



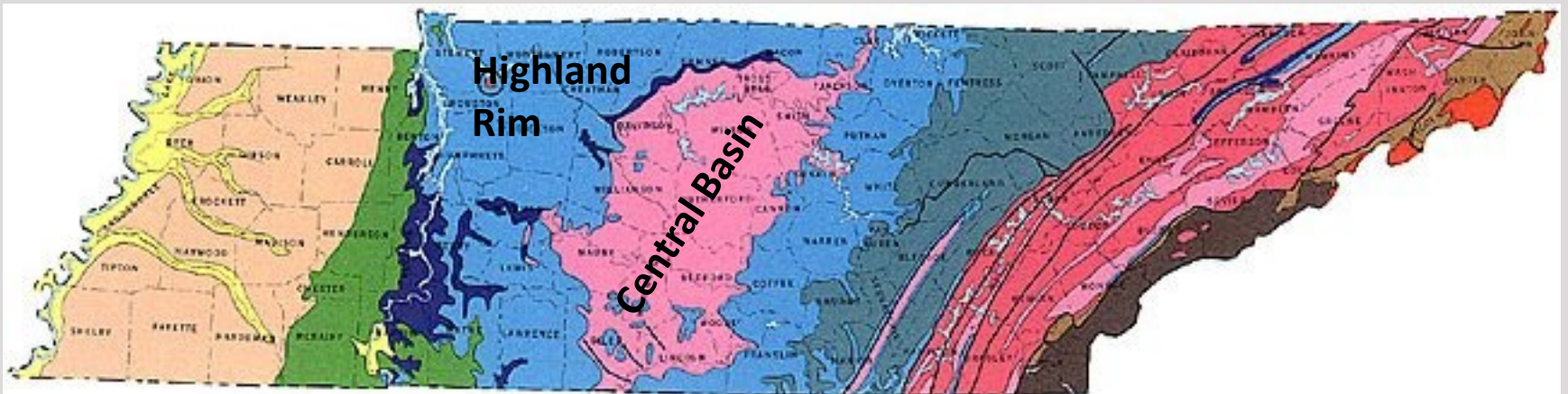
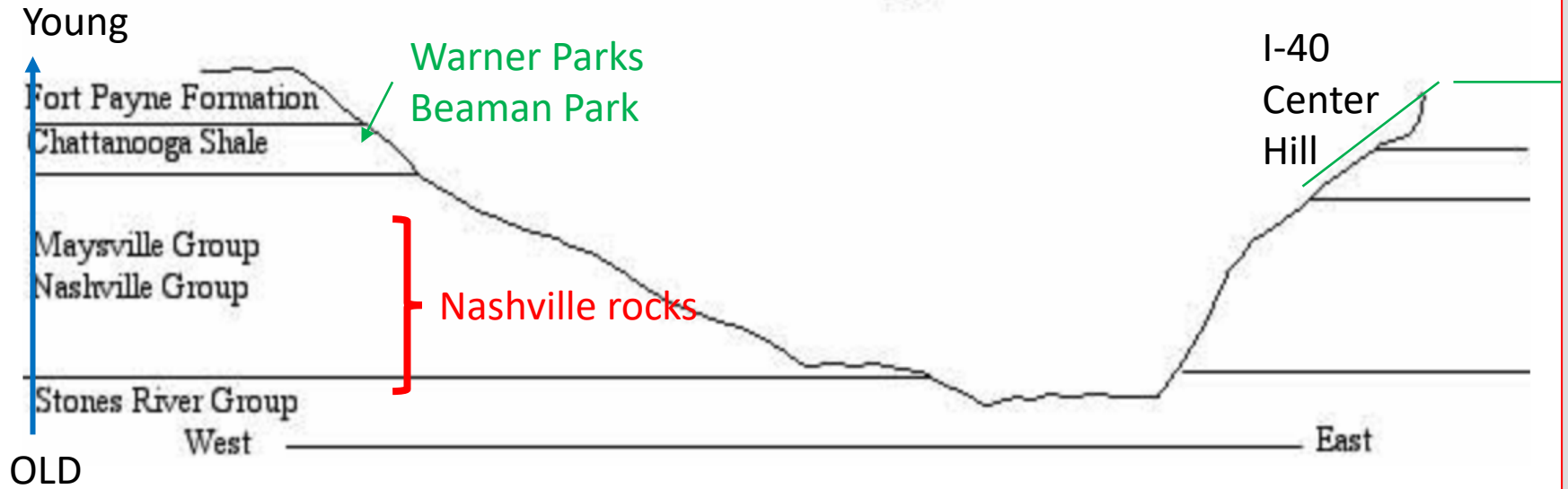
## Session #6 February 15<sup>th</sup>

# Nashville's Younger Rocks, History, Mysteries, Topography Environmental Issues

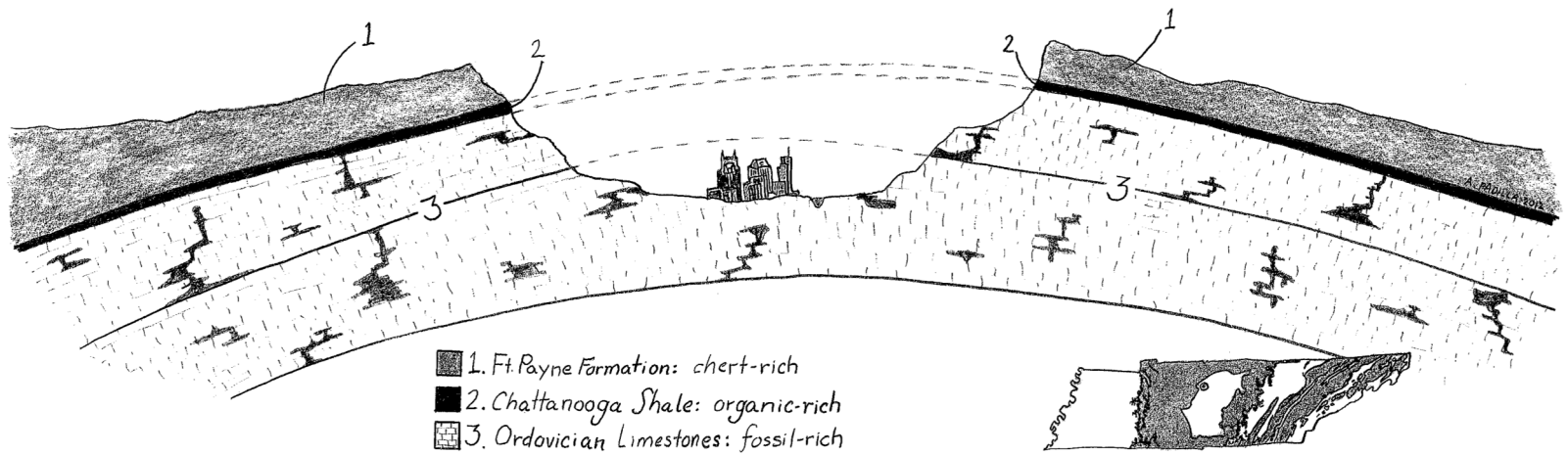
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  - Chattanooga Shale
  - Younger limestone
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4. How recently formed is our current landscape? (????)
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# Cross Section of the Nashville Basin

