At last, a theory about why Denver is a mile above sea level

March 13 2015, byDan Elliott

A marker carved in one of the west steps of the State Capitol denotes the "one mile above sea level" elevation in Denver on Friday, March 13, 2015. In an article published in March 2015, geologists from the University of Colorado suggest chemical reactions triggered by water far below the Earth's surface could have made part of the continental plate less dense. Because the plate floats on the Earth's mantle, the lighter portion might have risen like an empty boat next to one with a heavy cargo -- lifting the vast High Plains far above sea level. (AP Photo/David Zalubowski)

Geologists may finally be able to explain why Denver, the Mile High City, is a mile high: water.

A new theory suggests that chemical reactions, triggered by water far below the Earth's surface, could have made part of the North American plate less dense many millions of years ago, when the continents we know today were still forming.

Because plates float on the Earth's mantle, parts of the Western United States might have risen, like an empty boat next to one with a heavy cargo, pushing the vast High Plains far above sea level, according to the theory formulated by geologists Craig Jones and Kevin Mahan at the University of Colorado-Boulder.

Their work appeared last week on the website of the journal *Geology*, and is a big deal for Denver, where the 5,280-foot elevation is a point of pride and a big part of the city's identity. At Coors Field, where the Colorado Rockies play baseball, a single row of purple seats interrupts about 50,000 green ones, marking the mile-high line in the grandstand.

Geologists have long been puzzled by how the High Plains could be so big, so high and so smooth. The plains descend gently from roughly 6,000 feet to 2,000 feet above sea level as they stretch for thousands of square miles, from the Texas Panhandle to southern Montana, and from western Kansas to the foothills of the Rocky Mountains in Colorado.

It's well established that much of the West was still at sea level 70 million years ago, and that tectonic shifts don't fully explain the High Plains' altitude. The lifting began long after the ancient Farallon oceanic plate was shoved deep under a vast part of western North America and then settled deep into the planet's mantle over millions of years.

Why? "Crustal hydration," Jones and Mahan theorize.

They suggest that water that had been locked in minerals in the Farallon plate was released because of pressure from the overlying rock and heat emanating from the Earth's core. The water then rose into the continental plate, setting off chemical reactions that turned garnet and other dense minerals into mica and other less heavy minerals, making vast areas of the crust lighter.

Jones said the Earth's crust under the High Plains "floats higher" over the mantle, much like a plank of buoyant balsa wood rises higher in the water than a plank of dense pine.

The reason crustal hydration happened where and when it did has to do with how steeply the oceanic plate descended, Jones said. At some point, the angle at which the plate was descending became shallower, enabling the released water to rise for reasons that remain unclear, he said.

Few geological formations appear so uniform on such a vast scale as the High Plains—the only other known location in the world that's similar is in southern Africa, Jones said. The prevailing theory there is different, involving some other source of buoyance, Mahan said.

The composition of rocks found in the High Plains is strong evidence in favor of the hypothesis, Jones said, but it needs more testing, and that was one reason for publishing it.

"Do we think this is 'the' answer? No. Could it be 'an' answer? I suppose it's possible," said Jones, who is also a fellow at the Cooperative Institute for Research in Environmental Sciences, a partnership of CU and the National Oceanic and Atmospheric Administration.

The theory has merit, according to Ken Dueker, a professor of geology and geophysics at the University of Wyoming.

"It's a plausible hypothesis that has some data to support it," said Dueker, who was not part of the team that devised it. One unanswered question, which Jones and Mahan raised in the journal *Geology*, is what channeled the water up into the North American plate, Dueker said.

The Farallon plate also helped form the Rocky Mountains just west of Denver, which soar as high as 14,433 feet. As it moved under the continent, friction caused the North American plate above to compress horizontally, like a rug that bunches up if a foot is dragged across it, geologists say.

Cracks opened from that horizontal pressure, and one side was shoved higher than the other, creating the Rockies.

Not knowing why Denver is a mile high is a little awkward for Colorado geologists. Jones recalls having to tell a British TV producer a few years ago that he couldn't explain it.

"We probably need to figure this one out, guys, because it's kind of embarrassing," Jones said.