in my effort, often leading me to the best cutbanks and pointing out bones or logs sticking out of the alluvium. Many of them share my interest in the ancient history of the landscape and are eager to know the results of my research.

So what have I learned? I am certain that during the Pleistocene, the floodplains of streams in the Flint Hills were thirty to forty feet higher than the modern floodplains. Remnants of alluvial terraces perched high in valley landscapes represent those ancient floodplains. Around 14,000 years ago, near the end of the Pleistocene, the streams went through a major episode of incision, cutting through the Pleistocene alluvium and deep into the bedrock. From about 13,000 to 4,500 years ago, as the climate became warmer and drier, small creeks actively downcut and meandered, thereby eroding their valleys. Sediment transported out of those valleys often accumulated in the valleys of large creeks and rivers. Buried soils in the alluvium of large creeks and rivers indicate two major episodes of landscape stability: one about 7,000 years ago and the other about 5,000 years ago. As the climate became cooler and wetter 4,500 to 4,000 years ago, another major episode of stream incision occurred in the Flint Hills and was followed by multiple cycles of sedimentation and incision until the arrival of Euro-American settlers in the Flint Hills during the 1850s.

Since the 1850s, as settlers broke the sod, cut timber, and introduced cattle to the Flint Hills, erosion increased on the fragile upland landscape; gullies formed and stream channels incised because of the increased runoff that resulted from reduced grass cover. Sediment that washed off the uplands accumulated as "post-settlement" alluvium on the valley floors and buried some of the most productive soils in the region. Sedimentation in the stream valleys remains a problem today.

As far as I know, Norman Maclean never visited the Flint Hills. But I am certain that the clear, spring-fed streams would have enchanted him. Those streams, like Montana's Big Blackfoot River, flow over rocks from the basement of time and harbor many secrets. I have done my best to unwrap those secrets, but many more remain hidden in the sediments. Sometimes during late afternoons when the light begins to fade as I walk along creeks and rivers in the deep valleys of the Flint Hills, I forget about science. And I understand why Maclean envisioned similarities between a meandering thread of flowing water and the path of life.

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Lisa Grossman