News

How the Moon produces its own water

Electrically charged particles interact with the oxygen present in some dust grains on the lunar surface and produce water.

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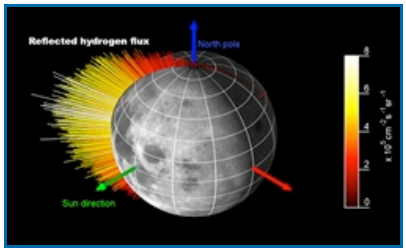

The Moon is a big sponge that absorbs electrically charged particles given out by the Sun. These particles interact with the oxygen present in some dust grains on the lunar surface, producing water. This discovery, made by the European Space Agency (ESA)-Indian Space Research Organization's (ISRO) Sub KeV Atom Reflecting Analyzer (SARA) instrument onboard the Indian Chandrayaan-1 lunar orbiter, confirms how water is likely being created on the lunar surface.

It also gives scientists a new way to take images of the Moon and other airless bodies in the solar system.

The lunar surface is a loose collection of irregular dust grains, known as regolith. Incoming particles should be trapped in the spaces between the grains and absorbed. When this happens to protons, they are expected to interact with the oxygen in the lunar regolith to produce hydroxyl and water. The signature for these molecules was found recently and reported by Chandrayaan-1's Moon Mineralogy Mapper (M3) instrument team.

The SARA results confirm that solar hydrogen nuclei are indeed being absorbed by the lunar regolith but also highlight a mystery — not every proton is absorbed, one out of every five rebounds into space. In the process, the proton joins with an electron to become an atom of hydrogen. "We didn't expect to see this at all," said Stas Barabash at the Swedish Institute of Space Physics.

Although Barabash and his colleagues do not know what causes the reflections, the discovery paves the way for a new type of image to be made. The hydrogen shoots off with speeds of around 447,387 miles per hour (720,000 kilometers per hour) and escapes without being deflected by the Moon's weak gravity. Hydrogen is also electrically neutral, and it is not diverted by the magnetic fields in space. The atoms fly in straight lines, just like photons of light. In principle, each atom can be traced back to its origin, and an image of the surface can be made. The areas that emit most hydrogen will show up the brightest.

While the Moon does not generate a global magnetic field, some lunar rocks are magnetized. Barabash and his team are currently making images to look for such 'magnetic anomalies' in lunar rocks. These generate magnetic bubbles that deflect incoming protons away into surrounding regions, making magnetic rocks appear dark in a hydrogen image. The incoming protons are part of the solar wind, a constant stream of particles given off by the Sun. They collide with every celestial object in the solar system but are usually stopped by the body's atmosphere. On bodies without such a natural shield, for example asteroids or the planet Mercury, the solar wind reaches the ground. The SARA team expects that these objects, too, will reflect many of the incoming protons back into space as hydrogen atoms.

This knowledge provides timely advice for the scientists and engineers who are readying ESA's BepiColombo mission to Mercury. The spacecraft will be carrying two similar instruments to SARA and may find that the inner-most planet is reflecting more hydrogen than the Moon because the solar wind is more concentrated closer to the Sun.

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