A GEOLOGIC WALKING TOUR

OF TURNERS FALLS
MASSACHUSETTS
The very beginning: A marriage of land masses. The geological story of Turners Falls begins about 250 million years ago, when all the continents on Earth had joined to form one large supercontinent called Pangea. Three hundred million years in the making, Pangea was an assemblage of six to ten ancient continents that collided and fused together. This supercontinent was so huge that its northern and southern edges reached Earth’s northern and southern poles.

Moving on: The land masses separate. This union of continents did not last long, geologically speaking. Around 245 million years ago, Pangea began to crack or rift apart. Fragments that would become Europe headed east, and those that would become Africa headed south. The basin between North America, Europe, and Africa became the North Atlantic Ocean. Pangea is still breaking up. To this day, the floor of the Atlantic Ocean continues to spread about one inch each year.

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Left in the rift. The little village of Turners Falls lies roughly in the middle of an extensive rift valley that spanned Pangea’s heart. In this rift valley (called the Newark Superbasin), we can see evidence of both the violent volcanic eruptions that heralded Pangea’s breakup and the mild periods of river and lake formation that followed. And we can read the story of the rifting in the composition of rocks found from Nova Scotia to South Carolina.

A lot of geology in a small place. Downtown Turners Falls offers a unique opportunity to see examples of all these features in a very small, easily walkable area. Let’s get started!
A GREAT RIFT RUNS THROUGH IT: RIVER AND ROCK OVERLOOK

Great Falls Discovery Center

Your geologic walking tour of Turners Falls begins at the three-dimensional model in the lobby of the Great Falls Discovery Center, an interpretive museum of the Connecticut River watershed. (A watershed is an area drained by a river.) The Great Falls Discovery Center is a community partnership in natural history and environmental education sponsored by the Silvio O. Conte National Fish and Wildlife Refuge, the Massachusetts Department of Conservation and Recreation, and the Friends of the Great Falls Discovery Center.

THINGS TO SEE

Valleys old and new. A prominent feature of the watershed model is the Connecticut River Valley, a remnant of that great rift valley that once spanned Pangea over 245 million years ago. Looking at the model, you'll see that the modern-day valley extends geographically from the northern tip of New Hampshire to Long Island Sound.

Pangea breaks apart and the land changes. The heating of rock deep within the Earth caused tremendous geologic forces that pulled Pangea apart. Those forces produced the depositional environment that formed the valley now cradling the Connecticut River. (A depositional environment is one in which sediments settle out of water.) Prodded loose by water and perhaps earthquakes, rock and sediment from ancient highlands to the west and east began to pour into the rift valley. As the valley sank under this heavy load, the surrounding highlands regained their relative elevation. This, in turn, resulted in more erosion and sediment buildup. This process went on for tens of millions of years.

THINGS TO KNOW

Valley sinks down, sediments pile up. As the heavy sediments sank, the southeastern flank of the valley slipped deeper than the northwestern flank. Sediment gradually filled the valley in overlapping deposits called alluvial fans. Eventually, the sediment filling the valley reached a thickness of up to 6,500 feet and, under the pressure of burial, turned to rock. Today, these southeastern-dipping rocks (called the Turners Falls “red beds”) form sandstone ridges that extend through Turners Falls and Montague until they disappear underground near the Montague/Sunderland town line.

Rifting helped the river grow. The pulling apart of Pangea caused long north-south cracks to form in the ancient rocks that underlie the valley. Over millions of years, those north-south cracks enabled the development of the Connecticut River, which flows north to south through the valley, from the New Hampshire/Quebec border to the Atlantic Ocean via Long Island Sound.

A hard right turn. Notice on the model how the river turns abruptly east at Middleton, Connecticut, before heading south to tumble into the Atlantic at Old Saybrook. The river takes that sudden turn because the basalt (or cooled lava) rock ridges west of the river—a remnant from the violent volcanic break up of Pangea—are too hard for the river to break through.

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Step outside the Discovery Center lobby, head down the driveway that runs along side the Great Hall as you face the building, and continue toward the footbridge over the Power Canal. Cross the footbridge and walk to the grassy area under the power lines overlooking the river.

A GREAT RIFT RUNS THROUGH IT: RIVER AND ROCK OVERLOOK

View of the Connecticut River below the dam at Turners Falls

Water has been an immensely powerful force in sculpting Turners Falls and the Connecticut River Valley ever since Pangea's breakup began forming our rift valley 245 million years ago. Streams and rivers moved down the ancient mountains, sometimes at tremendous speed, but always, no matter their speed, wearing down the rock and carrying the resulting sediments into the valley. The continuous process of erosion and deposition is still forming our landscape.
falls, except for one thing: In 1798, the Great Falls was dammed to construct a navigational canal. The canal and nine locks allowed riverboats to travel from Long Island Sound up the Connecticut River to Vermont. In the 1860s, the industrialists who founded Turners Falls rebuilt the canal and dam to provide power for their factories. Today, the dam and its canal generate electricity for everyone in the valley. Were the Great Falls not dammed, we would see a waterfall drop of about 40 to 50 feet—a reminder that water is still cutting and breaking down rock as it has for hundreds of millions of years.

