



# Reunite Pangaea!

## —Life in an orogenous zone



Callan Bentley explains the drama of tectonics and erosion

As a local historian I am used to thinking about what Takoma Park might have looked like 125 years ago. But when it comes to four hundred million years ago, I'm clueless. So I was intrigued by the "History Before History: Geology Tour of DC" offered as part of WalkingTownDC on April 21 and 22.

I know some basic geology: the three kinds of rocks (igneous, metamorphic and sedimentary), plus the ice ages, and, oh yes, Pangaea, the supercontinent. This was a chance to learn about how here came to be here.

Who knew that meant mountains ten miles high or dinosaurs roaming close at hand? In the end, the geological story wasn't as amazing as the fact that they could figure it out by looking at the rocks.

According to our guide, geologist Callan Bentley, a professor at Northern Virginia Community College, the traumatic events of four hundred million years ago can be traced in the land we stand on today along Rock Creek. He set out to prove it in a fashion no less mesmerizing than the CSI forensic magicians who fill the TV screen.

Bentley described geology as a battle between two gigantic forces: The god of Tectonics (the continental plates colliding with each other, building up great mountain ranges) versus the god of Erosion (the constant action of wind and rain to tear down those very same mountains).

Although the biggest impact on our geography happened 450 million years ago, he took us back 1000 million—a billion—years to set the stage for the more “recent” events.

To begin with, you have to give up the familiar world map of continents. The continents have been moving to and fro in a gigantic slow-motion bumper cars game for eons. The next 300,000 million years will scramble this arrangement even more, if we last that long.

Round One: In that far distant past, what we think of as North America was floating on molten lava below the equator, when it collided with the continent we know as Africa and formed a supercontinent Bentley and his colleagues call Rowinda. In the middle of this mass was the eastern Seaboard, including our future DC and Takoma Park homes.

The liquid rock (magma) created by the impact, known as the Grenville Orogeny (a fancy word for mountain-building), cooled into the igneous bedrock of granite and gabbro that underlies nearly all the East

level rose until most of North America was under water. In the quiet, sediment began to build up on the ocean bottom. But Tectonics was waiting in the wings.

Round Three: Beginning about 435 million years ago, the time period our guide was aiming for, Tectonics set in motion of series of three collisions. Over the course of 150 million years, they resulted in the formation of another supercontinent—Pangaea.

The first two bumps were minor compared to the final collision: Gondwana (Africa) returning for a second time. The



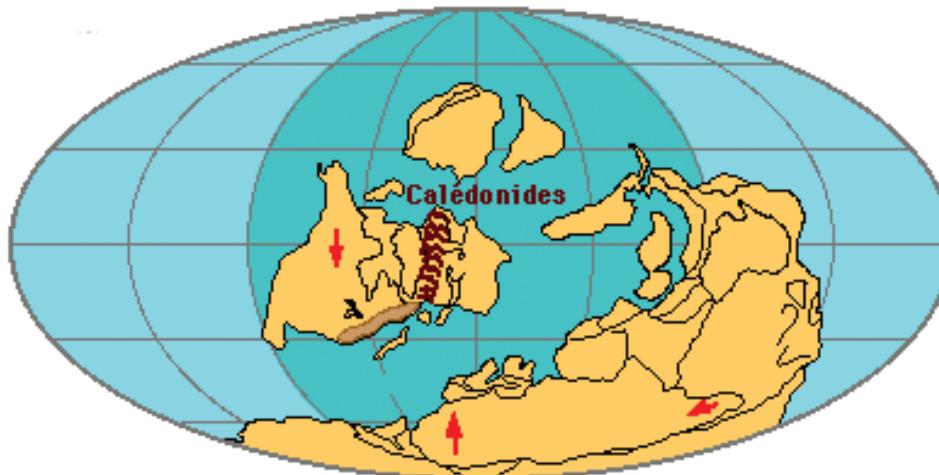
Garnets in meta-greywacke

final impact was so intense that the African plate moved over the top of North America, compressing all the sedimentary rock that had been building up thousands of feet thick in the Iapetus Ocean.

