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Fluid dynamical models of lunar crustal formation CALLUM WATSON, JEROME NEUFELD, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, CHLO MICHAUT, Laboratoire de Gologie, Terre, Plante, Environnement, cole Normale Suprieure de Lyon, France — Typical models of the thermal evolution of the Moon involve a solid crust growing via crystal flotation, with an underlying magma ocean then cooling by conduction through the crust. However, convection dominated by a temperature-dependent viscosity, producing a stagnant-lid, may be more relevant to the early lunar magma ocean and explain the long timescales for crust formation. This involves convection with in a fluid whose viscosity varies by several orders of magnitude as a function of temperature and crystal fraction. The temperature scale most relevant to the convection is that over which the viscosity varies. This scale is greatly reduced during rapid changes in viscosity, such as when jamming occurs at a critical melt fraction. We consider a one-dimensional model in which the lunar magma ocean is considered as one body of convecting silicate, with a viscosity that depends strongly on temperature, pressure and solid fraction. The resulting surface heat flux depends primarily on the temperature of the mixed interior and on the hydrostatic pressure at the base of the stagnant lid. This results in an initial unstable scenario with a lid that is mostly entrained back into the interior after approximately 200 Ma, which may explain the long persistence of the Lunar dynamo.

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