vertical dimension exaggerated



Map view



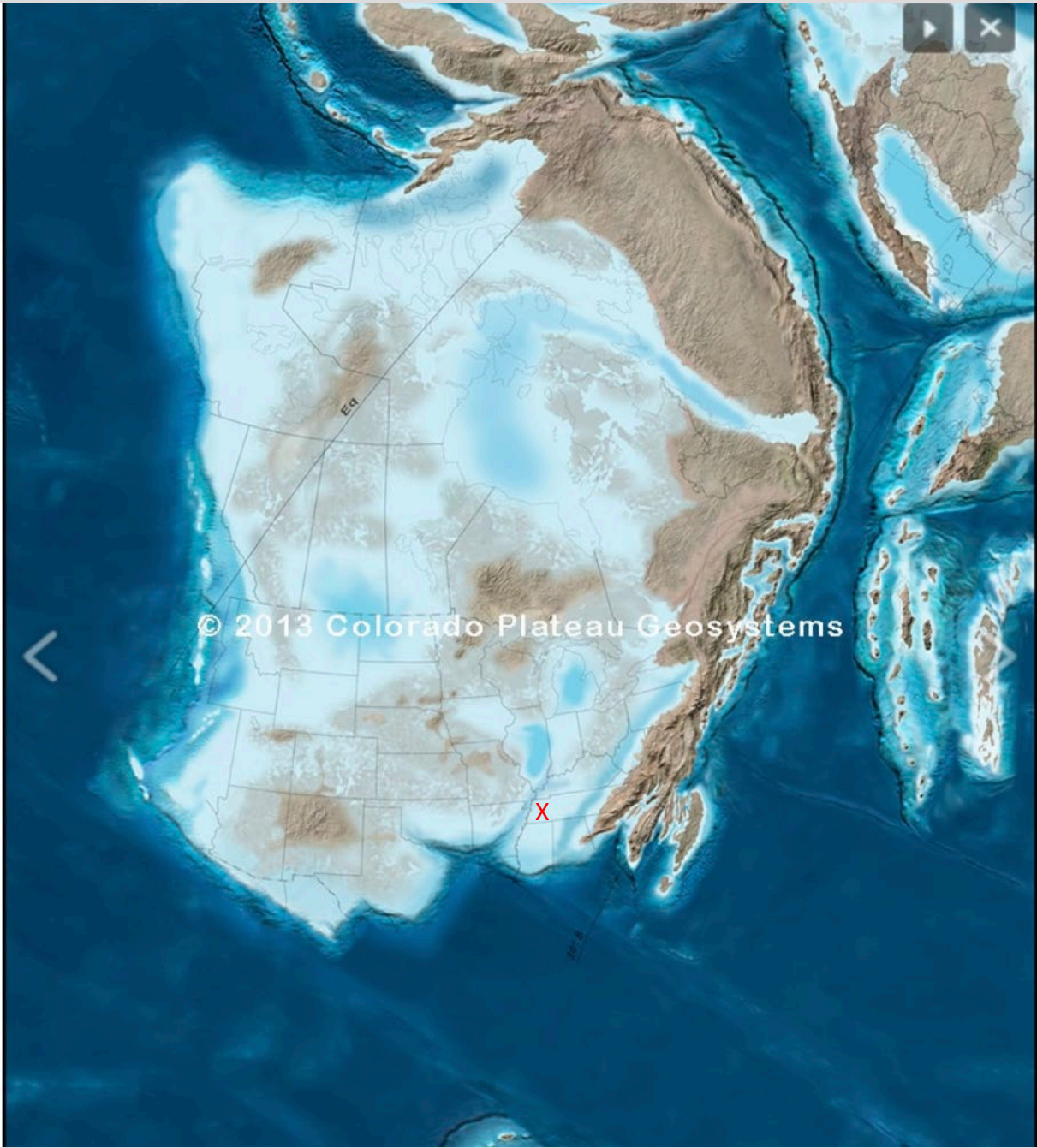
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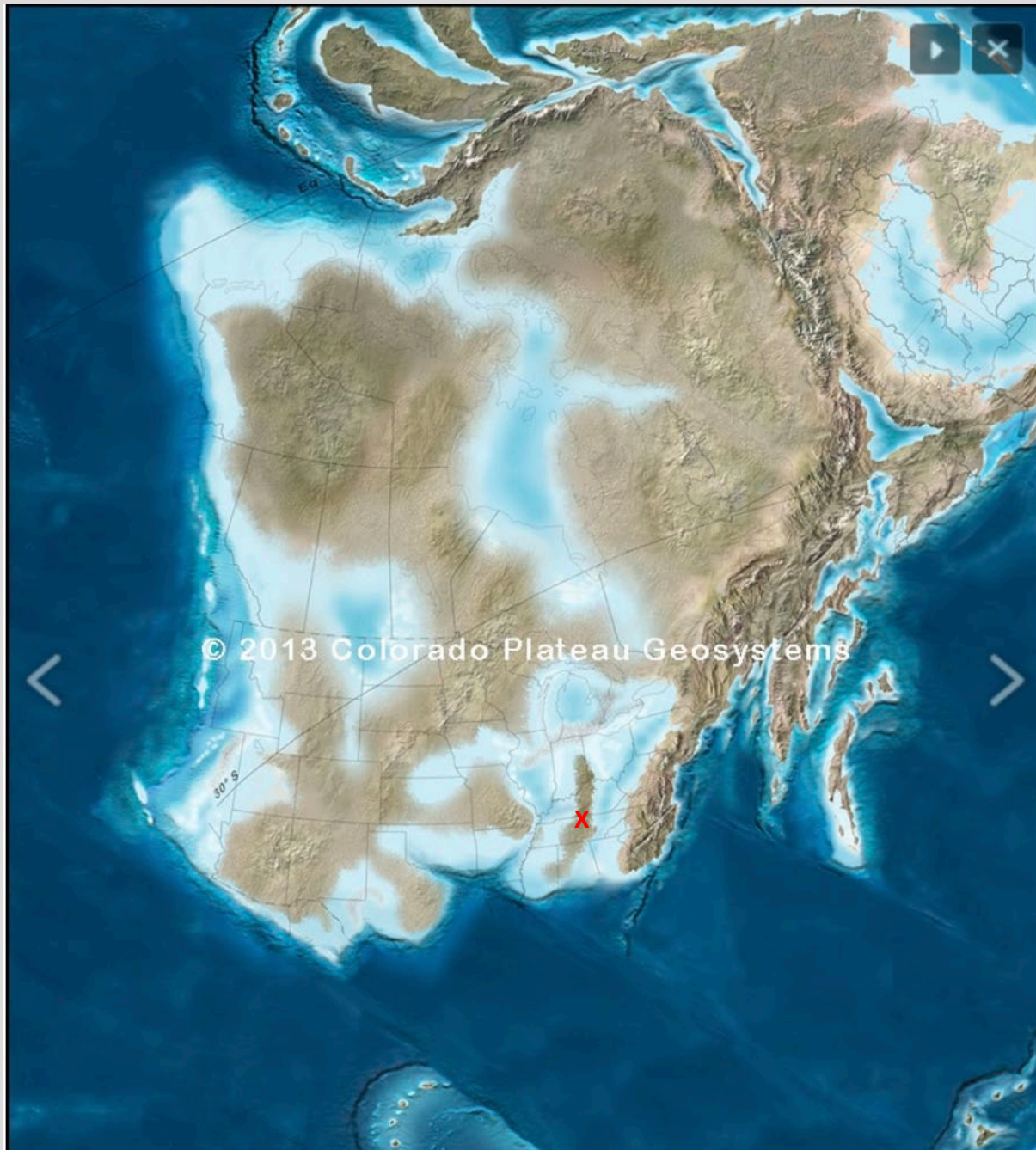
470 MYA