Take a look at a current world map, and you will see how easily Africa fits against the Eastern Seaboard. The intense impact of continent against continent crushed the underlying sedimentary rock (with the wonderful name of greywacke), squeezing and forcing the rock vertically upwards...to a height geologists estimate at 10 miles. (Ten miles! —by comparison, Mt. Everest is only six miles high). These were the original Appalachian mountains, not the pitiful remains we see today after so many millions of years under Erosion's assault.

Visualize the force it took for these collisions to raise 10 miles of rock and you get some idea of the heat and pressure which built up. Some of the minerals in the rock melted, but others did not. Professor Bentley calls this his Snickers Bar Effect. If you melt a Snickers in your mouth (which he requires his geology students to do to understand the metaphor), the caramel dissolves quickly (like some rock minerals), while the nougat takes longer (a different set of mineral, like mica), and the peanuts don't dissolve at all (like quartz).

Everywhere we walked along Rock Creek, our guide pointed out meta-greywacke that originated in that impact.



410 million years ago: Laurentia has absorbed one collision and Gondwana is moving north.

PHOTOS: JULIE WIATT



Rounded pebbles show the effects of the fast moving water of the ancestral Potomac.



Geologist Callan Bentley perches on a rocky hillside to explain the coastal plain

# Local historian goes way way back

The heat and pressure metamorphosed the greywacke into meta-greywacke. Mica sparkled (the same silver mica that gives Silver Spring its name), along with small dots of garnet and occasional chunks of billion year old gabbro (a harder cousin to granite).

Round Four—No sooner does the pressure ease than Erosion began to chip away. For 200 million years, the wind, rain and rivers like the ancestral Potomac ground down the mountains again, littering the ground with river gravel and pebbles to create a coastal plain. By 230 million years ago, the Appalachian was gone. The proto-Potomac was cutting deep toward the bedrock. Then about 210 million year ago, Pangaea itself began to split up. Africa and Laurentia started drifting away from each other, pulled by the cycling currents of magma that roil just below the bedrock surface (at least that's the geologists' best guess). As the crust cracks, new magma creates new crust. Professor Bentley noted that the underwater ridge that marks the original break is equidistant from the North American and African coasts. To



*Evidence like this granite shear cutting across older rock helps geologists trace the earth's story.*

make it clear, Bentley explained that the Blue Ridge is the western half of the foothills of the old Appalachian range, but to find the eastern half of the range, you have to travel to Morocco.

At this point, our guide could finally introduce the topic of fossils--because there finally was some evidence. This is a time when the Eastern Seaboard was swamp land like the bayous of Louisiana and the time is right for this to be the era of dinosaurs.

Fossils of many varieties of dinosaur have been found in Maryland, but the ones



*This cage protects a fault line where a Piedmont rock layer invaded Coastal Plain*

Then, in 1898, one vertebra was uncovered that bears the unique configuration of a raptor, except for the fact that the vertebra was five times larger than the "Jurassic Park" velociraptors, or any known raptor for that matter. He was dubbed the "capitolsaurus" and DC City Council decreed it to be the official City Dinosaur.

Round Four: Laurentia has become North America, though it is still missing its connection with South America. Tectonics is quiet and Erosion has created a coastal plain.

The ice ages change the amount of water and the amount of erosions – the Potomac again starts cutting through the gravel and into the underlying bedrock. Many of us recognize the fall line (where gravel meets bedrock). The fall line began at Georgetown and has been retreating upstream one millimeter a year, which amounts to about one foot every million years. Rock Creek traces the division in Maryland.

The tour ended at an abandoned quarry where nearly 200 people finished up the

PHOTOS: JULIE WIATT



*This 100-year-old quarry near Montrose Park is a perfect place to study the rocks.*

that captured the crowd's imagination were the ones found in the District (sorry, none so far in Takoma Park).

Teeth from a plant-eating dinosaur were dug up as early as 1858, making it one of the earliest dinosaurs discovered in North America. In the mold of a "brontosaurus," the star-shape of the teeth led to the name "Astrodon johnsonii" ("star-tooth" plus the name of the lucky fossil hunter). Enough bones have been found to calculate that the dinosaur stood 60 feet tall.

three-hour hike. Chalk some of that up to curiosity, and some to Bentley's charisma, but also to Cultural Tourism for putting together compelling walking tours.

You can sign up for Cultural Tourism's weekly events updates on their website, [www.culturaltourismDC.org](http://www.culturaltourismDC.org).

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