Insight into the Origin and Composition of the Moon

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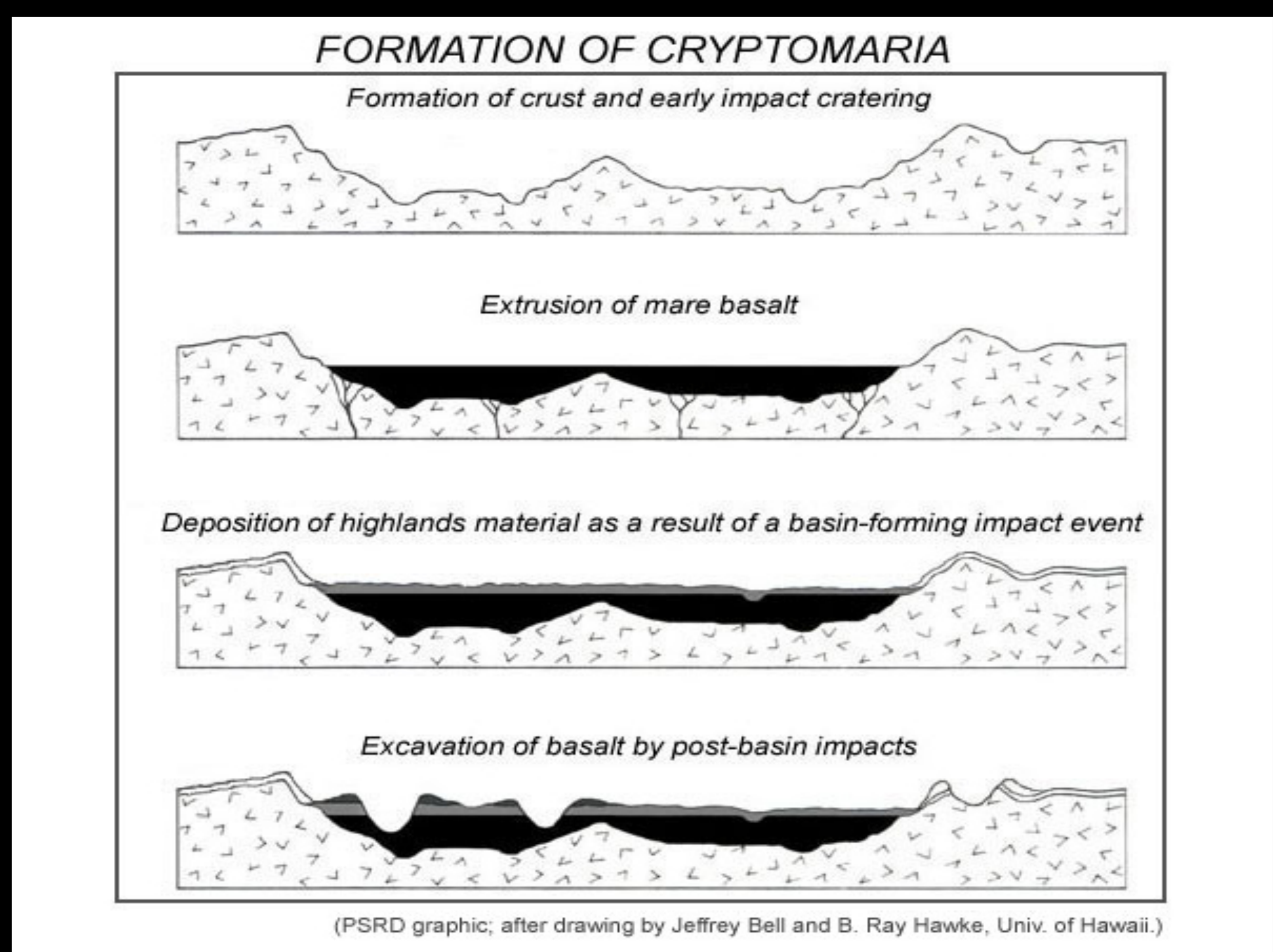
Abstract

The Moon presents many scientific challenges in understanding its history and composition. Gaining insight into these questions provides valuable information not only about the Moon, but to a better understanding of space and time. This is because the Moon has remained relatively unchanged since its violent inception and subsequent solidification. Thus, by studying the Moon, it provides a window into the past that may provide an enhanced outlook not only about the Earth - Moon systems early history, but about the various physical processes that are involved in the creation of solar systems.

The purpose of this poster is to encourage interest into Earth's only natural satellite and to inspire motivation to read and engage the literature concerning the Moon as well as the Earth.

