New research suggests North American continent is a slow eroder

January 6 2012, by Bob Yirka

(PhysOrg.com) -- When looking at the great expanse of the whole of North America, it's difficult to not see it all as a relatively permanent plot of land between the Pacific and Atlantic oceans. It doesn't seem to change all that much, except for what we people do to it. Thus, it likely won't come as much of a surprise to most that live here on this big continent, that new research shows that what we take for granted, does appear to be true, that is, the North American continent erodes very slowly. So slowly, writes Terrence Blackburn and his team of researchers from MIT, that not much has changed over the past billion and a half years. The team has come to this conclusion after studying volcanic rocks found in the mountains of Montana, and as they describe in their paper published, in *Science*, it doesn't look like much change is coming

in the future either.

It all comes down, the researchers say, to looking closely at material that once resided deep within the Earth's crust, but has been forced to the surface. In this case, the material is volcanic xenoliths, or rocks forced to the surface by volcanic eruptions. Such rocks contain uranium and lead isotopes which when examined by U-Pb thermochronology offer a long term, two billion year, temperature record of the place from which they came. And temperature timelines can be used to determine erosion rates because temperature changes are an indication of buoyancy of the Earth's crust. If rocky material is pushed to the surface, for example, its temperature will drop fairly rapidly. This is the first time such an approach has been used to measure erosion rates over such a long time period.

The mountains where the xenoliths were found are part of what is known as the North American Craton, which is one of just a few on the planet; they are believed to be the oldest parts of the Earth's crust and some of the mantle below. Other cratons exist in such places as Australia and Western Africa and serve as a sort of backbone for the rest of the continent in which they reside, keeping it from eroding very quickly.

In studying the isotopes in the xenoliths, the researchers came to believe that during the formation of the North American continent, there was a lot of erosion. This went on they believe, for some 300 million years as mountains grew and had some parts washed away, etc. But over time, things reached a sort of equilibrium, and since that time, not much has changed, and that's why it doesn't seem likely that much change will go on heading into the future either. Not unless some other force enters the picture, like say a large object shooting in from outer space knocking everything asunder.

More information: An Exhumation History of Continents over Billion-

Year Time Scales, *Science* 6 January 2012: Vol. 335 no. 6064 pp. 73-76.
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ABSTRACT

The continental lithosphere contains the oldest and most stable structures on Earth, where fragments of ancient material have eluded destruction by tectonic and surface processes operating over billions of years. Although present-day erosion of these remnants is slow, a record of how they have uplifted, eroded, and cooled over Earth's history can provide insight into the physical properties of the continents and the forces operating to exhume them over geologic time. We constructed a continuous record of ancient lithosphere cooling with the use of uranium-lead (U-Pb) thermochronology on volcanically exhumed lower crustal fragments. Combining these measurements with thermal and Pb-diffusion models constrains the range of possible erosion histories. Measured U-Pb data are consistent with extremely low erosion rates persisting over time scales approaching the age of the continents themselves.