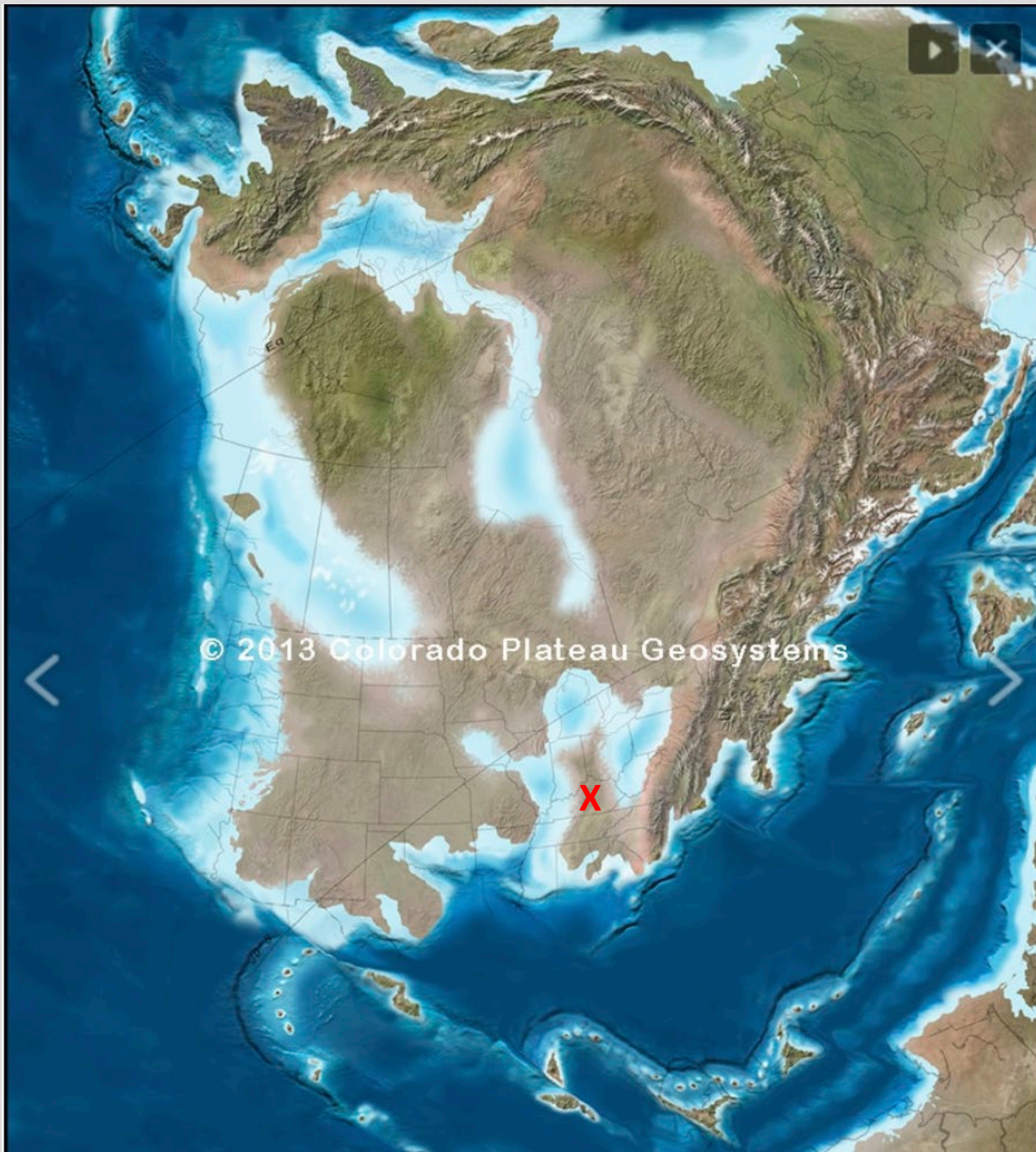
450 MYA

420 MYA





390 MYA



**375 MYA**



360 MYA



345 MYA



325 MYA



315 MYA



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375 MYA







**Chattanooga Shale – thin (20 feet thick), friable at surface, black shale, weathering scum of minerals. (gets covered with vegetation so hard to see at surface)**



Chattanooga Shale falls into shale chips at surface. Where to see in Nashville = Old Hickory Blvd Bellvue, (70S to Hwy 100), I-24 NW of Nashville at New Hope Rd, Hwy 70S at 9 mile hill

## Why was the Chattanooga Shallow Sea so Different from Earlier Shallow Seas? **STAGNANT**

Not totally understood – worldwide changes, local geography

### Possibilities

1. First large trees and forests appeared – weathered rocks more provided sea with nutrients – huge algal production
2. Chattanooga Sea was less extensive – sediment transported from land to sea, more protected from giant winds

<https://www.youtube.com/watch?v=8M0j4ZdaJF8>



Stumps of trees of earliest forest – Western Catskill Mountains, eastern New York  
Discovered during building of reservoir water system for NY City

<https://www.youtube.com/watch?v=8M0j4ZdaJF8>



**Forest reconstruction**



**Stump holes in quarry floor**



Nutrients and seasonal lack of mixing caused algal blooms. Algae fell to bottom of sea, Bacteria lacked oxygen to decay organic material – is preserved (oil and gas). Can smell gas..

**Large scale Radnor Lake setting &. Failure of carbon cycling**

360 MYA



## Economic Importance of Chattanooga Shale

Contains up to 20% organic matter – source rock for oil, gas

” scratch and sniff” rock – hydrocarbons released (Try it!!)