Composition and Magmatism of the Luna Maria



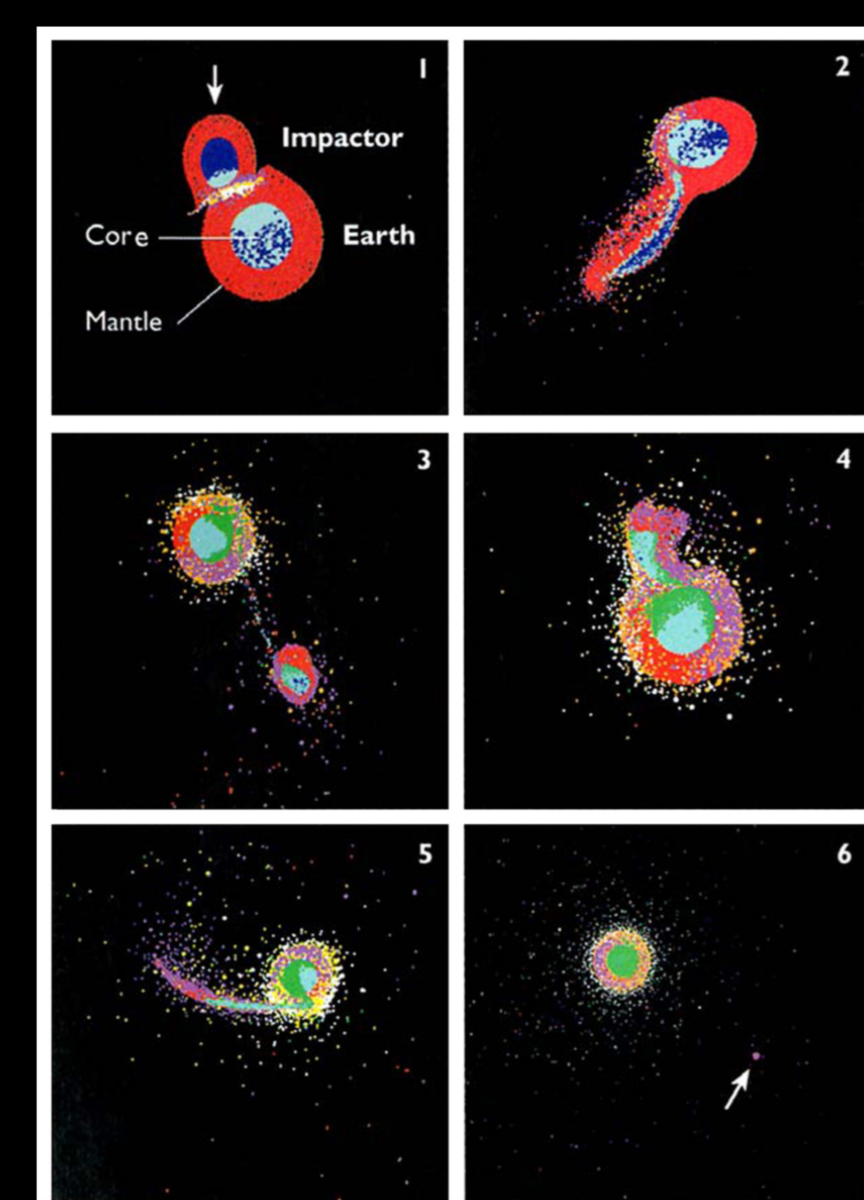
Reconstruction of the geologic history in the Schiller-Schickard region of the moon demonstrating evolution of volcanism, especially in crated sections.
(Bell, J. F. and Hawke, B. R., 1984, pp. 6906)

- Composed mainly of flood basalts in Basins on the near side of the moon
- Mare basalts cover approximately 17% of the surface, but only comprise ~1% of the lunar crust
- Most abundant mineral assemblages is that of olivine, plagioclase feldspar, pyroxenes (augite and pigeonite), ilmenite as well as spinel; also containing a TiO_2 range up to 14 wt%
- The Basins themselves are remnants of massive impacts and/or in part to ancient tectonic activity occurring long ago that caused the lower elevation for the lavas to flow into

