Scientists tap novel technologies to see water as never before

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Credit: Pxhere

From the creation of a single droplet to the flow of a river and the world's hydrological cycle—how water binds together, and to different surfaces, has far-reaching consequences. Examining water through a new lens, a group of scientists has redefined how this binding effect works at the level of the smallest molecule.

To date, scientists have believed that thin water films grow layer-by-layer to form recognizable liquid droplets. However, by visualizing nano-sized droplets of water in action, a new study published in *Science Advances* has turned this traditional model on its head.

By mapping nanodroplets on individual mineral particles, a group of researchers from Umeå University, Yale University and Pacific Northwest National Laboratory found that water "growth" first starts near the defect edges of minerals. Then, thicker water films are formed, before surface tension takes over to engulf the mineral surface and form familiar water droplets.

To make their findings, the team used a novel cocktail of atomic force microscopy (AFM) and infrared lasers at the Environmental Molecular Sciences Laboratory at the Pacific Northwest National Laboratory.

"This is the first time we have been able to see water droplets directly at the nanoscale, and to our surprise we found a selective binding effect at defect edges of mineral nanoparticles ," says Sibel Ebru Yalcin, research scientist working in the Malvankar Lab at Yale, and the study's first author.

"Looking at this important question in a new way, and at the nano-scale, has really solved a longstanding mystery in how water binds to minerals", says professor Jean-François Boily, leading expert in mineral surface chemistry at Umeå University.

His lab conceived this project and gained access to the imaging facilities of the Environmental Molecular Sciences Laboratory. The Umeå group is now using these new findings to explore how this selective binding of water affects natural processes taking place in soils and in the atmosphere.

More information: Sibel Ebru Yalcin et al. Direct observation of anisotropic growth of water films on minerals driven by defects and surface tension, *Science Advances* (2020). DOI: 10.1126/sciadv.aaz9708

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