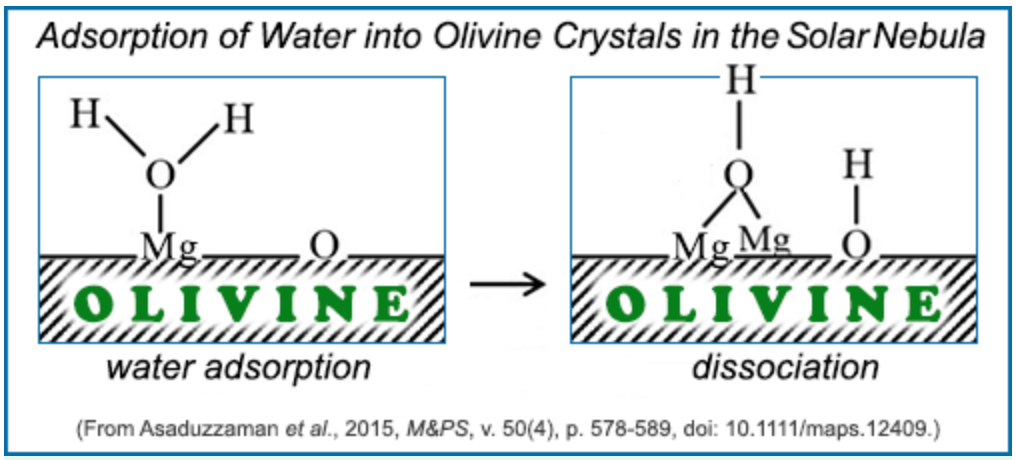
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks

Quick Views of Big Advances

Modeling Water Adsorption on Olivine Crystals in the Solar Nebula

Materials science and cosmochemistry join forces to examine possible ways water was directly incorporated into the solids that eventually accreted to form Earth and other planetary bodies.



Asaduzzaman and coauthors explain a hydration mechanism of olivine within the life span of the solar nebula. Their results suggest a pathway for the formation of phyllosilicates, which could have been accreted into Earth.

Calculations of mineral-water interactions and molecular dynamic simulations by Abu Asaduzzaman, Krishna Muralidharan, and Jibamitra Ganguly (University of Arizona) support the idea that some of Earth's water could have originated in the solar nebula from the incorporation of water into olivine crystals.

The scenario they propose begins with ***olivine*** mineral surfaces saturated by adsorbed water with additional incorportation of water in the subsurface. Previous studies had only considered surface adsorption of water, so the new work extends water reactions to the subsurface. This leads to the formation of brucite molecules on the surface and serpentine molecules in the subsurface, which are amorphous materals that could crystallize into proper ***phyllosilicates***. The idea that the amorphous materials precede crystalline phyllosilicates is compatible with observations made previously by other researchers of phyllosilicates associated with amorphous materials of similar compositions in the fine-grained matrices of some pristine carbonaceous chondrites (such as MET 00426 [***Data Link*** from the Meteoritical Bulletin].

Asaduzzaman and coauthors say that there was plenty of time for the precursor amorphous materials to form during nebular condensation. They continue to study the thermodynamics of the process, hydration deeper into olivine crystals, and the activation energy of hydration.

See Reference:

· Asaduzzaman, A., Muralidharan, K., and Ganguly, J. (2015) Incorporation of Water into Olivine During Nebular Condensation: Insights from Density Functional Theory and Thermodynamics, and Implications for

Phyllosilicate Formation and Terrestrial Water Inventory, *Meteoritics & Planetary Science,* v. 50(4), p. 578-589, doi: 10.1111/maps.12409. [***abstract***].

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