Evidence of ancient weathering from acid rain may explain melting of snowball Earth

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

(Phys.org)—A team of researchers from China and the U.S. has found evidence of ancient weathering in a glacial deposit in China's Hunan province. In their paper published in *Proceedings of the National Academy of Sciences*, the team outlines their findings and why they believe ancient weathering offers evidence of acid rain that might have played a role in the development of more advanced life forms on our planet.

Scientists believe that planet Earth was covered from pole to pole in ice at least twice in its long history. The most recent "snowball" event is believed to have occurred from approximately 635 to 650 million years ago. Such an event would obviously have marked a very cold period in Earth's history, but it has also led planet scientists to wonder what might have occurred to melt the snowball. One theory suggests that even as the surface of the planet was frozen, there were still factors that caused a massive amount of greenhouse gases to build up in the atmosphere.

Such a buildup would have trapped heat, eventually reaching a point at which surface ice would have melted. That amount of greenhouse gases, particularly carbon dioxide, would have also led to acid rain, which would have caused weathering on exposed rock after the ice covering melted. But scientists had not found any evidence of such weathering.

Now, researchers with this new effort report that they found evidence of weathering in rocks gathered high on a mountain above a glacier. After obtaining samples and studying their magnesium isotopes, the researchers concluded that the rocks had been subjected to intense weathering due to exposure to chemicals consistent with acid rain—during a period in time at the end of the last snowball period.

The researchers suggest acid rain might have been falling from the skies for hundreds of thousands of years, contributing, at least in part, to the Cambrian explosion, which occurred approximately 541 million years

ago. Their thinking is that runoff from rock weathering due to the acid rain would have made its way to the world's oceans leading to the formation of cap carbonate on the floor, which they believe might have paved the way for the development of more complex life forms.

More information: Kang-Jun Huang et al. Episode of intense chemical weathering during the termination of the 635 Ma Marinoan glaciation, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1607712113

Abstract

Cryogenian (~720–635 Ma) global glaciations (the snowball Earth) represent the most extreme ice ages in Earth's history. The termination of these snowball Earth glaciations is marked by the global precipitation of cap carbonates, which are interpreted to have been driven by intense chemical weathering on continents. However, direct geochemical evidence for the intense chemical weathering in the aftermath of snowball glaciations is lacking. Here, we report Mg isotopic data from the terminal Cryogenian or Marinoan-age Nantuo Formation and the overlying cap carbonate of the basal Doushantuo Formation in South China. A positive excursion of extremely high δ26Mg values (+0.56 to +0.95)—indicative of an episode of intense chemical weathering—occurs in the top Nantuo Formation, whereas the siliciclastic component of the overlying Doushantuo cap carbonate has significantly lower δ26Mg values (