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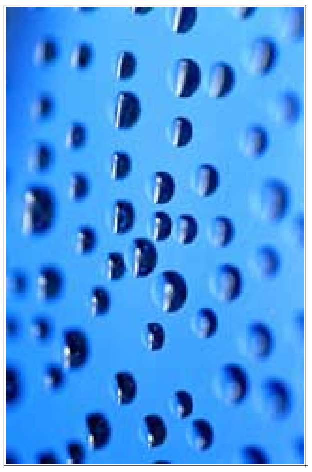
Water turns to jelly under pressure

Philip Ball

Syrupy squeezed water could affect proteins and plate tectonics.



At a pinch you can make jelly from water alone.

Water squeezed between two surfaces turns to jelly, US physicists have found[1]. This behaviour could affect proteins interacting in cells, sediments aggregating in rivers and rocks moving deep in the earth.

Confined between two mineral layers, a water film just a few molecules thick can have a viscosity many times greater than normal, say Yingxi Zhu and Steve Granick of the University of Illinois at Urbana-Champaign. This stickiness depends on the orientation of the surfaces relative to one another - rotating one alters the water's viscosity significantly.

This dependence on the surfaces' twist caught the researchers unawares when their initial experiments with oscillating slivers of mica - a clay-like mineral that can be cleaved to extremely flat sheets - generated seemingly irreproducible results. The more viscous the intervening layer of water, the greater the 'shear force' on the sheets.

The orderly arrangement of atoms at the mica surfaces affects the character of the film trapped between them, suggest Zhu and Granick. If the rows of atoms in one mica sheet are aligned with those in the other, this may encourage the water molecules to take on a similar configuration, like eggs in an egg carton. Otherwise, the water molecules may remain disordered.

Theorists have predicted this ordering effect of a crystal surface on the structure of a liquid layer adjacent to it. But contrary to these predictions, the water doesn't seem to adopt a strictly regular molecular structure, as they would when freezing to form a thin layer of ice. Instead, the molecules remain more mobile, like those in a gel.

Zhu and Granick reach this conclusion rather nervously. They are mindful of the 'polywater' scandal of the late 1960s, in which Soviet scientists claimed to have found a new, gel-like, polymerized form of water in thin glass capillaries. The claims ended in ignominy when the 'new' state was found to be the result of impurities.

However, the viscous films cooked up in Illinois are much thinner than those in 'polywater' samples, and have ample support from theory.

The films' influence on the interactions of biomolecules and minerals is not going to be easy to predict, given that the lateral atomic structure of the surfaces seems to influence how ordered the water film is.

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References

1. Zhu, Y. & Granick, S.Viscosity of interfacial water. *Physical Review Letters* **87**, 096104, (2001). | Article | PubMed | ChemPort |

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