# How Earth avoided global warming, last time around

June 11 2014

Credit: NASA

Geochemists have calculated a huge rise in atmospheric CO2 was only avoided by the formation of a vast mountain range in the middle of the ancient supercontinent, Pangea. This work is being presented to the Goldschmidt geochemistry conference in Sacramento, California.

Around 300 million years ago, plate tectonics caused the continents to aggregate into a giant supercontinent, known as "Pangea". The sheer size of the continent meant that much of the land surface was far from the sea, and so the continent became increasingly arid due to lack of

humidity. This aridity meant that rock weathering was reduced; normally, a reduction in rock weathering means that CO2 levels rise, yet in spite of this CO2 levels – which had been falling prior to the mountain formation- continued to drop, eventually undergoing the most significant drop in atmospheric CO2 of the last 500 million years. This phenomenon has remained unexplained, until now.

Now a group of French scientists from the CNRS in Toulouse have produced a model which seems to explain this contradiction. The period coincides with the rise of a vast series of mountains in the interior of Pangea, the "Hercynian" mountains". These mountains arose in a wide belt, running from what is now the Appalachians, through to Ireland, South-Western England, through Paris and the Alps into Germany, and on further East.

According to team leader, Dr Yves Godderis (CNRS, Toulouse, France):

"The formation of these mountains meant that the rock weathering, which was threatening to slow to a walk through much of the supercontinent, was able to continue. The steep slopes of these Hercynian mountains produced physical erosion. Occurring in a humid equatorial environment, this physical erosion promoted rock weathering and removing CO2 from the atmosphere".

He continued, "We believe that it is this which led to the dramatic drop in atmospheric levels of CO2. We estimate that if it hadn't been for the formation of the Hercynian mountains, the atmospheric CO2 levels would have reached around 25 times the pre-industrial level, meaning that CO2 levels would have reached around 7000 ppm (parts per million). Let me put that into a present-day context; the current atmospheric CO2 levels are around 400 ppm, so this means that we would have seen CO2 rise to a level around 17 times current levels. This would obviously have had severe effects on the environment of that

time. But the formation of the mountains in fact contributed to the greatest fall in atmospheric CO2 in the last 500 million years".

The team believes that even if the mountains had not formed and CO2 levels rose sharply, this would not have led to a runaway greenhouse effect as happened on Venus, because the increasing temperatures would have led to rocks being ultimately weathered, heat compensating for the scarcity of water. Rock weathering would have removed CO2 from the atmosphere, thus stopping the rising temperatures.

"So it would eventually have been self-correcting" said Dr Godderis, "but there's no doubt that this would have stalled Earth's temperature at a high level for a long, long time. The world would look very different today if these mountains had not developed when they did.

This is a new model which explains some of the events in the 80 million years following the start of the Carboniferous period, and of course the ideas need to be confirmed before we can be sure that the model is completely accurate. The take-home message is that the factors affecting atmospheric CO2 over geological periods of time are complex, and our understanding is still evolving".

**More information:** The Goldschmidt Conference is the world's leading annual conference on geochemistry. It takes place in Sacramento, California from 8-13 June 2014. goldschmidt.info/2014/

Provided by European Association of Geochemistry