

Major element isotopic fractionation in the proto-lunar disk

KAVEH PAHLEVAN

Lagrange Laboratory, Observatoire de la Côte d'Azur, Nice,
France 06304 (pahlevan@oca.eu)

Models of the Moon-forming giant impact generate silicate circumplanetary disks with initial thermal states ranging from mostly liquid [1] to mostly vapor [2] [3]. These hot disks are presumed to provide the initial conditions for lunar accretion over a timescale of $\sim 10^2$ - 10^3 years [4] [5]. While the fluid disk epoch is not well understood, it is during this stage of the evolution that the cosmochemical signatures of the processes of lunar origin are likely imprinted.

Two recent developments permit potential new insights on the evolution of the proto-lunar disk. First, it has been recognized that stable isotope liquid-vapor fractionation can be significant, even at the high temperatures encountered after the giant impact [6]. Second, stable isotopes in terrestrial and lunar samples have been measured to high ($\sim 0.1\%$) precision, potentially permitting high-precision reconstructions of the composition of bulk reservoirs from which they are sourced and providing new stable isotope constraints on the processes accompanying lunar origin.

Here, we couple a thermodynamic model of liquid-vapor silicates [6] to a recently proposed model of the evolution of the proto-lunar disk [7] with the goal of forging a connection between the initial conditions and/or evolutionary processes in the disk and the resulting stable isotope composition of the lunar material now being measured with increasing precision. We will present calculations of the evolution of Earth-Moon isotopic differences subject to such evolutionary models with the dual goals of providing a test/constraint on the models as well as to highlight the behavior of distinct major element stable isotopic systems to silicate liquid-vapor fractionation.

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