-- in Tennessee – was source rock for oil on Cumberland Plateau during oil boom of the 1980

-- has been source of natural gas near Wartburg, Cumberland Plat. fracking is easier there than PA because shale is closer to surface . Currently not economically viable in Tennessee

-- In 1950's during Cold War was investigated as a source of uranium for nuclear power plants, etc. Uranium in water is precipitated on organic matter.

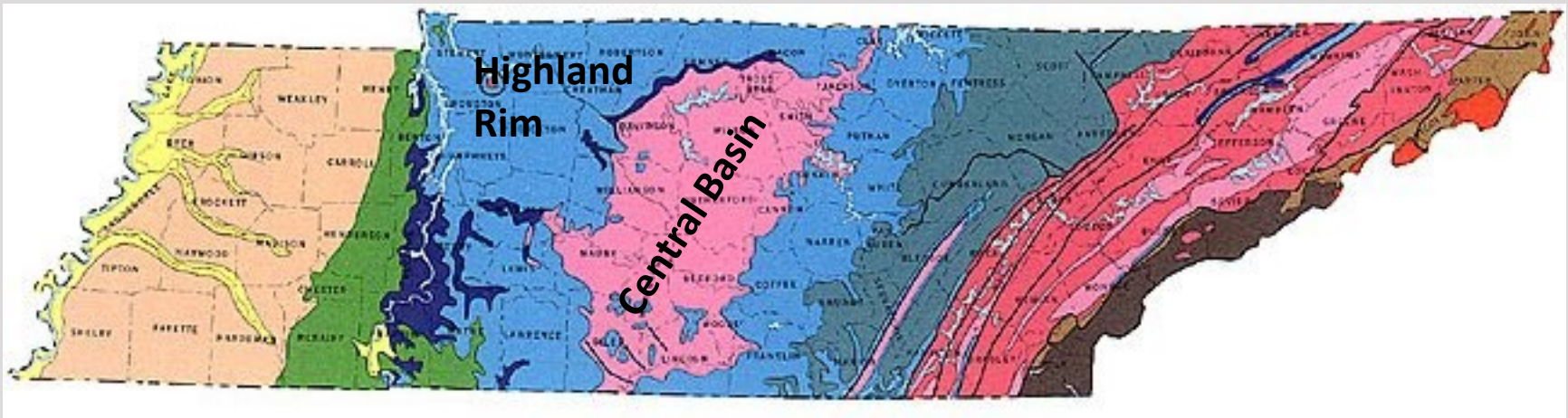
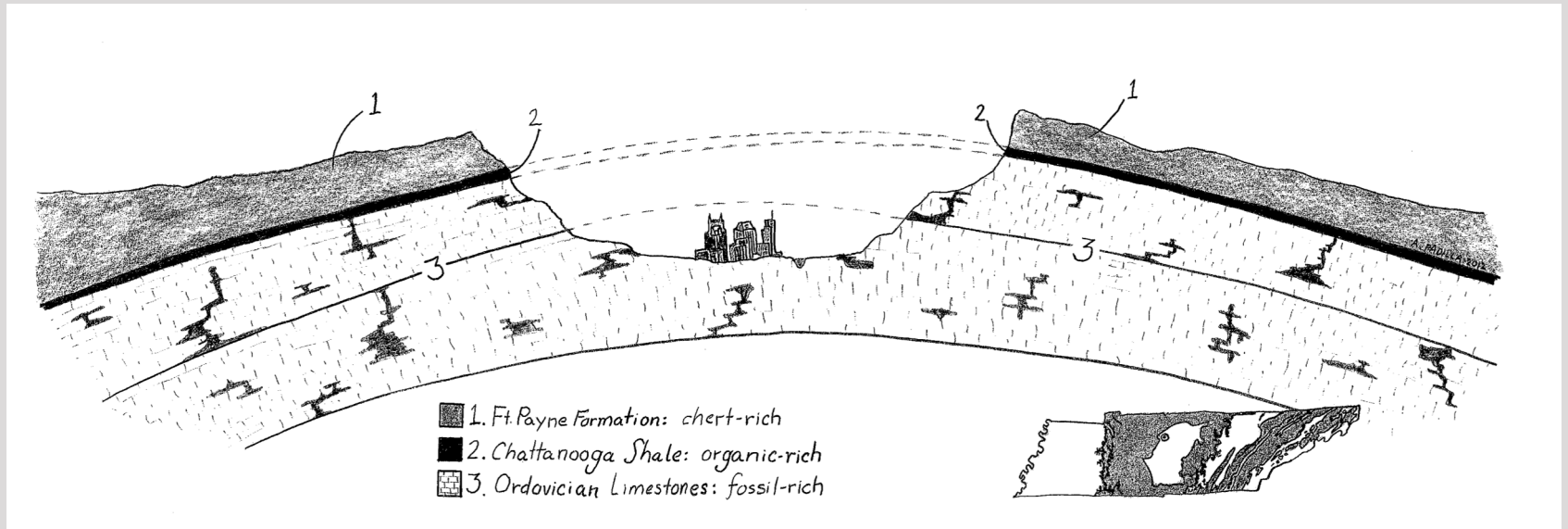


