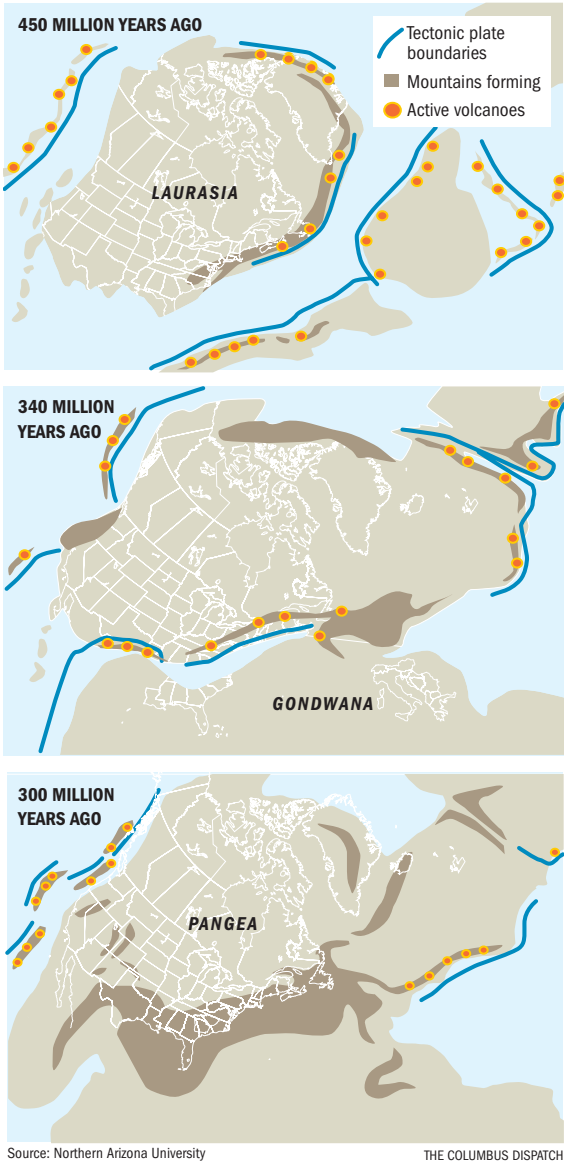
MAKING MOUNTAINS

OU researcher rethinks how and when **Appalachian** range formed

When continents collide

Mountains formed twice in what is now the eastern United States in the past 500 million years. This series of maps show how the continents shifted over millions of years, forming what is now the Appalachian Mountains. The supercontinent Pangea began to break up again about 250 million years ago.



Source: Northern Arizona University

THE COLUMBUS DISPATCH

By Mike Lafferty
THE COLUMBUS DISPATCH

When the Appalachian Mountains formed in a violent collision of continents hundreds of millions of years ago, their jagged, snow-capped peaks rivaled the world's tallest ranges.

"Looking out the window, we would have mountains like the Himalayas. … They would have got to be at least 20,000 feet high," said Damian Nance, an Ohio University geologist.

But the mountains weren't new, he says. They pushed up the bones of an earlier, eroded range.

And what's even more surprising, Nance says, is that the Appalachians are connected to a geological area of southern Mexico. If he's right, maps explaining the continental shifts and how they shaped the world will have to be redrawn.

Geologists estimate that the Appalachians were completed about 300 million years ago, the end result of the collision of two gigantic continents, creating a new supercontinent called Pangea.

"When those two came together, it was a crunch and a half," said Nance, who believes new research from southern Mexico completes the picture of the Appalachians' formation.

The second round of Appalachians, Nance says, spanned Pangea, stretching from what is now southern Mexico into Europe.

The accepted view says that they began 450 million years ago when insects and seed plants were evolving.

But Nance said the mountains were created when a group of islands, including one that eventually formed part of southern Mexico, broke off a large continent called Gondwana, which consisted of South America, Africa, India, Australia and Antarctica. Eventually, these islands collided with the other large land mass, Laurasia, which held what is now North America, Greenland, Europe and parts of Asia.

To complete the ancient map of the Appalachians, Nance and others used field data collected in the Acatlan Complex in southern Mexico, which most geologists never thought had been part of the mountain range.

Conventional thinking says Acatlan was attached to Laurasia and formed the mountain range that includes the Rockies. Nance and his colleagues say the Acatlan Complex was part of Gondwana, and that when the two continents smashed into each other — as many as 150 million years later than thought — they formed Pangea and the Appalachians.

Mountains form when continents, moving atop large plates that float on the Earth's semi-molten interior, collide. Volcanic magma pushes the plates across the globe at a centimeters-a-year creep.

Still, over tens of millions of years, continents

See **MOUNTAIN** Page **D5**

MOUNTAIN

FROM PAGE D4

can move thousands of miles. In the past 4.5 billion years, the continents have merged and broken apart six times, each about 500 million years apart, Nance said.

The plates pack enormous energy. Continental ocean shelves are pulverized, islands are destroyed and mountains are created.

One plate rides up over the other and, in the tumult, mountains, such as the ancient Appalachians or the far more recent Alps, Himalayas and Rockies, rise.

"It's not a simple jacking up of the crust. The crust becomes swollen with heat and the generation of molten magma," said Brendan Murphy, a member of the research team and a geologist at St. Francis Xavier University at Antigonish, Nova Scotia.

"There were volcanoes leading up to the birth of the Appalachians."

Nance said he knows that the new view of how the Appalachians formed, published in the October issue of the journal *Geology,* is controversial.

"There are other views out there," he said. "We think we've got the right answer, but we're a long way from being certain about things."

At issue is a Massachusetts-size piece of the ocean floor found in southern Mexico.

