Analysis of ancient raindrop pits offers clues about early Earth atmosphere

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(Phys.org)—Researchers from NASA's Ames Research Center have presented their findings regarding the study of raindrop imprints left behind in volcanic ash approximately 2.7 billion years ago, at the American Geophysical Union annual meeting in San Francisco. By studying the crater size of the drops left behind, the researchers reported that they have been able to estimate the density of the atmosphere at the time the drops fell.

Scientists have been trying to determine why planet Earth was not colder than evidence suggests during the time period 2.4 to 5 billion years ago. Back then energy from the sun has been estimated to be approximately 30 percent weaker than it is today, thus something else must have either created more heat, or helped conserve the heat that did strike the planet.

Most scientists believe the second option is more likely and that it came about due to the atmosphere serving as a blanket to keep heat from dissipating out into space. For that to have happened, the atmosphere would have had to have been much thicker than it is today.

In the presentation, NASA researcher Sanjoy Som suggested that there likely was a lot of nitrogen in the air at the time, but no oxygen – there was no life yet. Instead he suggests, there were likely more greenhouse gasses such as methane and carbon dioxide.

The raindrop indentations were formed, he said, by rain falling on volcanic ash, followed by more falling ash at a site in South Africa. They were hidden for billions of years but then were exposed as erosion slowly removed the rock on top of them. Measuring the crater size allows for calculating the speed at which the drops fell and since prior research has shown that the maximum size of raindrops cannot exceed the maximum size of drops that fall today, the researchers have been able to estimate how thick the atmosphere was at the time. They did so by replicating the environment in which the craters were formed – bringing in fresh volcanic ash from Iceland and dropping water from a pipette on it from a platform 25 meters overhead – high enough for the drops to reach their maximum speed, i.e. terminal velocity.

In examining their results the researchers found that if the drops were as large as possible, the atmospheric density at the time would have to have been nearly twice what it is today. But since the largest drops are rare, they suggest the drops were likely smaller and thus the air density would have been very close to what it is today – a finding that indicates that there must have been a significant amount of greenhouse gases in the atmosphere to account for why the planet wasn't colder at the time.

More information: Read also: Fossil raindrop impressions imply greenhouse gases loaded early Earth's atmosphere