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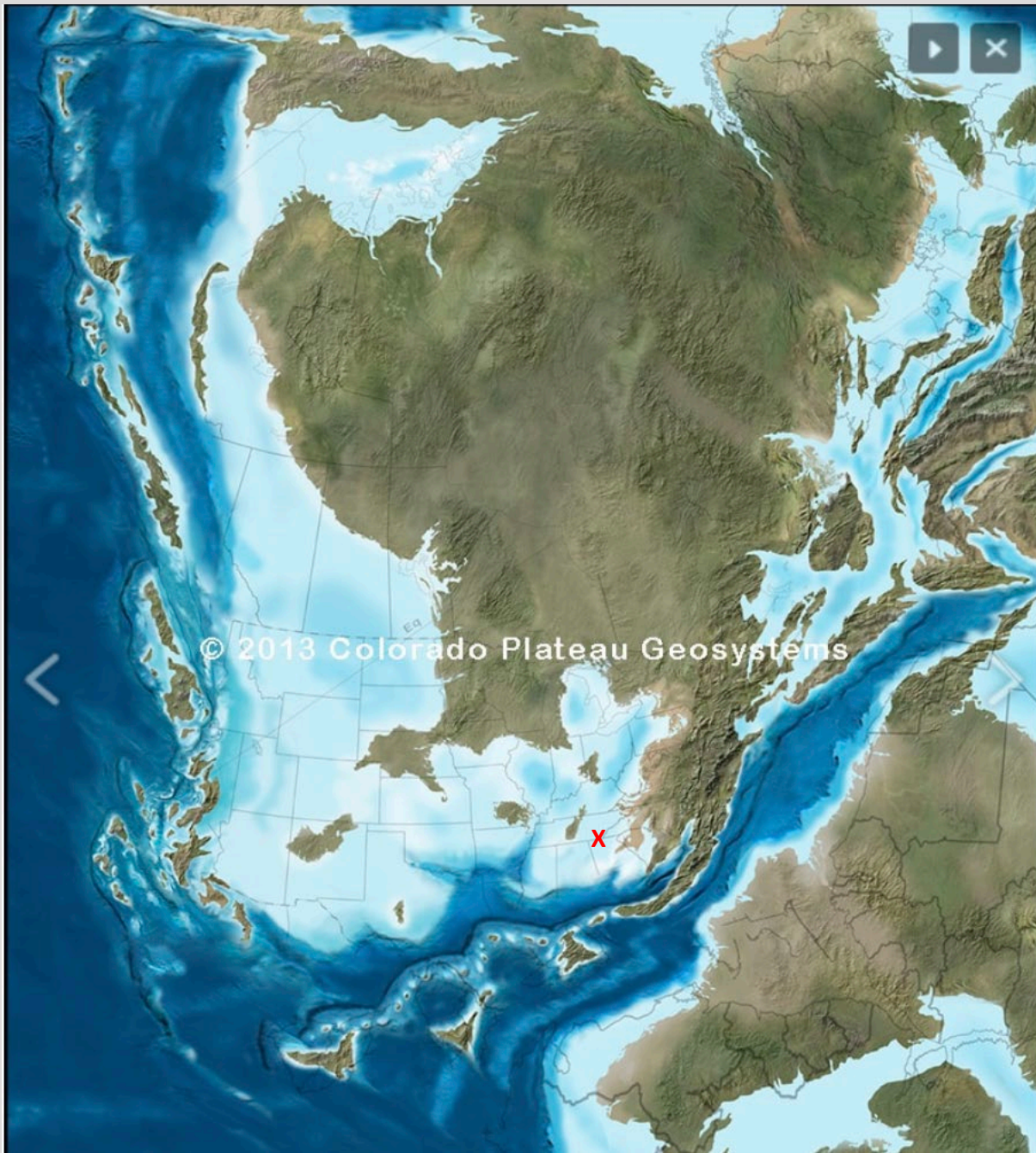
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Younger limestone deposited in shallow sea covers all of Highland Rim shown in blue



345 MYA





Dunbar Cave – (Clarksville) and many caves on Eastern Highland Rim, also Kentucky

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## **Changes after sediment deposited –**

### **1. Well understood = changes to organic matter in Chattanooga Shale**

As organic matter is buried, it is heated and transformed, eventually at  $> 100$  degrees C into oil, then into natural gas - typically when buried by 7,000 feet or more

To east Chattanooga Shale was thicker and buried by more sediments – so produces more natural gas than in TN

### **2. Not well understood in younger limestones**

a. replacement of limestone with silica (quartz) and formation of chert all over Middle TN –



Silica precipitated as quartz, chert cement between grains very common in younger limestones

After deposition of sediment, silica in water replaced other minerals and was ] precipitated in rocks.

Formation, process, not well understood.

Tons of geodes in Nameless, TN

Between Carthage and Cookeville

Huge amount of chert right above The Chattanooga Shale –

Warner Park "Red Trail".

Does not dissolve, forms gravel bars In Harpeth and other streams





**Gravel bars along Harpeth Rivers – tons of chert from hills nearby**





Sidewalks at Vanderbilt and elsewhere

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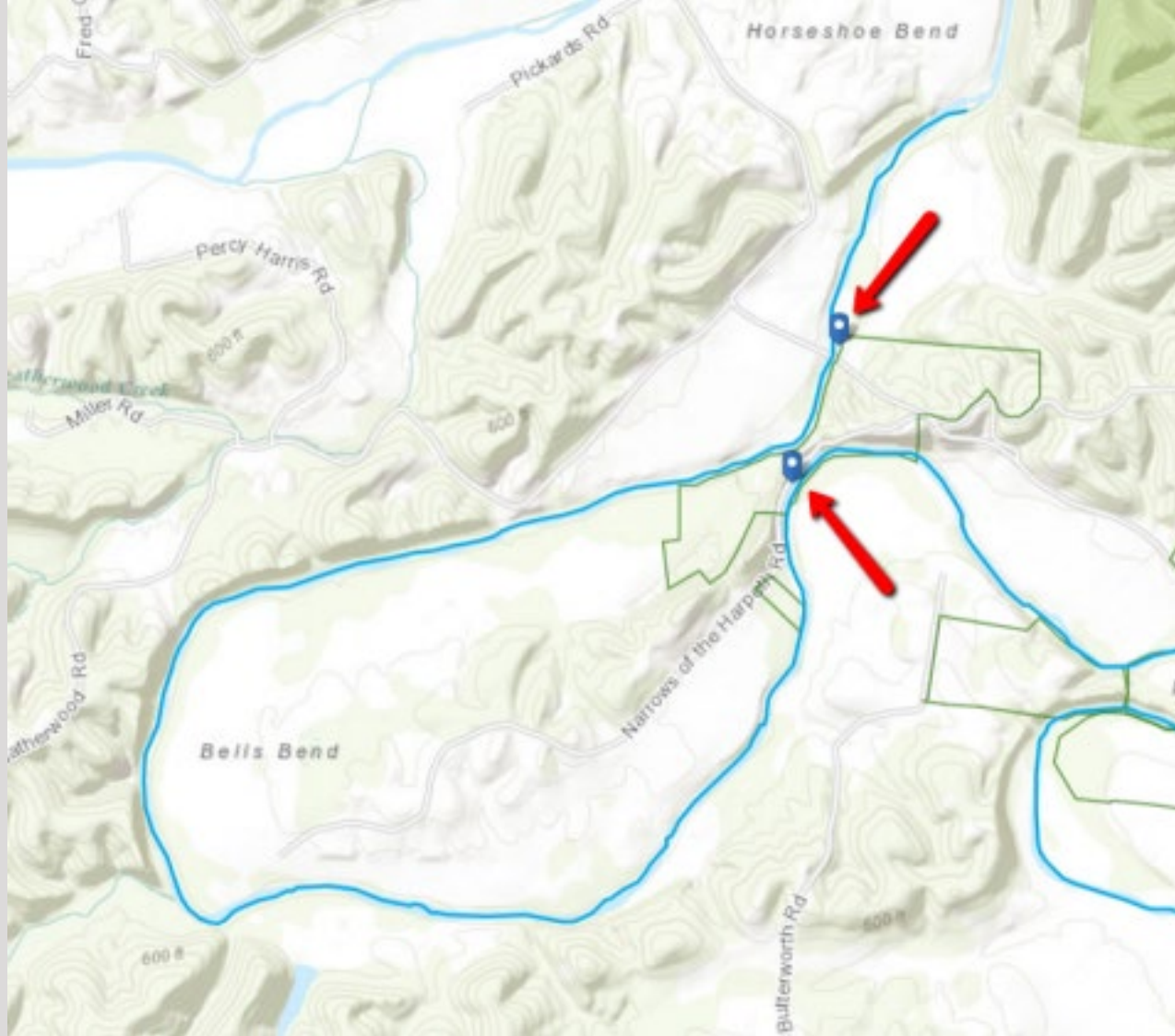
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Meander loops like these form in flat areas (e.g., west Tennessee

If area is uplifted river will cut down and make cliffs but meander loops persist. Montgomery Bell made tunnel in such a setting on Harpeth River.



