Fluid phase equilibrium in confinement: effects of compressibility and wetting

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The liquid-vapor transition is affected by confinement. Even for water in sub-millimeter containers, the density of the liquid in equilibrium with its vapor differs from the bulk value, and the vapor becomes unstable before the liquid reaches the bulk equilibrium pressure [1-4]. I revisit this phenomenon with a fully analytic approach. A natural length emerges: the Berthelot-Laplace length $\lambda=2\gamma\kappa/3$, where γ and κ are the liquid-vapor surface tension and the liquid isothermal compressibility, respectively. This allows to easily determine the various regimes for any fluid, and to extend the results to the case where the liquid phase wets the container walls only partially. This has practical implications in the use of fluid inclusions in minerals for palaeotemperature reconstruction [2,5].

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