# Geoscientists Get to Work as Quake Memories Fade

Scott Olson/Getty Images

AFTERMATH Restocking in Mineral,Va., the earthquake's epicenter.

By HENRY FOUNTAIN
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Remember the earthquake?

The magnitude 5.8 quake that struck central Virginia on Aug. 23 may seem like a distant memory to most Northeasterners, a brief physical and emotional rattling that was promptly overwhelmed by Hurricane Irene.

But the quake, which caused no deaths but damaged buildings in and around the epicenter, about 40 miles northwest of Richmond, as well as in Washington and Philadelphia, is still very much on the minds of seismologists and geophysicists.

For one thing, these scientists say, the earthquake offers a chance to learn more about the seismology of the East Coast.

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Jay Paul for The New York Times

'SIGNIFICANT SHOCK' Workers repaired the town hall roof in Mineral, Va. Central Virginia is one of the more active seismic regions on the East Coast.



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For another, it could have been worse.

“This earthquake didn’t actually do very much damage because it happened between some very heavily populated areas,” said Meredith Nettles, a geophysicist at Columbia University who felt the quake in her office at the Lamont-Doherty Earth Observatory in Palisades, N.Y. “If it had happened directly underneath or very close to Richmond, Washington or New York, we would have been looking at a completely different story.”

Scientists say quakes of a similar magnitude could happen in such cities, because the East is riddled with old faults, the legacy of the pushing and pulling that created the Appalachian Mountains and the Atlantic Ocean several hundred million years ago. While those faults sit in the middle of the North American tectonic plate — far from any boundaries whose interaction can produce the strong quakes experienced in more active seismic areas like California — they are accumulating stresses as the plate is gradually pushed west.

“It’s a really good reminder that it’s not just a California problem,” Dr. Nettles said. “Earthquakes likes like this can and do happen on the East Coast.”

The quake’s size — it was one of the strongest to occur east of the Rockies in the past century — is about the only thing that surprised seismologists. The area where it occurred, known as the Central Virginia Seismic Zone, has seen numerous earthquakes dating back to the 18th century, including one of similar magnitude in 1897 and one of magnitude 4.5 in 2003.

“After it sunk in that a significant shock occurred, I wasn’t surprised about the location,” Martin C. Chapman, a geophysicist at Virginia Tech who has long studied the seismic zone, said about last month’s quake. “Central Virginia is one of the more active areas.”

Active is a relative term, however, and central Virginia is not active enough to be laced with seismic monitoring stations, as California and other hot spots are. “There was only a sparse network of stations to record the initial shock,” Dr. Chapman said. Data from those and more distant seismometers was enough to provide basic information about the quake and the orientation of the fault, a type that ruptures by one section of rock sliding over another along a plane.

But detailed knowledge of the fault structure and how the earthquake’s energy propagated — the kind of information that could help scientists better understand the types of quakes that occur in the East, and the damage they might do — requires more and finer data.

So within a day of the quake, Dr. Chapman — who took a red-eye flight back from the West Coast, where he had been attending a conference — and scientists from Lamont-Doherty, the United States Geological Survey, the University of Memphis and other institutions were installing seismometers in the area near the epicenter.

They were interested in recording aftershocks, which occur along the same fault as the main shock as the fractured and displaced rock moves toward equilibrium and any remaining stress is relieved. There have been about 80 aftershocks so far, most so slight as to have gone unnoticed by the public.

“The idea is to improve the estimate of where the main shock actually occurred,” Dr. Chapman said. “You don’t just have a point. It’s ruptured over a plane six to seven kilometers wide.” The rupture also occurred more than three miles underground, leaving no visible signs of the fault on the surface.

Daniel McNamara, a research seismologist with the geological survey, said that about 40 portable seismometers, which measure ground motion, were installed, some in a ring

about five miles of the epicenter and others up to 40 miles away.

Generally, data from the closer-in seismometers should help scientists better understand the fault's structure and location. The more distant devices are for studying attenuation, or how fast the wave energy produced by the fault motion dissipates. That helps the geological survey's goal of improving the accuracy of maps that show the earthquake hazard potential in specific areas.

"It's all aimed at more accurately predicting shaking levels," Dr. McNamara said. In the Virginia quake, the wave energy did not dissipate very fast. As millions of people can attest, shaking was felt into northern New England, Canada and parts of the Midwest.

Whether shaking is widespread or not is all about the characteristics of the underlying rock. "How fast the energy attenuates is controlled by geology," Dr. Nettles said.

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The vast midsection of North America is ancient, having last experienced any kind of tectonic activity ages ago. “It’s old crystalline bedrock that hasn’t been deformed for in some cases a billion years,” Dr. Nettles said.

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Alex Welch/Richmond Times-Dispatch, via Associated Press

School officials in Louisa County, Va., inspected damage.

Compare that, Dr. Nettles said, to the tectonically active West, which is being deformed now as plates move against each other and magma comes up from far below the surface.

West Coast quakes, though potentially stronger than those in the East and Midwest, are not felt as far away. That is because actively deforming rock is hotter, more fractured and contains more fluid; older rock is colder and more contiguous.

“You’re losing energy faster in that deformed, warm, more fluid-rich rock,” Dr. Nettles said. She likened it to taffy, which would tend to dampen vibrations when warm and stretchy, but when cooled and stiffer would let the energy pass through with little loss.

Shaking from an earthquake is not uniform. “The waves are a lot more intense in some directions than others, Dr. Chapman said. In the Virginia quake, for instance, shaking appeared to have been felt more strongly in Washington, to the northeast, than in Charlottesville, Va. — which, although closer, is northwest of the epicenter.

Such differences may have something to do with local conditions — certain soils or fill can amplify the seismic vibrations — but the orientation of the fault also plays a role, said Robert B. Herrmann, a geophysicist at St. Louis University who is among those analyzing the aftershock data. “Some of that could be a radiation pattern effect,” he said, with the seismic waves being stronger in certain directions than others. That is one reason why understanding the complexities of the fault structure is important.

Significant Eastern earthquakes are few and far between, and there is very little data from them, Dr. Herrmann said. The Virginia quake should help scientists answer a basic question: why Eastern quakes occur.

“In California you have the plate boundaries; we know how much these things move each

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year," he said.

Here, he added, "the Atlantic is spreading, it's pushing us toward the Midwest. But it's not the nice easy model that we have out of California."

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