Montgomery Bell tunnel on Harpeth River: river drops ~25 feet in ~4 mile loop. Cut loop to make waterfall for power.

Meander loops form in flat areas.

Now there are cliffs formed by uplift since the meander loops formed





**Steep cliffs along meander of Harpeth River**

**Landfill fo household garbage**



Related Question – with very new answer

What has been the history of the Appalachian Mountains

Old Idea: Formed 300 MYA and have been wearing down since,  
(with period of uplift, but minor)

New Idea: The Appalachians have been worn down to almost  
sea level several times

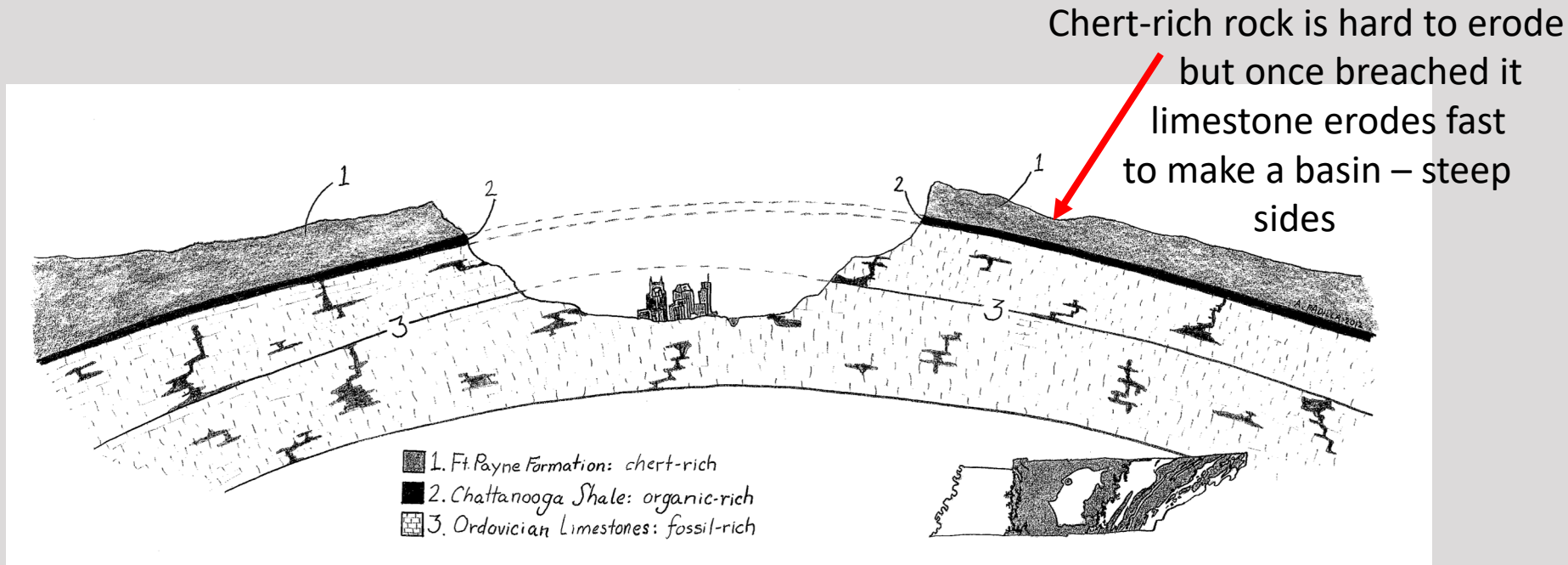
Present topography – very steep – carved within the last  
few million years –

Connection to Nashville Dome – unclear, not known. -- but is the  
history of Nashville topography also very recent

Interesting idea with supporting evidence is yes – a few million yrs



When Nashville area pushed upward in last few million years...



Result = rapid erosion of limestone, making steep cliffs around Nashville

Rapid erosion of cliffs by meandering streams – meanders formed by sluggish streams – but erode when area is uplifted

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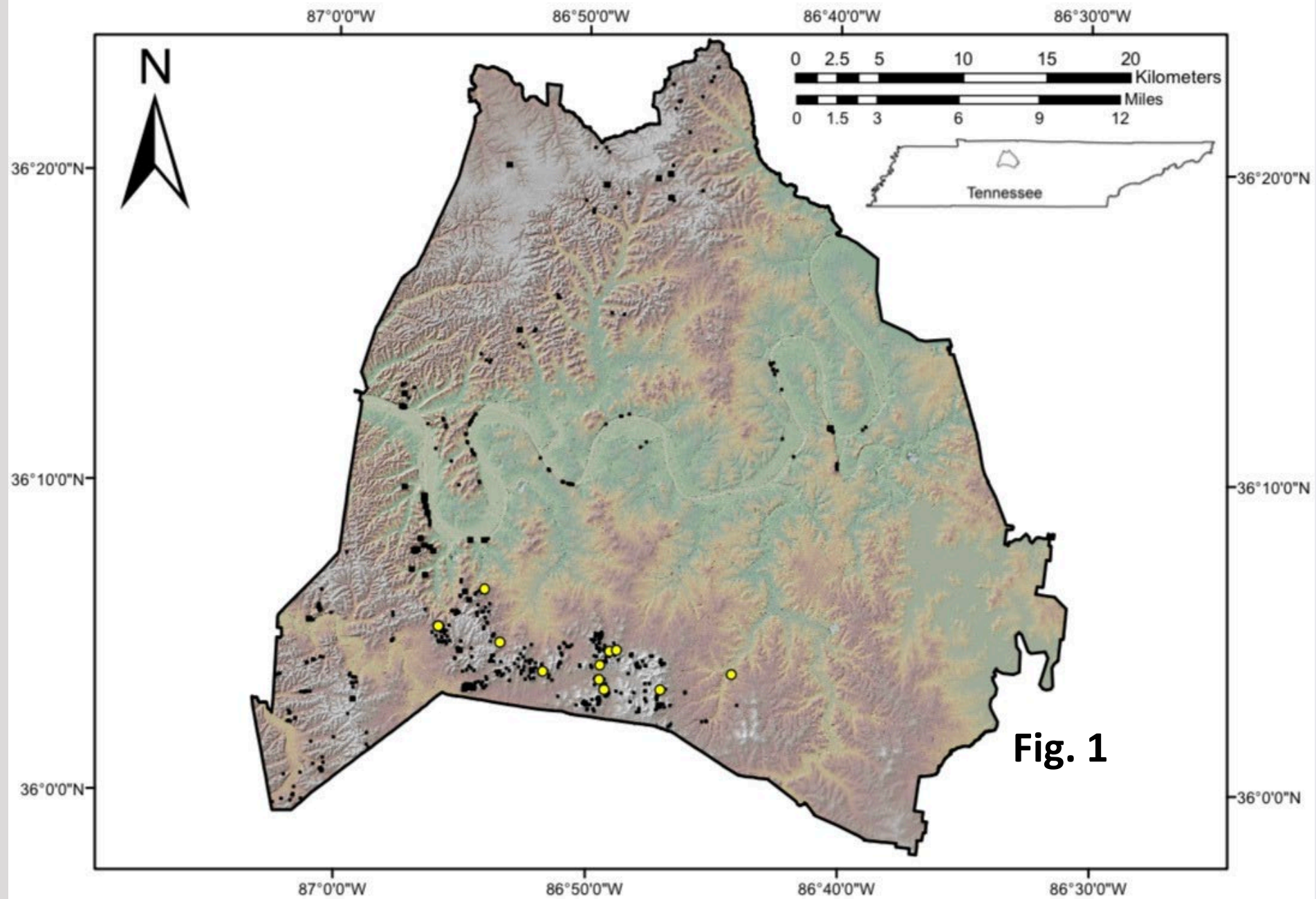
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## Nashville as an “It” City: But What’s the “It”?

