

Is old rock really as 'solid as a rock'?

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

In the course of billions of years continents break up, drift apart, and are pushed back together again. The cores of continents are, however,

geologically extremely stable and have survived up to 3.8 billions of years. These cores that are called cratons are the oldest known geological features of our planet. It was assumed that the cratons are stable because of their especially solid structure due to relatively low temperatures compared to the surrounding mantle. A team of German-American scientists now discovered that these cratons that were assumed to be "as solid as a rock" are not that solid after all.

The team lead by Dr. Mikhail Kaban from the GFZ German Research Centre for Geosciences now discovered that the craton beneath the North American continent is extremely deformed: its root is shifted relative to the center of the craton by 850 kilometers towards the west-southwest.

This fact is in contrast to the prevailing assumptions that these continental roots did not undergo substantial changes after their formation 2.5 to 3.8 billion years ago. The study that appears in the latest online publication of *Nature Geoscience* contradicts this traditional view. "We combined and analyzed several data sets from the Earth's gravity field, topography, seismology, and crustal structure and constructed a three dimensional density model of the composition of the lithosphere below North America", explains GFZ scientist Mikhail Kaban. "It became apparent that the lower part of the cratonic root was shifted by about 850 kilometers."

What caused the deformation of the stable and solid craton? A model of the flows in the Earth's mantle below North America, developed by the scientists, reveals that the [mantle](#) material below 200 kilometers flows westward at a velocity of about 4 millimeters per year. This is in concordance with the movement of the tectonic plate. Due to the basal drag of this flow the lower part of the cratonic lithosphere is shifted. "This indicates that the craton is not as solid and as insensitive to the [mantle flow](#) as was previously assumed", Kaban completes. There is far

more mechanical, chemical, and thermal interaction between the craton of billions of years in age and its surrounding in the [upper mantle](#) of the Earth than previously thought.

More information: Mikhail K. Kaban, Walter D. Mooney and Alexey G. Petrunin: "Cratonic root beneath North America shifted by basal drag from the convecting mantle", *Nature Geoscience*, Advance Online Publication, 07.09.2015, [DOI: 10.1038/NGEO2525](https://doi.org/10.1038/NGEO2525)

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