Walk back to the footbridge and up the driveway, turn right and head into the courtyard near the entrance to the Great Hall of the Discovery Center.
An ancient alluvial fan: the Sugarloaf Arkose

**THINGS TO SEE**

So much of our valley (like much of the ancient east coast of North America) has disappeared as a result of erosion that it’s hard even for geologists to visualize the landscape in and around Turners Falls as it was around 200 million years ago.

But these reddish rocks (called Sugarloaf arkose) document what must have been going on. Alpine-scale mountains to the east were being quickly eroded by monsoon-like storms. Mountain stream waters, containing huge amounts of rocky sediment, poured into our ancient valley. We know this by the streambed features and the large, angular pebbles and small boulders you see in these big red rocks.

**THINGS TO KNOW**

These rocks come from points west of Turners Falls, mainly from the Greenfield area. The streambed deposits from which these red rocks formed were very thick—over a mile in some places. Mt. Sugarloaf (in South Deerfield) consists entirely of Sugarloaf arkose.

We call the rocks that formed from these sediments arkosic sandstones (named for the angular pebbles and coarse sand they contain) and conglomerates (conglomerations, or mixtures, of large but rounded pebbles and cobbles).

These are exactly the materials we expect to see when the sediments from nearby mountains have been aggressively eroded. Mountain stream sediments like these are being deposited today in areas such as Death Valley. We call these deposits alluvial fans.

Walk south across the Discovery Center parking lot to 2nd Street. Walk around the block to the corner of 3rd and Canal Streets.

Tiny crater-like depressions in this rock are 200-million-year-old raindrop impressions.

**THINGS TO KNOW**

A different climate. Back in the Jurassic, Turners Falls was near the equator, so the noon sun was directly overhead and very bright. Our climate was tropical to semi-tropical, and, because this was a rifting or sinking valley, a shallow lake periodically flooded much of our area.

In fact, the whole Earth was warmer in the early Jurassic than it is now. As with the present-day climate of Costa Rica, summer rains were likely short but intense. The hot sun would quickly dry the fine muddy lakeshore, leaving large mud cracks—like those we can still see today on mud flats in many regions of the world, from Utah to eastern Africa. Once in awhile in those ancient days, afternoon showers would pummel the lakeshore and sometimes these showers left behind tiny raindrop impressions.

**THINGS TO SEE**

As you look at the large rock near the side door in the Discovery Center's inner courtyard, you'll see many small impressions, the size of a dime or smaller. These are the remnants of raindrops from a summer day in the Jurassic period, 200 million years ago.

How did the raindrop impressions form? Because the warm sun would quickly dry these impressions to a solid or semi-solid state, they were not washed away when the lake water rose. Instead, when more rains would come, the lake waters brought more fine mud that buried the impressions a few fractions of an inch beneath the water surface. Like a photograph from the early Jurassic period 200 million years ago, the raindrop impressions in this rock record a moment in the history of the Earth.

**THINGS TO KNOW**

Walk to the Rock Garden in the middle of the Discovery Center grounds.
DIPAOLO’S BREAD LOAF ROCK: ANCIENT ROCK EVEN WHEN DINOSAURS ROAMED OUR VILLAGE

Bread Loaf Rock sits in its corner at DiPaolo’s.

THINGS TO SEE
Ensconced in the corner of the restaurant’s outdoor dining area, you’ll see a loaf-shaped object that serves as a bench for waiting customers. Carved by Turners Falls artist Tim De Christopher, Bread Loaf Rock is formed from one of the oldest of all the rocks in Turners Falls: a 345-million-year-old limestone from Bloomington, Indiana. Bread Loaf Rock was ancient even when the dinosaurs roamed our village!

If you have an opportunity, look closely at the rock and you’ll see innumerable tiny marine fossil shells.

THINGS TO KNOW
The tiny fossil shells in the Bread Loaf Rock tell us the environment in the Midwest approximately 345 million years ago: a warm, shallow sea, such as we may find today off the Florida Keys. Eventually, this ocean (called Panthalassa) became the Pacific Ocean when Pangea broke up 245 million years ago.

Walk on to Peskeomskut Park on Avenue A between 6th and 7th Streets.