**Landslide. > 500 landslides associated with 2010 rain**

Why so many landslides?

- steep topography caused by recent uplift, fast erosion
- large lots so city grew outward rapidly
- construction practices
- Attitudes: “Hey – this isn’t California!”



**Fig. 1**

## Landslide - prone

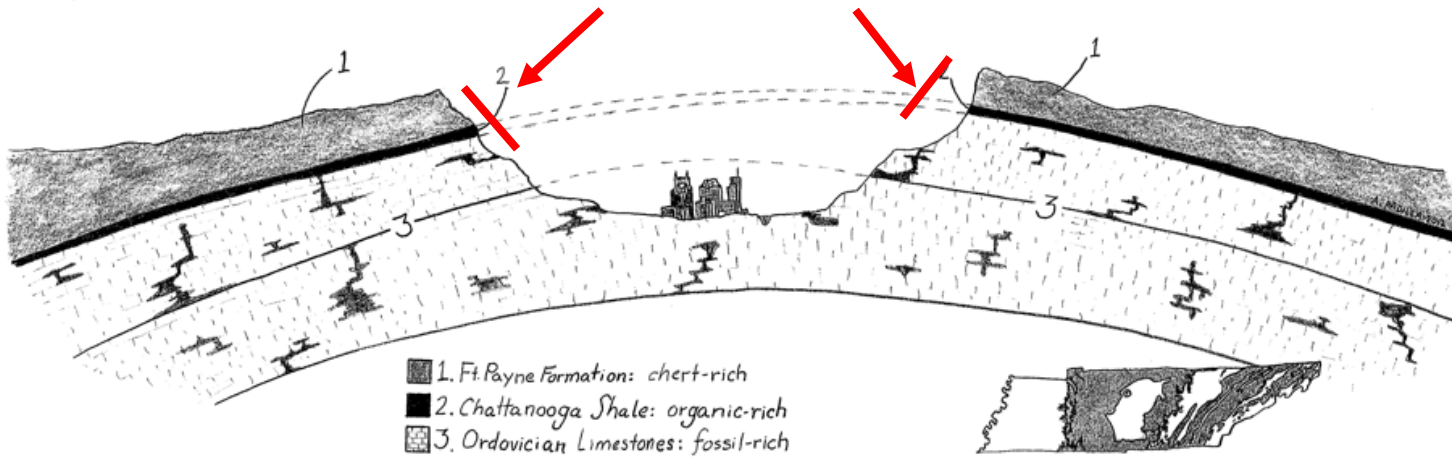
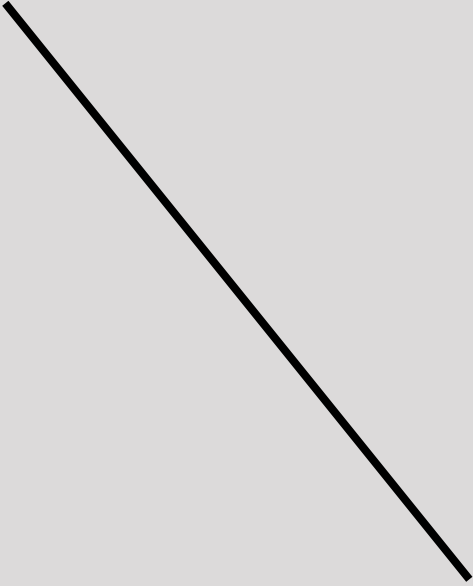


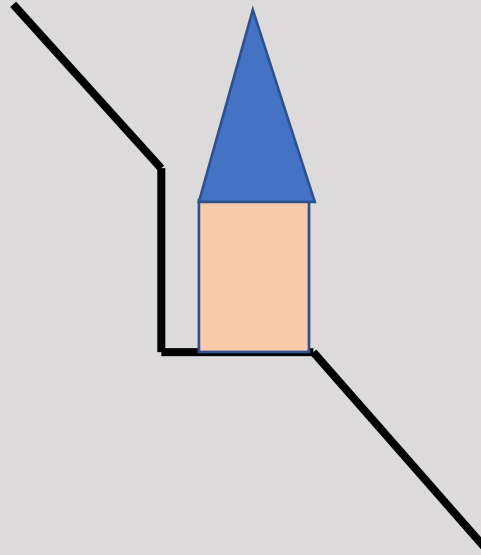
Fig. 2: Note “Batman Building” at left of building cluster in Nashville Basin. Red lines show interval of steep slopes that are prone to failure (landslides). Hills in West Meade are in this zone, including the proposed development site (Hawk’s Haven) on Rodney Drive.

# **How to increase the chance of a landslide**

- 1. Steepen the slope**
- 2. Add weight to the slope**
- 3. Add water to the slope (e.g., extreme rain events)**



a.



b.

b. Has steepened slope and added weight. Just add 6" of rain.