Ocean floors are almost always destroyed in continental collisions. This find in the Acatlan Complex provides a rare glimpse back in time.

The entire Acatlan Complex, Nance and others say, is a piece of Gondwana that stuck to North America when Pangea eventually fractured. It preserves a complete history of Pangea, from assembly to breakup. And it is a piece of the Appalachian puzzle.

"The older history of (the) Appalachians is best documented in Canada, and the younger events are better documented in the U.S," Murphy said.

"Here we have a region in Mexico that has both of these major events. It is one of the most important pieces in the entire Appalachians. It's been overlooked up to now."

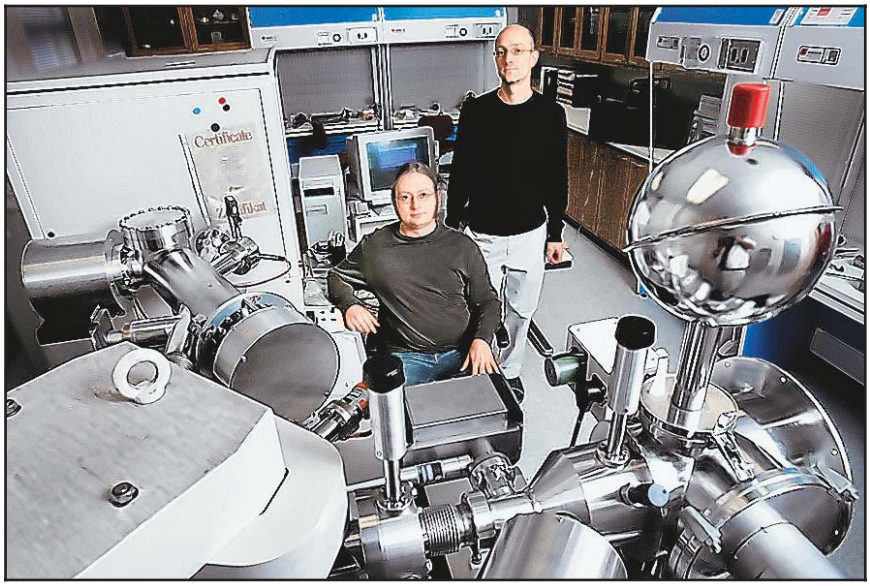
James Hibbard, a geologist at North Carolina State University, in Raleigh, said the study seems to be solid.

"I think Nance and his team are onto something," he said. "The research makes us more aware of the complexity of the mountain formation."

Others say it's more complicated.

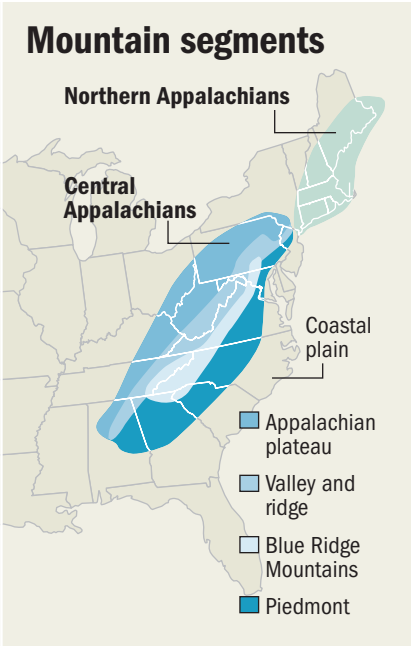
Ohio State University geologist Matthew Saltzman said the geology in the Acatlan is poorly understood.

"It's like trying to reconstruct a bad train wreck," he said.



FRED SQUILLANTE | DISPATCH

Graduate teaching assistant Seth Young, left, and Ohio State University associate professor Matthew Saltzman are studying how the early Appalachian Mountains affected climate change hundreds of millions of years ago.



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Saltzman also studies the Appalachians but focuses on the role that mountain-making has on climate.

He thinks the formation of the first Appalachians changed the global climate, cooling the world and setting off a mass extinction about 443 million years ago. That period rivaled the later demise of the dinosaurs.

Land plants and animals had not yet evolved. But sea life, which included the ancestors of modern squids and octopuses, primitive fish and corals, was devastated.

Geologists think each of the past three bouts of global mountain building/eroding including, most recently, the Himalayas, resulted in similar cooling.

"When you look back at these ice-house periods, you want to find similar mechanisms operating," Saltzman said.

As mountains erode, rocks weather and slowly dissolve, setting off a chemical process that pulls carbon dioxide from the air, said Seth Young, a graduate student working on Saltzman's project.

The drop in carbon dioxide associated with erosion of the earliest Appalachian range dramatically cooled the planet within about 8 million years and set off a long period of glaciation.

It was the opposite of what is happening today. Now, carbon dioxide is being added to the atmosphere, creating more heat-retaining insulation around the planet, threatening another reorganization of life.

Saltzman said the results reinforce the role of CO2 in global weather.

"You would like to have the smoking gun, and that's what we're finding in this case," he said.

And it could all happen again. Earth's tectonic plates are still moving. Geologists predict that another world supercontinent will form once again.

Eventually, Europe and Africa will begin moving westward again, and Nance said he thinks a third round of mountain building is in store for the East Coast of the United States.

"If the Atlantic closes, it would produce an even younger set of Appalachian Mountains," Nance said.

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MIKE KODAS | HARTFORD COURANT VIA AP

The White Mountains in New Hampshire are part of the Appalachian Mountains. When the range first formed hundreds of millions of years ago, it rivaled the highest mountains worldwide and stretched into southern Mexico, an Ohio University geologist says.