Rocks Of The Flint Hills

Tracey Graham

The Field Journals are made possible in part with funding from the Fred C. and Mary R. Koch Foundation.

Two Rocks
Steve Snell

ROCKS OF THE FLINT HILLS

If you were in Wabaunsee County 250-plus million years ago, you'd be standing on a nearly flat surface of gooey mud.

Over millennia, this surface was sometimes covered by shallow seas, and sometimes the seas drained away so this muddy surface was intermittently exposed to the air in a tidal flat or lagoon setting. At other times, this surface was above sea level full time as a land surface.

From 290 million through 250 million years ago, this area was far from any kind of active mountain building. The ancestral Rockies were more than 300 miles to the west, and the Ouachita and Wichita uplifts were about 300 miles to the south. Here the seas rose and fell on the Craton—a nearly flat surface of ancient rocks eroded down from previous episodes of mountain building.

The entire continent began this time period very near the equator and underwent a long-term climatic change from humid to arid, coinciding with the northward drift away toward its present position. Superimposed on this general trend were regular, repeating, global-scale climatic changes that caused changes in environments, which caused changes in the types of sediments deposited. Over a span of more than fifty million years, repeated warming events raised sea levels, and cooling events caused sea levels to fall due to glaciation at the poles.

The different environments—shallow seas, tidal flats, lagoons, and subaerial land areas—supported wide varieties of living organisms. Invertebrate animals, fishes, and plankton were abundant in the shallow seas. Different invertebrates, fishes, and plants that could thrive in alternately salty and fresh water lived in the tidal flats and lagoons. Land plants and animals lived here during their respective periods. When these organisms died, their soft, squishy parts generally decayed and were recycled into other organisms, and the “hard parts” (shells, teeth, bones) became sediments.

During the warm periods, the sediments were mostly the shells of living things that lived either floating in the water or on the seafloor itself. The majority of these shells are made of the mineral calcite. Some were large enough that you can see the fossils today—brachiopods, bryozoans, corals, fish teeth, etc. Some were shells and skeletons of tiny, even microscopic, planktonic plants and animals, which settled to the seafloor to make up a calcite mud, which geologists call (technical term coming up here … get ready …) ooze.

A smaller number of planktonic organisms made their shells out of silica. Silica is what the very hard mineral quartz is made of and is also the primary component of glass. These tiny critters lived in the water column and settled to the sea floor, adding to the ooze. In addition, some sponges built silica structures which also added to the ooze.

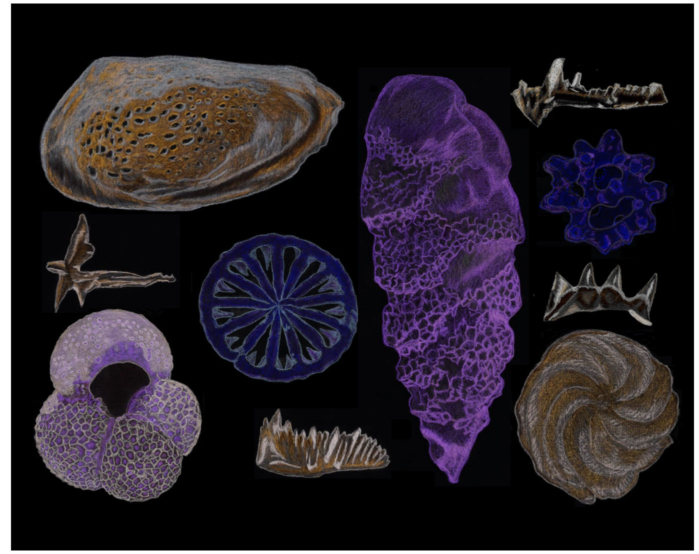
During the colder periods, when sea levels were low because water was tied up in glaciers, the sediments deposited here were mostly clays, blown here by winds from distant areas that were above sea level.

All told, we had an alternation between deposition of ooze (calcite and silica) and clays over time, and those conditions were the same over a very large area for significant spans of time before changing again. Each of the rock layers that you can see today is a reflection of each of those periods of deposition.

As more sediments were added to the top of the pile, the lower sediments were squeezed and compressed, turning into rocks. Clay became mudrock, or with more compression and some recrystallization, shale. As the water between the sediments was squeezed out, much of the calcite and silica in the ooze recrystallized. Because calcite has an affinity for calcite, and silica has an affinity for silica, the rocks formed from these layers of sediments were mostly limestone (made from calcite) with nodules of chert (made from silica) within it.

Limestone, especially limestone with a lot of chert in it, is harder than shale, so it forms cliffs. Mudrocks and shales erode very easily, forming gentle slopes. This differential erosion causes the stair-step pattern seen throughout the Flint Hills, as modern streams erode the surface.

