

**HSE REMOVAL FROM THE LUNAR MANTLE
AND THE TIMELINE OF THE LUNAR
BOMBARDMENT.**

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Introduction: The contrasting scenarios of terminal cataclysm and accretion tail have been proposed to explain the intense bombardment that the Moon suffered ~3.9Ga ago. Support to the cataclysmic hypothesis was provided in [1], under the traditional assumption that HSEs track the amount of chondritic material that hit the Moon since its formation.

However, a new result [2] shows that HSE sequestration into the core of a planetary body continues until 50-70% of the mantle has crystallized, due to the pervasive exsolution and segregation of FeS. If this is true also for the Moon, and the crystallization of its magma ocean occurred late [3], the lunar HSEs would severely underestimate the total mass accreted by our satellite since its formation.

New results: we have re-examined the results of [2] for the case of the Moon. Due to the low-pressure, FeS exsolution from the upper mantle can occur even after complete crystallization, until the eutectic temperature in the Fe-FeS system is achieved (~1,000K). FeS exsolution can explain the current S content of the Moon and could remove the pre-existing HSEs.

In this case, we show that the accretion-tail scenario can explain the lunar crater record. In this new scenario the Moon accretes in total 5×10^{-5} Earth masses, but retains HSEs only starting from 4.35Gy ago. An advantage of this scenario is to explain why the Moon is so depleted in HSEs relative to the Earth, without ad-hoc assumptions on the size distribution of the projectiles [4].

[1] Morbidelli, A., et al. 2012. *EPSL* 355, 144-151. [2] Rubie, D.C., et al. 2016. *Science*, 353, 1141-1144. [3] Elkins-Tanton, L.T., et al. 2011. *EPSL* 304, 326-336. [4] Bottke, W.F., et al. 2010. *Science* 330, 1527.