4. Glacial Terraces
The land along the trail alternates between fairly level to quite sloping.
Along the Devils' Football Trail, between the Devils Football boulder and Rte. 47; along the Halfway House Trail between the Halfway Area and Rte. 47.

5. Conglomerate Rock
From the Halfway Area, walk uphill along the Auto Road to the red-blazed Conglomerate Rock Trail on your left. The boulder is about 200 yards along the trail.

6. Vesicular Basalt fragments
These are small ¼" – 2" rocks lying on the ground. Further up the Auto Road near Taylor's Notch: as you walk toward the summit, they are at the base of a cliff across the road from the cement guard rail. Also along Halfway Trail – just before and at the sharp elbow bend.

7. Sedimentary rock cliff and outcrops
Along the auto road near Taylor's Notch: as you walk toward the summit, this cliff is across the road from the cement guardrail. Also along Halfway Trail, both before and just after the sharp elbow bend.

8. Basalt / Sedimentary Rock contact zone
The sedimentary outcrop ends suddenly, replaced by blocks of basalt.
Along the Auto Road, just at Taylor's Notch, look up the cliff.

9. Basalt ridge and south slope
At the Summit House and most of the other summits on the Range.

10. Glacial smoothing on basalt
At the summit, looking down the Halfway Trail from the deck's west staircase. Elsewhere, many places throughout the Mt. Holyoke Range.

11. Glacial grooves on basalt
Can be difficult to see at times. Sometimes low-angled light makes them more visible.
Near the summit picnic grove's north end, on sloping basalt bedrock.

To continue the tour, drive to the Mt. Holyoke Range Notch Visitors Center on Rte. 116.

12. Basalt Talus Slope at Mt. Holyoke Range State Park
Southbound along the M-M trail from the Notch Visitors Center, about a third of the way up Bare Mountain, is an impressive slope of brick-sized basalt fragments.

13. Horse Caves at Mt. Holyoke Range State Park
On the white-blazed Metacomet-Monadnock trail, about 250 yards north of the Norwottuck summit. The caves can be reached by a variety of trails. The shortest route is the MM trail northbound via Norwottuck summit, with steep pitches and loose rocky footing in places. The orange-blazed Robert Frost trail to the white-blazed M-M trail southbound is a longer but easier route on old woods roads with rolling hills.

Parking

There are several places to park for the geology walking tour at Skinner State Park:

- At the Skinner State Park Main Gate parking area.
- Along the unpaved section of Skinner Park Road (*note that the road is one-way*).
- At the Halfway Area parking lot.
- At the Summit parking lot.

For the Mt. Holyoke Range State Park, park at the Visitors Center on Rte. 116.

Maps

Trail maps are available at the Summit House at Skinner State Park or at the Mt. Holyoke Range Notch Visitors Center.

They can also be downloaded from the DCR website at www.mass.gov/dcr

SKINNER STATE PARK
Mountain Road, Hadley
413-586-0350

MT. HOLYOKE RANGE STATE PARK
Rte. 116, Amherst
413 586-0350

Department of Conservation and Recreation
www.mass.gov/dcr

Self-guided Geology Walking Tour

Skinner State Park

Mt. Holyoke Range State Park

Conglomerate Rock in Skinner State Park

dcr
Massachusetts

Connecticut River Valley geohistory

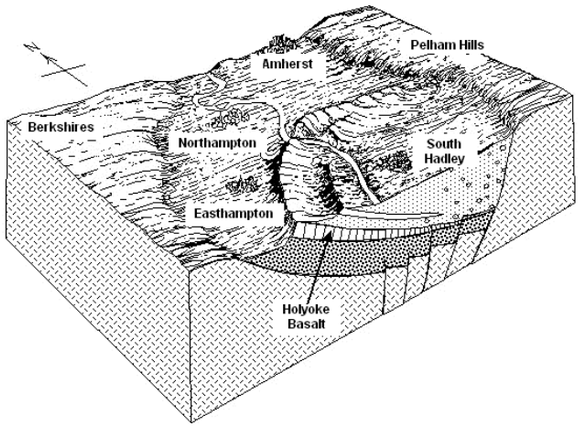
Most sources agree that the landscape of present-day Massachusetts originated with the accretion of many smaller colliding land masses of the supercontinent Pangea, roughly 450 to 250 million years ago.