PESKEOMSKUT PARK: A PLACE TO EXPLORE

View of the southeast-dipping rock outcrop along J Street.
One of a pair of ginkgo trees at the corner of Avenue A and 5th Street

**THINGS TO KNOW**

Once abundant in the Triassic and Jurassic periods around the world, the ginkgo almost went extinct about 5 million years ago, except for a small area of central China where the modern species survived.

Ginkgos are called living fossils. What does it take to earn that moniker? Like the famous coelacanth fish, you need to be a member of a mountain of ice and snow 1 to 2 miles thick and the size of a continent covered Canada and the northern states of the U.S. from about 1.6 million to 25,000 years ago. This continental glacier did not remain static but grew and shrank as climate cooled and warmed over this period. New England experienced at least four of these glacial advances and retreats over the past 1 million years. Only the last, called the Wisconsinan, left much of a trace.

As the glacier moved south into Massachusetts, its southern margin fanned out into lobes bulging southward. Unimaginably heavy, these ice sheets scoured the landscape down to the bedrock. If boulders were lodged at the base of the ice sheet, the glacier would drag them over the bedrock, scouring it with grooves that geologists call striations. Even without boulders, the pressure from the ice alone could smooth and polish the rocks, as if they were gems in a jeweler’s shop.

Go back down the stairs to Avenue A and walk to the corner of 5th Street.

**LIVING FOSSILS: GINKGOS**

Imagine yourself taking a break on a sunny day under the Mesozoic shade of a Turners Falls ginkgo tree—an ancient species almost lost to the world 5 million years ago. Actually, we needn’t imagine: Ginkgo trees are alive and well today at the corner of Avenue A and 5th Street in Turners Falls.

**THINGS TO KNOW**

The smoothing-over of the rocks results from the movement of glacial ice over them approximately 25,000 years ago, in the Pleistocene epoch.
species otherwise known only from fossils. Plus, you’ve got to have no close living relatives. You should have an extremely long lifespan (some ginkgos at Chinese temples are believed to be over 1,500 years old), a slow reproduction rate, a wide and apparently contiguous range, and a low population density. Despite its reputation as a living fossil, the ginkgo is a hardy tree that can tolerate the often polluted and confined soils of cities. It’s disease-resistant and rarely attacked by insects. Male trees are particularly valued (some find the female tree’s seeds noxious) and are a popular choice to line the streets of many of the world’s cities.

Continue along Avenue A to 1st Street, head toward the river, and turn right (east) to walk along the bike path where it follows along the river. At the end, you’ll come to a parking lot.

THE WORLD-FAMOUS ARMORED MUD BALLS OF TURNE RS FALLS

THINGS TO SEE
As you approach the parking lot from the bike path (with the river to your left), look for three large boulders, about the size of riding lawn mowers. These half-ton blocks of stone are the remnants of the Old Red Bridge that joined Gill and Montague from 1878 until the great flood of 1938, when the bridge was irreparably damaged. All that’s left today are the stone supports on both the Gill and Montague sides. Some years ago, local history buffs and geologist Richard Little noticed unusual round features called armored mud balls embedded in these stones.

THINGS TO KNOW
How do you make an armored mud ball? Golf- to tennis-ball-sized, these dark brown spheroid inclusions originally were chunks of clay that rolled down the hillsides bordering the Jurassic lake (and sometime mudflat) that was once our Connecticut River Valley. As the inclusions rolled, their corners rounded, and they became ball-shaped.

THE WORLD-FAMOUS ARMORED MUD BALLS

Some of the rolling mud chunks picked up pebbles of hard rock that stuck to their surfaces, as if wrapping the chunks in a protective armor. When the mud balls reached the lakeshore, they were quickly buried by fine mud or sand and preserved for the ages as the Famous Armored Mud Balls of Turners Falls.

A Turners Falls exclusive.
Although not common in the geologic record, armored mud balls from marine environments have been found and are still forming in alluvial fan environments near glaciers or ocean beaches.

But armored mud balls from inland or terrestrial lakes (such as existed in the Connecticut River Valley of the early Jurassic) are found only in Turners Falls.

Here, at the armored mud balls, ends our journey through over 200 million years of geologic history. Be sure to visit the Great Falls Discovery Center and check the resources at the end of this walking tour if you’d like to learn more about the fascinating geology and natural history of our valley.

References on Turners Falls/Western Massachusetts Geology


A Geologic Walking Tour of Turners Falls

1 Great Falls Discovery Center 2 Avenue A
2 Connecticut River and Rock Overlook
3 Courtyard at Discovery Center
4 Sugarloaf Rock Garden at Discovery Center
5 Turners Falls Formation at Canal and Third St
6 Bread Loaf Rock at DiPaolo’s
7 Peskeomskut Park
8 Our Lady of Czestochowa
9 Ginkgos, the Living Fossils
10 World Famous Armored Mudballs

www.turnersfallsriverculture.org