PHYS ORG

In the Jersey suburbs, a search for rocks to help fight climate change

May 2 2024, by Kevin Krajick

George Okoko of Lamont-Doherty Earth Observatory samples an outcrop of basalt in Berkeley Heights, N.J., as part of an investigation into rocks that might be used to absorb carbon emissions. Credit: State of the Planet

In early spring, George Okoko was perched on a ledge 15 feet up a crumbly cliff, trying to whack off a basketball-size piece of rock with a hammer and chisel. The locale was suburban Berkeley Heights, N.J. The rock was basalt, a common product of volcanism. This batch formed some 200 million years ago, during vast eruptions that occurred as Europe slowly tore away from North America, creating a chasm that became the Atlantic Ocean.

Okoko, a Ph.D. candidate at Columbia University's Lamont-Doherty Earth Observatory, was not so much interested in geologic history as in a modern use for basalt: to capture and store carbon permanently below the nearby seafloor in solid form.

Basalt underlies much of New Jersey, and is believed to extend well out into the Atlantic seabed. On land, it mostly lies hidden under soil, other kinds of rocks, roads, buildings, parking lots and other human infrastructure.

This particular outcrop, about 400 feet long, was exposed when people cut into a hillside to create a narrow, upward-winding track dubbed Ghost Pony Road. Today, Ghost Pony Road is wedged uphill of the constant roar of Interstate 78 and a busy thoroughfare into the town center.

For more than 20 years, scientists have been studying how basalt formations may be used to help mitigate climate change. The rock's chemical qualities can vary, but in many cases, it naturally reacts with carbon dioxide. When these reactions take place, the carbon is locked into a solid mineral similar to limestone. The natural reactions happen at a slow pace, but researchers think they could be sped up dramatically using a process similar to fracking, in which carbon is pumped down under high pressure.

Already, a project in Iceland that Lamont scientists helped launch is sending emissions from a power plant into the basalt below. There are many other potential sites around the world, including the central rift valley of Kenya, where Okoko is from. Ditto parts of the U.S. East Coast.

Okoko was not on Ghost Pony Road because anyone expects to build a carbon injection operation there. Rather, his research is aimed at characterizing related formations believed to lie under the seabed off New York and New Jersey. Lamont geophysicist David Goldberg, Okoko's advisor, says they could be potentially absorb large amounts of carbon dioxide produced by industries in the region.

Based on seismic data collected in the 1970s, scientists have long suspected that basalts similar to the ones on land lie 30 to 60 miles offshore, under 400 to 600 feet of water and some 2,000 feet of sediment. But they have not yet been definitively mapped nor sampled.

Goldberg is heading a project to learn more about them. He points out that not only is basalt plentiful along the coast; so are factories, oil refineries, power plants, and cement and steel producers that currently emit some 100 million tons of CO_2 every year.

Emissions could be captured directly from these point sources and transported by ships or pipelines to seabed injection sites, he says. He and colleagues first proposed this idea for a basalt-rich area off the Pacific Northwest in 2008, and also for the Northeast in a 2010 paper.

"The coast makes sense," he says. "That's where people are. That's where power plants are needed. And by going offshore, you can reduce risks."

Among other things, injection into seabed basalts would minimize the chances that carbon dioxide could escape back to the surface before it solidified, as emissions would be sealed in by sediments above the rocks. And undersea sites would avoid the need to occupy land in this densely populated region, as well as reduce legal and jurisdictional hurdles.

But not all basalts are created equal. Researchers need to better characterize potential carbon reservoirs to make sure they would work as hoped. That is where Okoko comes in. By studying easily accessible basalts on land, he and others hope to use them as analogs for what are believed to be rocks of similar composition under the sea.

An earlier study suggests that some batches of basalt in New Jersey have some of the world's fastest chemical reactions to lock in carbon. However, more work needs to be done on that, says Goldberg. Also, the rocks must contain enough fractures for the carbon dioxide to make its way through cracks and pores in large quantities.

Okoko had brought two helpers with him on today's excursion: Lamont geochemistry master's student Tavehon "TJ" McGarry, and Alexander Thompson, an undergraduate studying economics at Columbia College, who had come along for the ride.

Along with taking samples for later lab analyses, the team's main task was to examine and document the density and orientation of fractures in the rock.

These fractures could have been formed by any number of processes, including the pressure of previously overlying sedimentary rocks that have since eroded away over millions of years; the grinding of giant glaciers that have repeatedly moved across this landscape; or earthquakes in the distant past that were far more powerful than the magnitude 4.8 one that hit about 20 miles west of here in April 2024.

At several points, McGarry and Thompson set up a 5-by-5-foot square-foot frame cobbled together from plastic plumbing pipes to delineate areas for close inspection and photos. Okoko clambered up to a halfdozen spots with a hand sledge and a chisel to extract samples.

Exposed to weather and with water seeping out in some spots, the stuff was actively disintegrating; he frequently struggled to find his footing. Each time he loosened a rock, he handed it down to the students, who laid it out at the edge of the road. Okoko then came down to inscribe marks indicating the rocks' original positions.

Rocky, cracked-up places like these are ideal habitat for poisonous copperheads and rattlesnakes, and New Jersey has both. Indeed, at one point, the students backed away when they spotted a well-camouflaged snake curled up next to a boulder. After that, everyone was careful where they stepped. (Closer analysis later showed it was a harmless eastern milk snake.)

The team ran a long tape measure against the cliff base, and Okoko crept along foot by foot, counting fractures and taking detailed notes on their size and orientation in a weatherproof notebook. Occasionally, he pulled out a chunk of loosened rock for closer inspection. Behind one, in a wet spot, he found a slug, which he gently relocated.

Okoko flew a camera-equipped drone along parts of the cliff—a treacherous task, given that the cliff was partly screened in with little trees growing up from the bottom, though still bare of leaves. This lasted until the drone tangled with a small branch and crashed, leaving it too damaged to fly. To compensate, Okoko had Thompson walk along the cliff and take images with a cell phone.

After a few hours, the team loaded a few hundred pounds of sample boulders into the back of a station wagon and made the hour-long drive back to the Lamont campus. in the coming months, colleagues will perform various tests to analyze their porosity and chemical characteristics.

This summer, Goldberg and colleagues have arranged for an aircraft to fly more than 6,000 miles of grid lines over the suspected undersea basalt formations. Equipped with instruments measuring magnetism and gravity, this will provide a lot more information about what is down there. The next step would be drilling.

From there, things could move relatively quickly to industrial-scale injection, says Goldberg, depending on the research results. "It could be done in as little as five years," he said. For Okoko's part, he will return to Kenya this summer to investigate basalts there.

This story is republished courtesy of Earth Institute, Columbia University http://blogs.ei.columbia.edu.

Provided by State of the Planet

Citation: In the Jersey suburbs, a search for rocks to help fight climate change (2024, May 2) retrieved 26 June 2024 from https://phys.org/news/2024-05-jersey-suburbs-climate.html