Meteorites 'behind volcanic eruptions' say scientists

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(PhysOrg.com) -- Gases that cause volcanoes to erupt may have spewed from meteorites that smashed into the earth billions of years ago, according to research presented at The BA Festival of Science in Liverpool today.

Research conducted by earth scientists at The University of Manchester in conjunction with other institutions, challenges the conventional belief of scientists that the earth's earliest atmosphere came from solar nebular gases attracted and trapped by gravitational pull.

Gases are trapped in the deep earth and only released when rock is melted and volcanic eruptions and fire fountains occur, driven by the explosive expansion of these gases.

But putting gas into rock in the first place is hard and requires extreme conditions.

Researchers say a clue to how this actually happens is the release of 'light' helium – or the 3He isotope - from mid ocean ridges. Light helium is not produced on earth and somehow became trapped when the earth formed.

Scientists have previously argued that to put enough light helium into the deep earth to explain the volcanic emissions, the early earth was completely molten and surrounded by a dense atmosphere more like that around Jupiter than anything we see today.

But new research on neon gas led by Prof Chris Ballentine, Professor of Isotope Geochemistry in The School of Earth, Atmospheric and Environmental Sciences, casts serious doubt on this.

He said: “We have shown that the neon gas fingerprint expected for the captured solar nebula model is not matched.

“Instead we have found a meteorite signature, which suggests the massive early atmosphere is not trapped by gravitational attraction as originally thought but a result of meteorites spewing out gas on impact.

The research being presented at The BA Festival by Prof Ballentine also suggests that sea water appears to be leaking into the deep earth, with half of the water in the earth’s mantle – the region of the earth between the crust and the core – estimated to come from this source.

Prof Ballentine said: “The second signature or gas ‘fingerprint’ we have found in the deep Earth is identical to that of seawater, which is itself unique in the solar system.

“The only explanation for this is that seawater trapped in ocean crust is being driven back down into the deep Earth in a tectonic process called subduction.”

This statement challenges the belief of many scientists who argue this is impossible. They say the water should be squeezed and melted out during the subduction process.

Professor Ballentine added: “This process has the potential to fundamentally change how scientists think Earth has behaved over time. Even a little bit of water added to rock in the deep earth makes it more plastic and allows movement of tectonic plates sitting on top to be quicker.

“The source and fate of atmospheres and water on planets is central to understanding the origin of life and the conditions that lead to our own planet looking as it does today. Our work provides evidence that changes our big picture understanding of how planetary systems acquire their volatile elements.”

The research team have drawn their conclusions after studying commercially produced volcanic CO2 gas from the Colorado Plateau in the US.

The Manchester team is currently using a new state of the art instrument funded by the Natural Environment Research Council (NERC) to identify whether or not they can see this 'meteorite signature' in other trace gases such as krypton and xenon isotopes.

Scientists at Manchester are also working with colleagues at the Carnegie Institute, Washington and The University of Michigan to understand how changing the water content of the mantle will change the way in which the Earth convects and drives continents over time.

Source: University of Manchester