Although limestone is harder than mudrock and shale, it is soluble, so water can migrate through it very easily, and many limestone layers have developed caves and solution cavities. Thus, these alternating layers of rock types are also responsible for the thousands of springs found throughout the Flint Hills. Rain falling on the surface infiltrates the soil and moves down through the limestones until it hits an impermeable

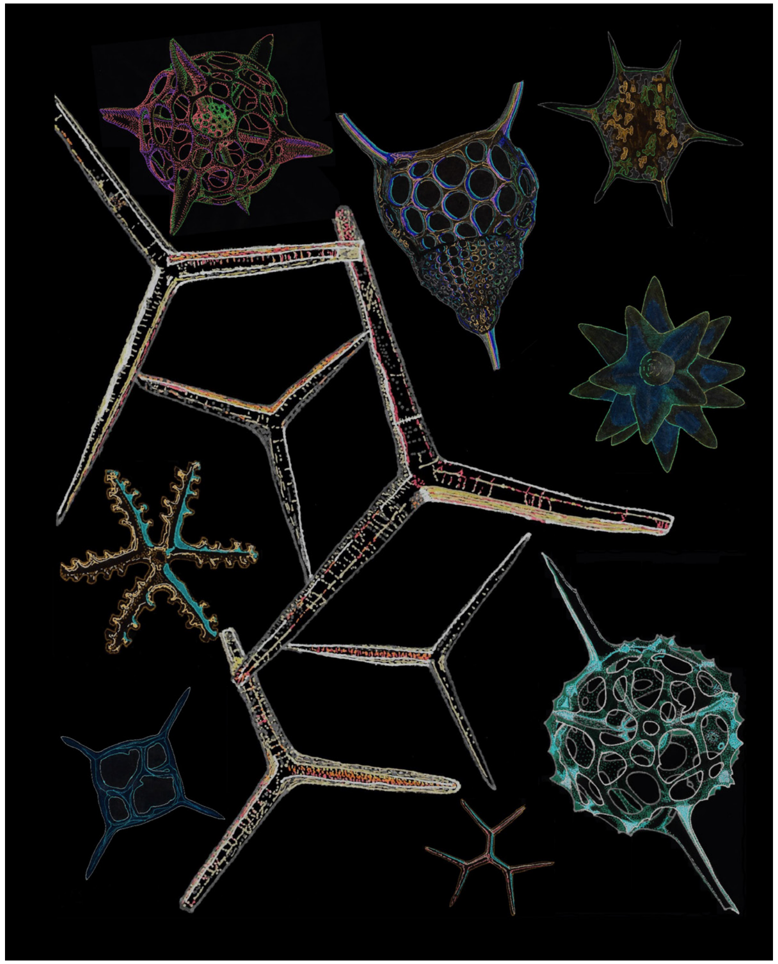


Ooze I: Forams and Friends
Tracey Graham

shale layer. The water then moves sideways above the shale until it finds a way out. This is why springs are common at the interfaces between limestones above and shales below.

The sediments that now comprise each of the individual rock layers were deposited at roughly the same time over nearly all of Kansas, Oklahoma, and Nebraska. When the climate changed, the sea level changed, so the type of deposition changed and different rock layers resulted. When the climate changed again, deposition changed again, etc.

Each distinct layer is given a name, based on where it was first described in the geologic literature. For example, the Matfield shale that is exposed throughout much of the Flint Hills was first described near Matfield Green. The younger Barneston limestone, also exposed throughout the hills, was first described near Barneston, Nebraska. Everywhere throughout the Flint Hills, the younger Barneston limestone is always found above the older Matfield shale. Below that is the older Wreford limestone. Above is the younger Doyle shale, and so on. Each layer is named for the town nearest where it was first identified and described but is found over a very large region.



Ooze II: Flint Hills Forerunners
Tracey Graham

Anywhere in the Flint Hills, you can read the geologic history in the topography. Each gentle slope you see formed on one of the shale layers and represents a period when the climate was cool, glaciation was strong, and Kansas was mostly above sea level. The steeper slope breaks and cliffs of limestone layers represent warm inter-glacial periods when Kansas was covered by seas. During those warm periods, calcite-forming organisms were abundant, so limestones are the resulting rocks. During some of those warm periods, conditions also favored the development of silica-forming animals, so the limestones contain significant amounts of chert. Another name for chert is flint. Flint Hills … get it?

Over time, as limestones have dissolved, lag deposits of chert nodules were left behind. Some of the limestone layers are particularly flinty (contain a lot of the chert), and in areas where erosion has removed the layers above those layers, we get very stony rock surfaces. These surfaces can be difficult to walk on without turning an ankle, but they have protected the Flint Hills from the plow and extensive development. So, when you are relaxing and enjoying the spectacular views of this last remnant of the once-vast tallgrass prairie, take a moment to thank the siliceous planktons and sponges of long ago for making all this possible today.

Tracey Graham earned her PhD in Earth and Planetary Sciences at the University of New Mexico. Tracey is active as a caterer, fiber artist, local food advocate, Qigong trainer, and volunteer.

A FLINT HILLS HAIKU

Siliceous sponges
And radiolarians
Keep the Flint Hills free