Regenerative water sources on the Moon

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More and more observational evidence supports the existence of water (H_2O) on the Moon. Recent studies found up to 2000 ppm water in the impact glass beads extracted from the Chang'e-5 mission returned lunar soils.[1] However, the sources and chemical and/or physical processes responsible for the production of the lunar water are not fully unveiled.

We provide evidence via laboratory simulation experiments that water can be generated and liberated through thermal shocks induced by micrometeorite impacts on solar-wind proton saturated anhydrous silicates (Figure 1).[2] For airless bodies containing organics and phyllosilicates, non-reactive electrons coupled with intense thermal shock could generate water by low-temperature oxidation of organics and mineral dehydration without proton irradiation.[3]

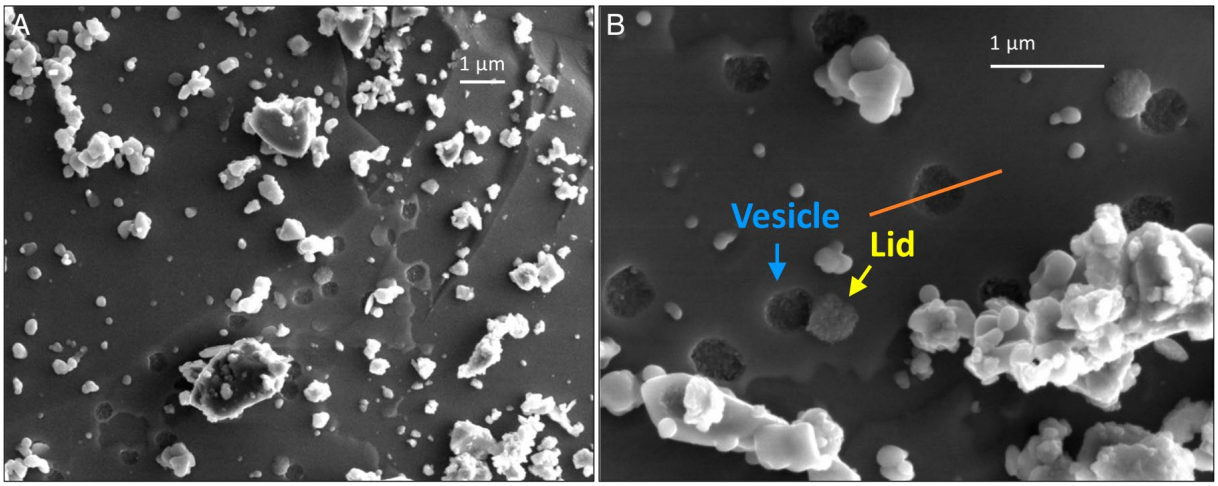

Figure 1. Secondary electron images of deuterium ion implanted and infrared laser processed anhydrous olivine grains. The samples simulate the lunar soil processed by micrometeorite impacts and solar wind proton implantation.

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[1] He, H.; Ji, J.; Zhang, Y.; Hu, S.; Lin, Y.; Hui, H.; Hao, J.; Li, R.; Yang, W.; Tian, H. et. al. A solar wind-derived water reservoir on the Moon hosted by impact glass beads. *Nat. Geosci.* **2023**, *16*(4), 294-300.

[2] Zhu, C.; Crandall, P. B.; Gillis-Davis, J. J.; Ishii, H. A.; Bradley, J. P.; Corley, L. M.; Kaiser, R. I. Untangling the formation and liberation of water in the lunar regolith. *P. Natl. Acad. Sci.* **2019**, *116*(23), 11165-11170.

[3] Zhu, C.; Góbi, S.; Abplanalp, M. J.; Frigge, R.; Gillis-Davis, J. J.; Dominguez, G.; Miljković, K.; Kaiser, R. I. Regenerative water sources on surfaces of airless bodies. *Nat. Astron.* **2020**, *4*, 45–52.