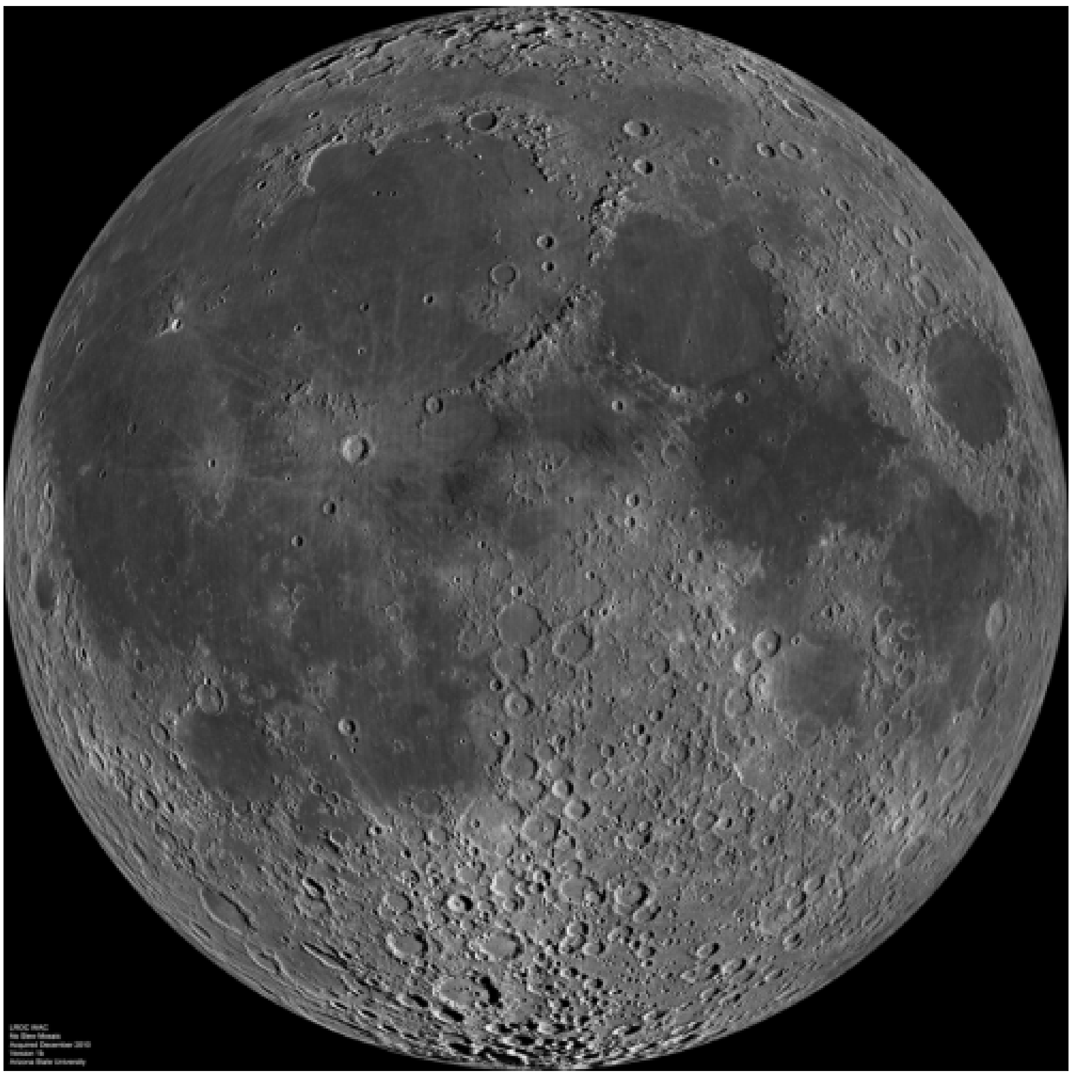
Study shows most water in lunar soil generated by solar wind, not result of comet or meteorite impacts

October 7 2014, by Bob Yirka



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

(Phys.org) —A pair of researchers with the Sorbonne Universités, Muséum National d'Histoire Naturelle, has determined that most of the water in the soil on the surface of the moon was formed due to protons in the solar wind colliding with oxygen in lunar dust, rather than from comet or meteorite impacts. In their paper published in *Proceedings of the National Academy of Sciences*, Alice Stephant and François Robert describe their study and the results they found.

When NASA astronauts brought back soil and rock samples from the moon, it was assumed by most in the scientific community that everything they found was dry—that there was no water in any of it. Subsequent analysis using newer techniques has revealed that not only is there water beneath the surface in some places, but the dust on the surface also has small amounts as well. Once this became known, most scientists assumed the water got there due to comet or meteorite impacts —in this new effort, the research pair suggests that conventional thinking is wrong once again and that the water, at least in the surface dust, comes about due to the impact of solar wind on tiny dust particles.

In studying tiny grains of lunar soil samples, the researchers found that the reduction of oxygen from silicates in the soil by protons from the solar wind was almost certainly the means by which the water was generated. They came to that conclusion through determining the lithium isotope ratio in the samples (plagioclase rock found on the surface of the moon) which gave the isotope ratio for the hydrogen—from that they were able to calculate the deuterium-hydrogen ratio which they compared to the amount of water actually in the granule sample. They found that on average, the granules contained just 15 percent water from somewhere else (presumably comets or meteorites) leaving the rest to have been formed due to the solar wind interaction. They note also that for some samples, all of the water was due to solar wind interaction.

The duo is quick to point out that their conclusions only relate to water found on the surface of the moon—where the water below the surface came from is still up for conjecture.

More information: The negligible chondritic contribution in the lunar soils water, Alice Stephant, *PNAS*, DOI: 10.1073/pnas.1408118111

Abstract
Recent data from Apollo samples demonstrate the presence of water in the lunar interior and at the surface, challenging previous assumption that the Moon was free of water. However, the source(s) of this water remains enigmatic. The external flux of particles and solid materials that reach the surface of the airless Moon constitute a hydrogen (H) surface reservoir that can be converted to water (or OH) during proton implantation in rocks or remobilization during magmatic events. Our original goal was thus to quantify the relative contributions to this H surface reservoir. To this end, we report NanoSIMS measurements of D/H and 7Li/6Li ratios on agglutinates, volcanic glasses, and plagioclase grains from the Apollo sample collection. Clear correlations emerge between cosmogenic D and 6Li revealing that almost all D is produced by spallation reactions both on the surface and in the interior of the grains. In grain interiors, no evidence of chondritic water has been found. This observation allows us to constrain the H isotopic ratio of hypothetical juvenile lunar water to $\delta D \leq -550‰$. On the grain surface, the hydroxyl concentrations are significant and the D/H ratios indicate that they originate from solar wind implantation. The scattering distribution of the data around the theoretical D vs. 6Li spallation correlation is compatible with a chondritic contribution