Then, around 220 million years ago, Pangea began to rift apart. This created a lowland basin, edged by towering 4,000 foot highlands, the ancestor of today's Connecticut River Valley. Over time, the highlands eroded, washed into the basin and ultimately hardened into sedimentary rock.

The grain size and shape of the rock particles indicates how fast the waters flowed when they deposited their sediments. Larger fragments settled to the bottom of swiftly-flowing streams. The smoother and smaller the fragments, the farther they traveled, tumbling and rounding out their edges. Very tiny grains means the sediments washed into the still-water environment of shallow "playa" lakes.

Skinner State Park's **Conglomerate Rock** is filled with large fragments embedded into a sandy matrix. This suggests it originally formed near the edge of the highlands in high-velocity streams. Some of the eroding sediments dropped smaller-grained particles in slower-flowing or still-water environments. They lithified, layer upon layer, and are now outcrops or cliffs, such as the **cliff near Taylor's Notch** at Skinner State Park.

The **Horse Caves**, overhanging ledges on Mt. Norwottuck, are mostly conglomerate. Within are remains of fine-grained, thinly layered sedimentary rock.



The basalt layer forming the Mt. Holyoke Range is tilted upwards.

Over time this rock eroded away, leaving behind the roof and walls of the more strongly-cemented conglomerate.

As the highlands wore down, lava oozed from vents deep within the earth. It flooded the basin and hardened into a rock called basalt. When the earth's crust shifted and moved, the basalt sheet tilted upwards. What was originally flat is now upended, hundreds of feet higher than the valley floor.

As it hardened, the basalt developed cracks and chunks of the basalt sheet broke off into individual rocks. Their sharp angles reflect this fracture pattern. The rock is heavy, dark and rich in the element iron. It can take on a reddish cast like rusted nails.

Devil's Football, a basalt boulder near the Halfway Area at Skinner State Park, has all these features including a few spots where a compass needle pulls away from north and points to the rock.

Enormous basalt columns, much thicker than large tree trunks and much taller, are scattered throughout the park.

Columnar basalt occurs when lava cools more slowly, allowing its fracturing pattern to gradually develop. **Titan's Piazza** at Skinner State Park is a stunning example. The lower edges of its polygonal columns are in scalloping folds, giving it the look of a massive theater curtain.

Small, inch-size stones with tiny holes are fragments of **vesicular basalt**. This is the result of lava hardening soon after reaching the surface. It is occasionally seen where the basalt makes contact with sedimentary rock or on south-facing slopes.

The Ice Age left its mark on many of the land's surface features. The glacier spread southward, scooping up everything in its path. Within the glacier, some rocks disintegrated back into sediments – sand, silt and clay. Others fractured into gravel, pebbles, cobbles and boulders of various sizes. When the climate warmed, torrents of meltwater formed enormous rivers. Filled with rocks and sediments, they tumbled down the barren hills. Their waters filled glacial Lake Hitchcock, which covered much of the valley floor.

We see evidence of glacial action throughout the valley and on the Mt. Holyoke Range. **Lawrence Swamp** is a vestige of Lake Hitchcock. **Mount Castor** and **Pollux** in South Amherst are drumlins. Sand dunes lie near the ancient lake's eastern shoreline.

We occasionally find shallow, **glacial grooves** on the basalt rock on the Mt. Holyoke Range. About as wide as a thumb, they run in long, parallel rows. As the glacier melted, Lake Hitchcock formed **terraces**, and some are visible along trails on Mount Holyoke's northwest flank. The glacier also left **quartzite boulders** scattered throughout the range as it retreated north.

Begin the Tour!

Be sure to pick up a trail map before you set off.

1. Titan's Piazza
Park at the Main Gate on Mountain Road and walk about 300 yards down the unpaved section of Skinner Park Road. A short trail on the left leads up to a clearing where this magnificent formation is more easily seen. Please avoid walking up the steep slope with slippery loose basalt fragments to Titan's Piazza base.

2. Quartzite boulders
Tan to white in color, some rounded smooth, others more angular and revealing the quartz minerals fused together. Return to the Main Gate and walk uphill along the Auto Road. The boulders are scattered along the road between the Main Gate and Taylor's Notch.

3. Devil's Football
Park at the Halfway Area and walk downhill about 130 yards on the Auto Road to the start of the yellow-blazed Two-Forest Trail on your right, opposite the Halfway Trail steps. The trail leads directly to the Devil's Football, at the intersection with the blue-blazed Devil's Football Trail.