Dunes, climate models don't match up with paleomagnetic records

November 26 2007

For a quarter-century or more, the prevailing view among geoscientists has been that the portion of the ancient supercontinent of Pangea that is now the Colorado Plateau in southern Utah shifted more than 1,300 miles north during a 100-million year span that ended about 200 million years ago in the early Jurassic Period, when Pangea began to break up.

Paleomagnetic records are found in igneous rocks that permanently record the direction of the Earth's magnetic field at the time they solidified from the molten state. Paleomagnetism is an important tool for geoscientists in tracking the movement of Earth's tectonic plates over time and records in North America indicate that the Colorado Plateau moved from the equator to about 20 degrees north latitude from 300 million years ago to 200 million years ago.

But new research by geoscientists from the University of Nebraska-Lincoln and the University of Michigan challenges that theory, based on extensive climate modeling studies and sedimentary records found from Wyoming into Utah and Arizona.

In the Nov. 23 issue of the journal *Science*, UNL geoscientists Clinton Rowe, David Loope and Robert Oglesby, former UNL graduate student Charles Broadwater, and Rob Van der Voo of the University of Michigan, report findings that indicate the area must have remained at the equator during the time in question.

"It's a puzzle, a 'conundrum' is the word we like to use," Oglesby said.

"And in the Science paper, we're not solving the conundrum, we're raising the conundrum."

The root of the conundrum is Loope's ongoing research in the Colorado Plateau that began when he was working on his doctorate at the University of Wyoming in the early 1980s. A sedimentologist and an expert on dune formation, he eventually saw that from central Wyoming into central Utah, ancient dunes preserved in the region's 200 million- to 300-hundred-million-year-old sandstone formations all faced southwest, meaning that the winds over that extensive area were almost constantly from the northeast. As his study progressed, he discovered that the direction of the dunes shifted to the southeast in what is now southern Utah, meaning the wind direction shifted to the northwest. What's more, those prevailing winds were consistent over the entire 100 million years in question and the shift in wind direction could only have occurred at the equator.

"I thought that was very curious," Loope said. "It didn't seem to fit with what we think we know about where the continents were."

Loope is also a paleoclimatologist (who studies ancient climates), as are Rowe and Oglesby, who also have expertise in climate modeling. The three geoscientists began working together, trying to find a computerized climate model that would explain the discrepancy, but they couldn't find any that worked.

"We ran the model in any different number of configurations just to see if we could make it do something different," Rowe said. "It didn't matter what we did to it, as long as you had some land, and it was distributed north and south of the equator, you would end up with this monsoonal flow that matched these records from the dunes.

"The equator is the only place you could get this large-scale arc of winds that turn from the northeast to the northwest as they moved south. Nowhere else would you get that as part of the general circulation unless the physics of the world 200 million years ago was very different from what it is today. And we just don't think that's the case."

Puzzled by the discrepancy between their research and the paleomagnetic records, they turned to Van der Voo, an expert on paleomagnetism.

"We brought Rob in to try to see if he could help us sort it out, and he's like, 'Gosh, guys, I don't know. This is a conundrum,'" Oglesby said. "It's important to note that we have not just a paleomag person as a co-author, but arguably the best-known paleomag person in the world -- and he's as confused as we are."

Van der Voo agreed that, for now, there's no clear answer to the conundrum.

"The nicest thing would have been if we had a solution, but we don't," Van der Voo said. "All we can say is that we have this enigma, so perhaps our model of Pangea for the period in question is wrong or the wind direction didn't follow the common patterns that we recognize in the modern world. Neither seems likely, but we're bringing this inconsistency to the attention of the scientific community in hopes of stimulating further research."

And further research is exactly what's on the agenda, Oglesby said.

"We'll come up with everything we can possibly think of," he said. "From the point of view of the climate model, the paleogeography, the vegetation, the topography, local-scale vs. large-scale, paleomag, going back and rethinking everything that the dunes tell us. We'll go back to square one in everything, trying to figure it out."

Source: University of Nebraska-Lincoln