Astrochemical Inheritance of Terrestrial Planets Water from Local Wet Silicates

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The delivery of water to the inner Solar System rocky planets, including Earth, remains debated, as standard models assume that they formed from dry grains.
However, we showed in a recent work, that a non-negligible amount of water formed during the prestellar phase could have been retained by pebbles and planetesimals at the Earth's orbit in enough quantities to reproduce its water content. We based this study on a kinetic approach using quantum mechanics calculations of the binding energy of water on amorphous ice.
In this work, we present new quantum calculations of the binding energy of water frozen on the surface of silicate grains, and show that it is on average about twice stronger than that on the amorphous ice. The contribution of this first layer of frozen water increases the dust temperature at which frozen water can be retained. This provides a local source of water not only for the Earth, but also for the inner rocky planets. The predictions from our model are in agreement with the available estimates of water content in terrestrial planets. This suggests that water delivery from the outer Solar System may not be required.