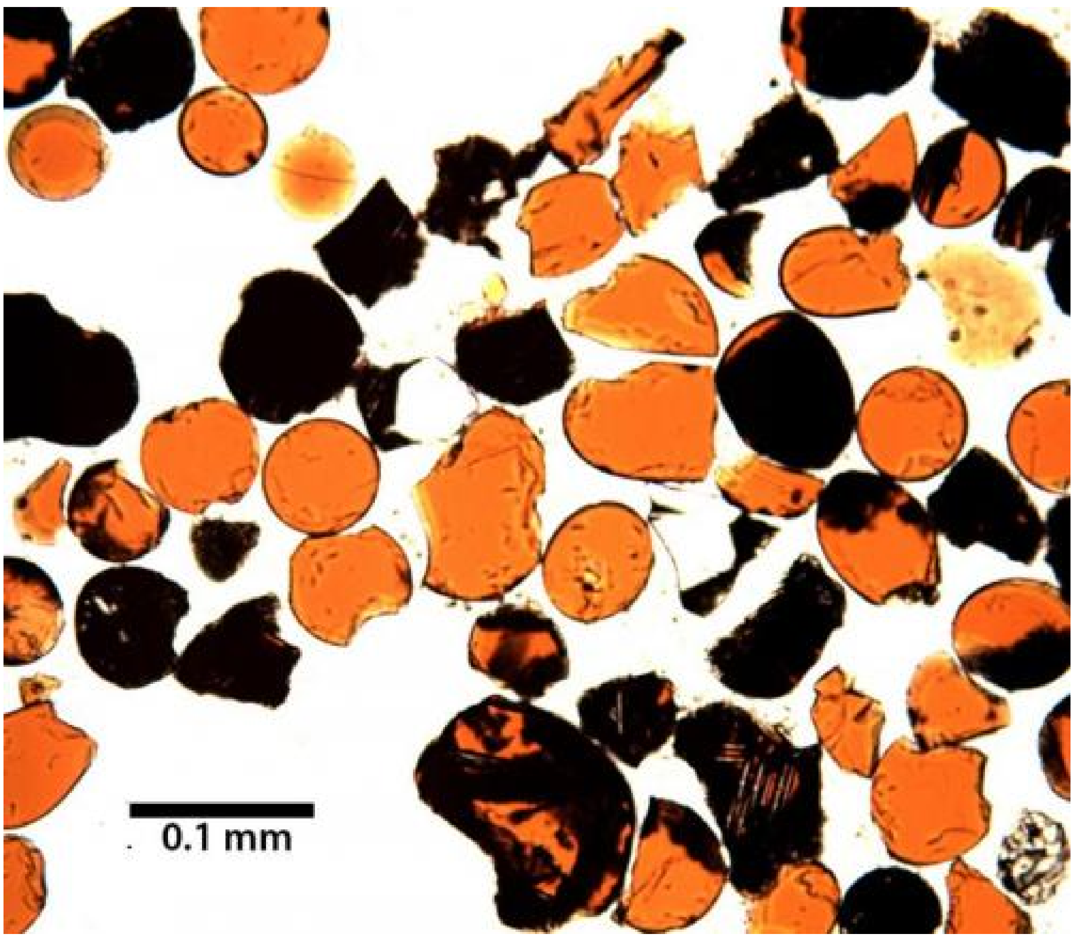
Lunar rock samples reveal variations in water concentrations