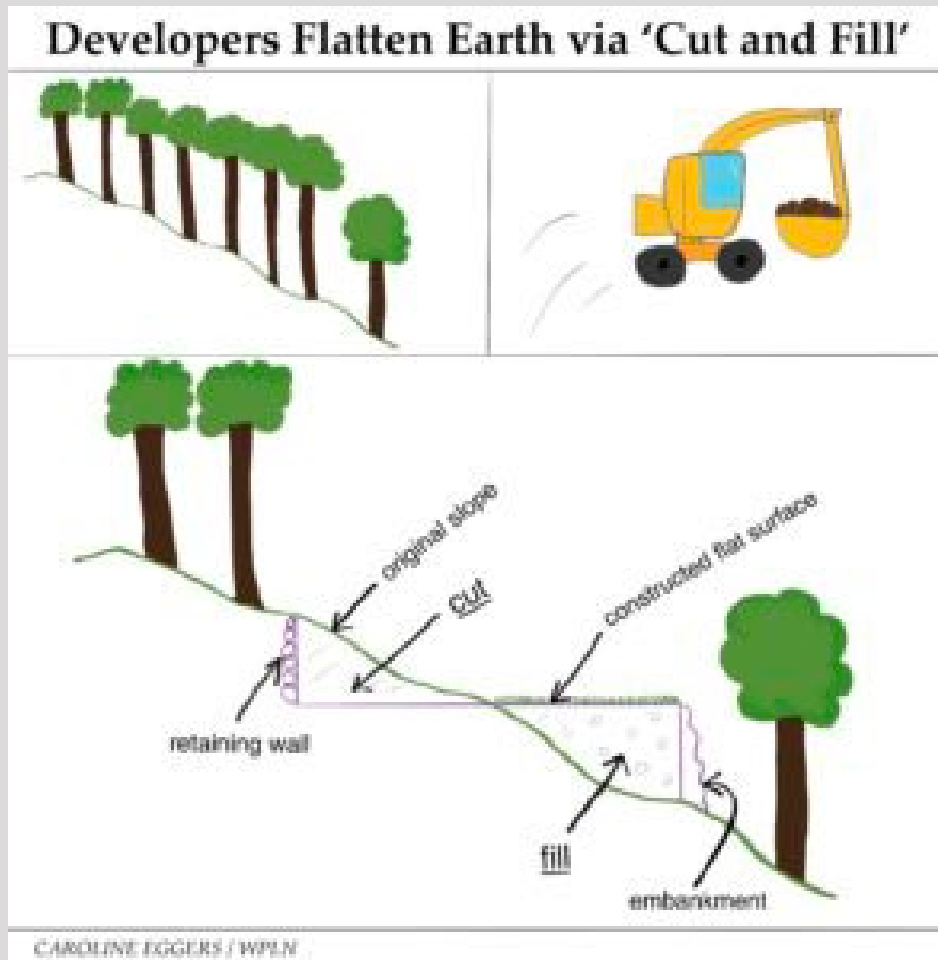


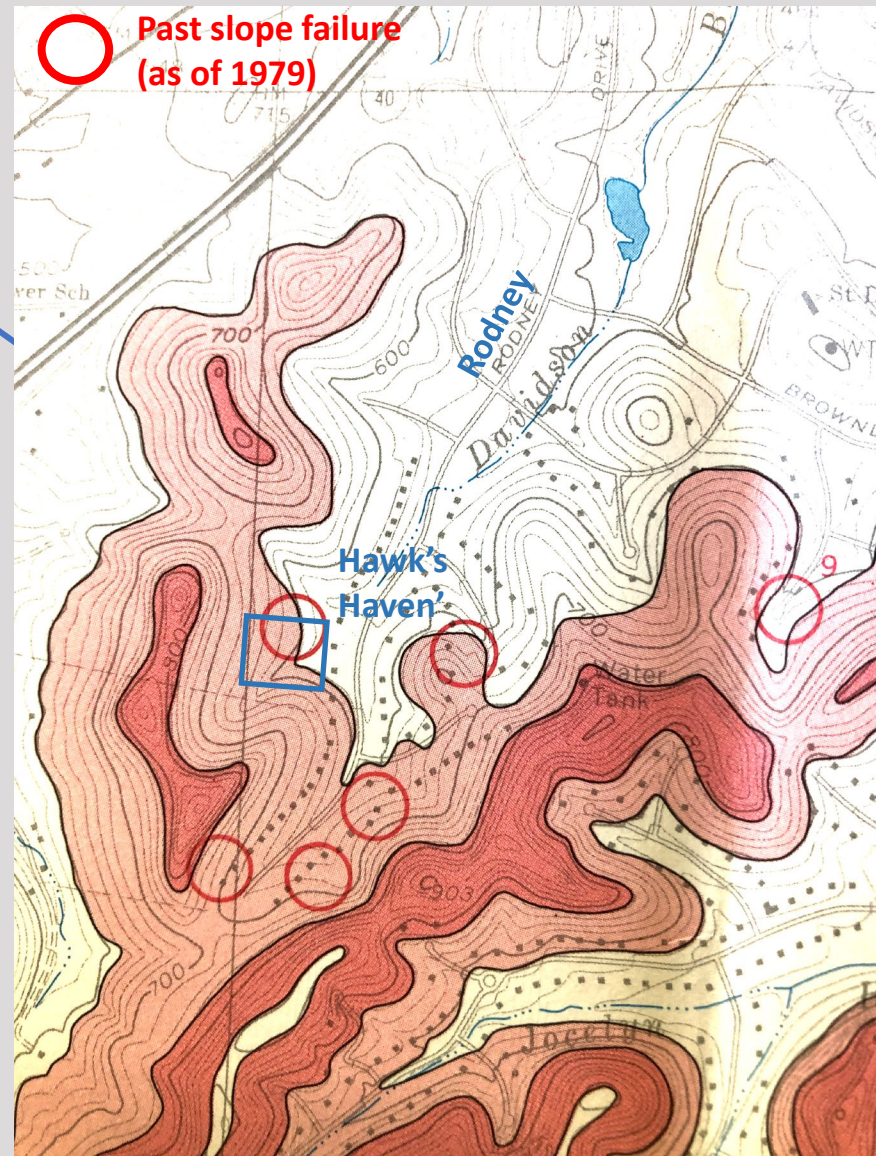
Fig. 4: How commonly used “cut and fill” technique of siting a house increases slope and thus increases chance of landslide on a naturally unstable hillside such as proposed “Hawk’s Haven”. Disturbance on such a hillside even without cut and fill terracing can destabilize slope, especially given added weight of four large houses. No information regarding construction disturbance have been provided, nor have plans for minimizing failure during extreme rain events. Diagram from C. Eggers, WPLN





Built in 2022. ~ 6100 sq ft. Asking price = \$3, 199,000 lot size = 1.74 acres  
Note steepened slope.

Red arrow points to retaining wall holding back steepened slope



**Fig. 3. Bellevue Quad: Harpeth River flowing from SE to NW. Slope failure hazards in pink and red.**

Areas in pink subject to fail if disturbed, areas in red are steep, potentially unstable slopes >20%. **Red circles denote previous landslides.** Hawk's Haven is proposed development. Houses are indicated by small black squares along Rodney Dr.

From Miller, R.A., 1980. Geologic hazards of the Bellevue Quadrangle: TN Div of Geology, Environmental Series 7, 21p.

Currently – developers are not required to inform potential buyers of landslide hazards – nor are realtors.

Have seen several properties been sold as building sites that are for demolition only....

Landslides will only increase with increasing extreme rain events.