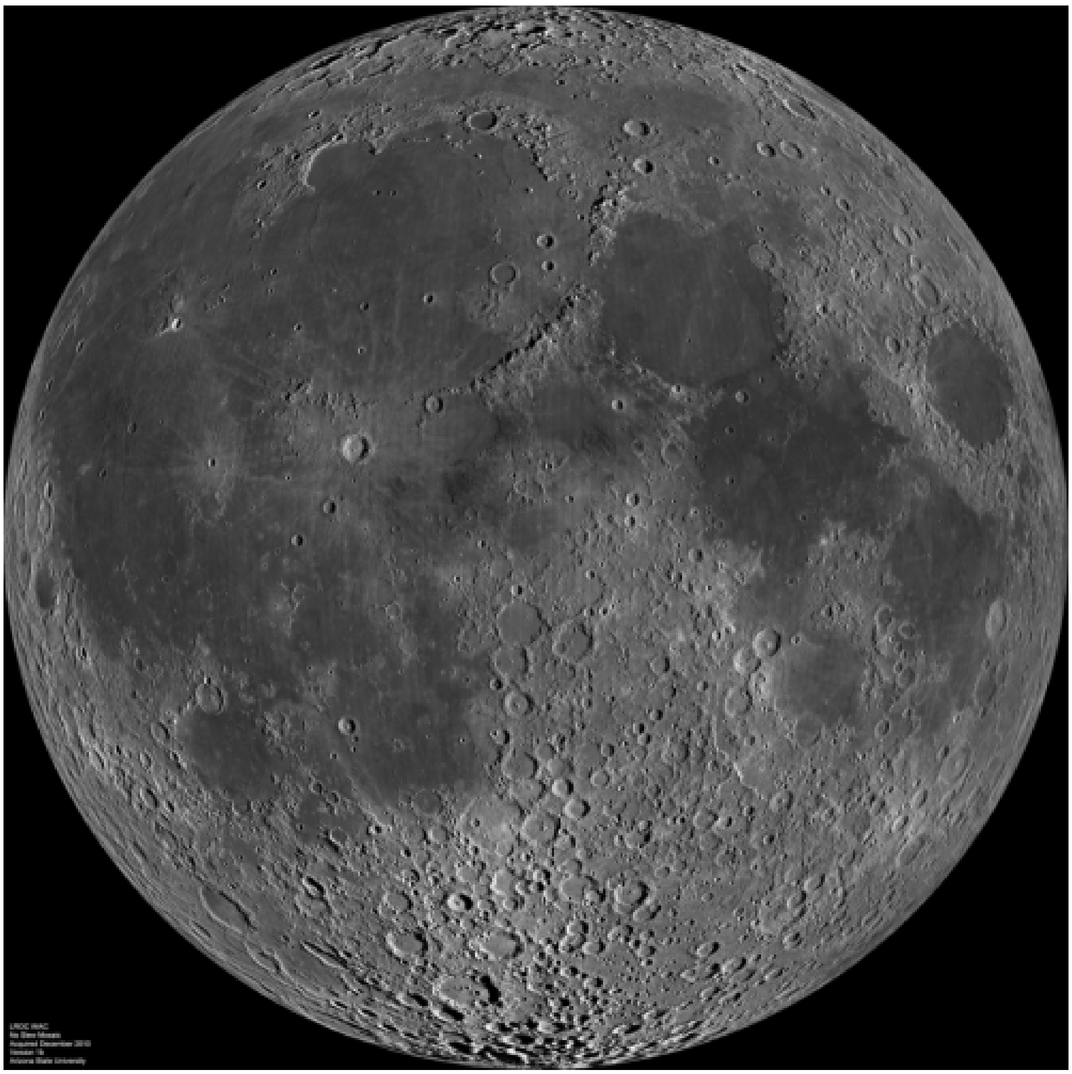
A dash of water on the lunar rocks

July 7 2016



This is a composite image of the lunar nearside taken by the Lunar Reconnaissance Orbiter in June 2009, note the presence of dark areas of maria on this side of the moon. Credit: NASA

Ever since Apollo astronauts walked the lunar surface in 1969 and brought rocks back for laboratory analysis, it has been clear that lunar rocks are missing chemical components that boil off at relatively low temperature, the so-called "volatile" elements. This is evidence that the moon experienced high temperatures during its formation and has led researchers to current ideas about the origin of the moon in a cataclysmic impact with the Earth.

Water is often considered to be one such volatile substance that would have boiled off, and indeed, after Apollo, the moon was thought to be bone dry. Then, in 2008, researchers reported the first measurements of lunar water in the form of molecules dissolved into rocky materials that came from the moon's interior.

Following this discovery, made on the same samples returned during Apollo but using improved laboratory techniques, researchers analyzed other lunar samples and noticed a persistent level of dissolved water in the rocks – it now appears that the moon is not as dry as researchers once supposed.

This bit of water on the lunar rocks has been a puzzle because water, either as liquid or ice, is among the most volatile substances on the rocky planets—it should have boiled off after the giant impact when the material that formed the Earth and moon were hot, even molten and vaporized.

Writing in a recent issue of *Earth and Planetary Science Letters*, researchers report new calculations of the behavior of water immediately after the moon-forming giant impact. Whereas in the solar system's parental cloud, the solar nebula, water exists either as a gas or as ice, in the vapor cloud from which the moon formed, water or hydrogen could exist either as a gas or dissolved in the magma.

The new calculations show that despite the high temperatures, a significant amount of hydrogen would dissolve into the magma disk from which the moon would form. The amounts dissolved explain the small but unmistakable water traces observed in lunar rocks since 2008. The existence of a dash of water in lunar rocks is consistent with a violent origin for our satellite and may indeed be a signature of such a birth.

More information: Kaveh Pahlevan et al, Speciation and dissolution of hydrogen in the proto-lunar disk, *Earth and Planetary Science Letters* (2016). DOI: 10.1016/j.epsl.2016.04.015

Provided by The Observatoire de Nice