May 26 2014, by Bob Yirka

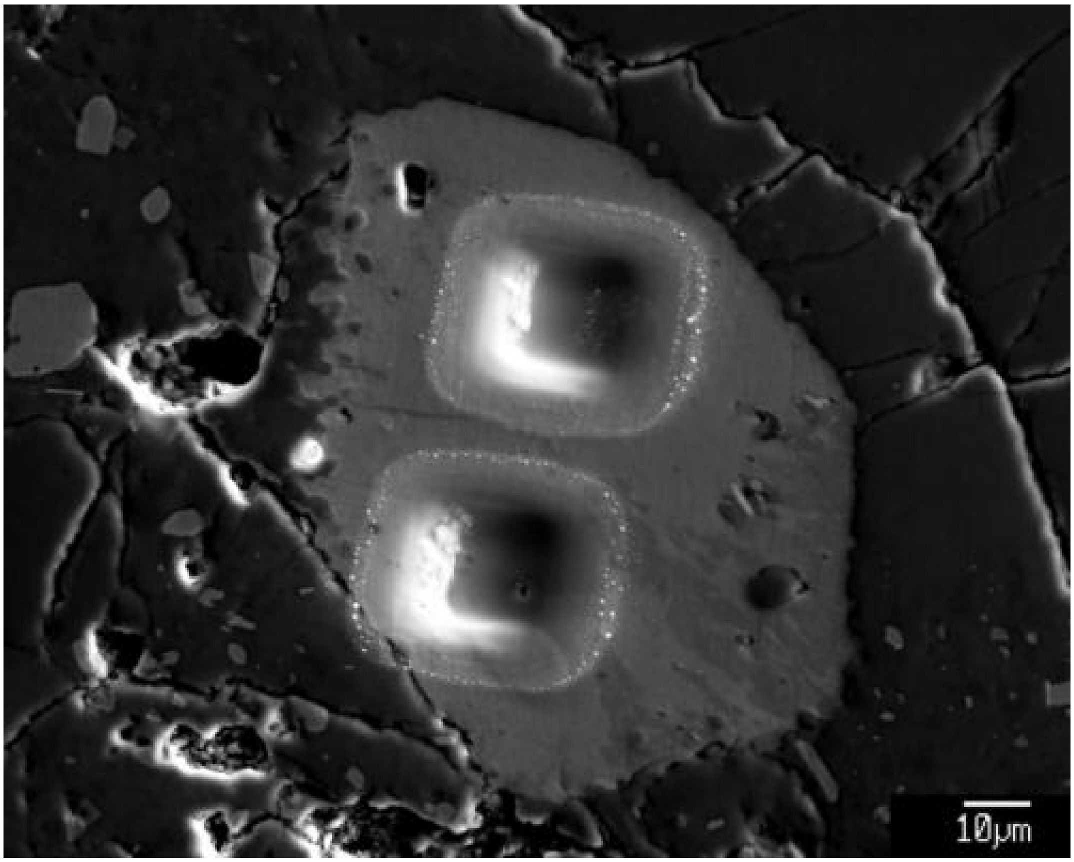


Optical micrograph of pyroclastic glass beads in Apollo sample 74220, 383, the famous "orange soil". Water was first detected by Saal et al., 2008 in glass beads similar to these. Credit: G.J. Taylor, HIGP

(Phys.org) —A team of researchers studying rocks returned from the moon by Apollo 17 astronauts has found that rocks found in different locations have different amounts of water in them. In their paper published in the journal *Nature Geoscience*, the team describes their findings and offer possible explanations for the concentration differences.

It was just six years ago that scientists learned that there was water on the moon, prior to that, conventional wisdom suggested the moon was not only barren, but completely dry. That discovery led to more research which revealed that not only is there water on the moon, but it's actually widespread—sealed inside of rocks, but present nonetheless. In this new effort, the research team reports that in studying the findings of several other teams analyzing the rocks since water was first found in them, they've discovered that some of the rocks have more water sealed inside of them than others—the difference appears to be related to where on the moon the rocks were found. This suggests, the team reports, that some parts of the moon are wetter than others. The new research team also found that the chemical composition of the water was different depending on the rock source as well.

The findings have led the researchers to consider how differing water concentrations relate to theories regarding the origin of the moon. Most scientists believe the moon came to exist approximately four and half billion years ago when a collision occurred between Earth and another planet. The general consensus is that some of the moon came from Earth, some from the other planet and the rest from other bodies such as comets and asteroids that subsequently struck the moon. Water on the moon could therefore have come from the Earth, the other planet or comets. Intriguingly, the researchers have found that the chemical makeup of water samples in some of the rocks (volcanic glass) is similar to magma samples that once resided in Earth's mantle. Others, on the other hand, were found to be much drier. The researchers conclude that the formation of the moon appears to have been a far more complex series of events than theories have suggested.



Secondary electron image of pits left by ion microprobe analyses of a heterogeneous apatite grain in Apollo sample 14321, 1047. Water has now been detected in apatite in many different lunar rock types. Credit: K.L. Robinson, HIGP.

More information: Heterogeneous distribution of water in the Moon, *Nature Geoscience* (2014) DOI: 10.1038/ngeo2173

Abstract

Initial analyses of lunar samples returned by the Apollo missions indicated that the Moon was essentially devoid of water. However, improved analytical techniques have revealed that pyroclastic glass beads in Apollo samples contain measurable amounts of water. Taking into account volatile loss during eruption of the glass beads onto the surface, the pre-eruption magma could have contained water on the order of 100 ppm by weight, concentrations that are similar to the mantle sources of mid-ocean ridge basalts on Earth. Lava flows from vast basaltic plains—the lunar maria—also contain appreciable amounts of water, as shown by analyses of apatite in mare basalt samples. In contrast, apatite in most non-mare rocks contains much less water than the mare basalts and glass beads. The hydrogen isotopic composition of lunar samples is relatively similar to that of the Earth's interior, but the deuterium to hydrogen ratios obtained from lunar samples seem to have a larger range than found in Earth's mantle. Thus, measurements of water concentration and hydrogen isotopic composition suggest that water is heterogeneously distributed in the Moon and varies in isotopic composition. The variability in the Moon's water may reflect heterogeneity in accretion processes, redistribution during differentiation or later additions by volatile-rich impactors.

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