Lunar mantle overturn conditioned by magma ocean crystallization (and vis-versa)

At the end of the lunar magma ocean crystallization, Ti-rich cumulates formed, which denser than the underlying mantle and prone to overturn. However, these cumulates form at shallow depth, and can become trapped within the cold stagnant lid before they are mobilized. Nevertheless, the long lifetime of the lunar magma ocean ensured an enduring weak top boundary for the early convecting mantle, that could have accelerated the overturn of the Ti-rich layer before the growth of a stiff lid. The fate of high-Ti cumulates is crucial to many aspects of the lunar evolution, likely influencing mare volcanism, possibly helping to drive a core dynamo and perhaps responsible for the presence of a partially molten layer atop the lunar core. Using a coupled model for thermal evolution of the crystallizing lunar magma ocean, and for thermo-chemical convection of the (solid) mantle, we performed simulation of the lunar overturn below a crystallizing magma ocean. By varying the rheological parameters of the Moon, we showed that Ti-rich extensive overturn is highly likely, and occurs via small-scale dripping. We unravel thermal feedbacks between the lunar overturn and the crystallization of the lunar magma ocean, and study the long-term evolution of the Moon in light of this event.