# Team identifies hidden clues to ancient supercontinents, confirms Pannotia

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A composite image of the Western hemisphere of the Earth. Credit: NASA

An Ohio University geologist who first proposed the now-accepted supercontinent cycle theory in the 1980s has rallied to the cause of one of those supercontinents, Pannotia, that is in danger of being overlooked.

Dr. Damian Nance, Distinguished Professor of Geological Sciences, said the supercontinent cycle is known to have had a profound influence on the course of Earth history and the evolution of its oceans, atmosphere and biosphere, and is now thought to be, in addition, the dominant influence on the circulation of the Earth's mantle, even fundamentally affecting the behavior of Earth's magnetic field.

"We now know a whole lot more about what's going on between the surface and the Earth's core," Nance said. "It seems quite clear now that the supercontinent cycle plays an enormous role in the circulation of the material in the earth's mantle, and that has an impact on the Earth's magnetic field. It's taken the implications of the cycle to a whole new level. That's really pretty fundamental stuff."

Nance and Ohio University colleague Tom Worsley proposed the supercontinent cycle in the early 1980s. Based on data available at the time, they proposed the existence of five supercontinents that pre-dated the well-known Pangaea supercontinent. Some of them have been accepted, such as the supercontinent Rodinia, which came together about 1,100 million years ago, and Columbia, which broke up some 400 million years before that. However, the most recent pre-Pangaean supercontinent, Pannotia, is still subject to disagreement. Nance and Worsley argued that it came into existence about 600 million years ago.

"When we first put forward this supercontinent cycle idea, this was one of the supercontinents we had identified from the data we had at that time, and we weren't the only ones who have done so," Nance said. "In the intervening 20 or 30 years, an awful lot has been made of some of the earlier supercontinents we had proposed, but this one has been

shortchanged, largely because the database which has allowed these things to be identified has not been able to nail this one down very successfully."

The understanding of much of that data has changed since the 1980s, he added. Another group had published a paper in the 1980s that documented the breakup of a supercontinent, later called Pannotia. But later dating suggested this breakup occurred at around the same time it would have formed, leading some to question whether it ever actually existed. However, subsequent changes to the geologic time scale indicates a broader gap for Pannotia to have existed, he said.

The new paper, published by Nance and colleague Brendan Murphy of St. Francis Xavier University in Nova Scotia, Canada, is titled "Supercontinents and the case for Pannotia." It was published by the *Geological Society of London*. Nance and Murphy argue that the recognition of past supercontinents need not rely solely on continental reconstructions, but can also exploit a variety of phenomena that accompany their assembly and breakup.

For example, supercontinent assembly is accompanied by worldwide mountain building as the continents collide, just as evidence of continental rifting will accompany supercontinent breakup. Similarly, supercontinent assembly fosters extinctions as surface conditions change and habitats are destroyed, whereas breakup fosters radiations as new habitats are created.

Supercontinents also affect the world's sea level, ocean chemistry and climate in predictable ways and produce an array of isotopic signals that can be identified in rocks. When the geologic record is examined for evidence of these accompanying phenomena, the case for Pannotia is unmistakable, they argue. The time interval encompassed by the assembly and breakup of Pannotia was accompanied by some of the

most profound changes in Earth history, changes that were heralded by widespread mountain building, followed by global evidence of continental breakup, and affected the Earth's oceans, atmosphere, biosphere and climate just as predicted.

These signals, Nance and Murphy caution, argue strongly for the existence of Pannotia, and to ignore them and dismiss this supercontinent is to potentially overlook the profound changes in mantle circulation that likewise accompany the assembly and breakup stages of the supercontinent cycle.

Provided by Ohio University

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