http://d1jqu7g1y74ds1.cloudfront.net/wp-content/uploads/2010/06/Moon.jpg

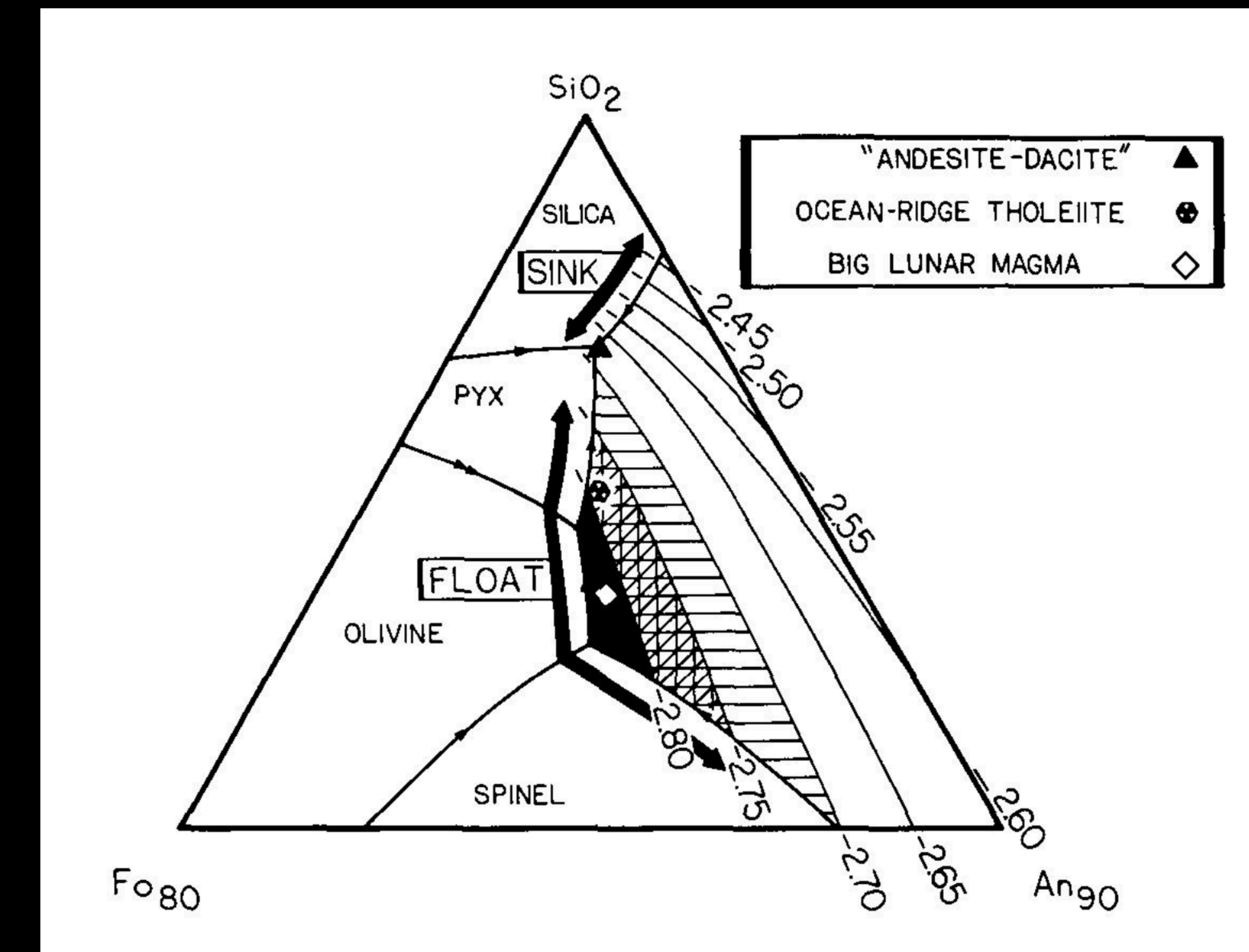
The Origin of the Moon

- It is widely believed that the Moon is the result of a collision between Earth and some celestial body that occurred 4.5 b.y.a.
- Active debate resides in the specifics of the impactor; although the current leading theory suggests an oblique impact by a roughly Mars-sized planetesimal called Theia
- This theory suggests that the Moon should be composed primarily from Theia (70 – 90% by mass), however isotropic similarities with Earth suggest a terrestrial origin
- A couple proposed explainations for an absence of a differentiated Theia isotopic signature include:
    - Proto-Earth and Theia formed at similar heliocentric distances from the same isotopic reservior which resulted in having similar isotopic compositions
    - Isotopic re-equilibrium after the impact event that destroyed the original heterogeneity



Simulation of the giant impact event that is hypothesized to have led to the formation of the moon.
(Jaumann, R., et al 2012, pp. 35)

Composition of the Lunar Highlands



Calculated density contours of liquid at liquidus temperature for the plagioclase liquidus field. The diagram compares olivine (Fo_{80}), plagioclase (An_{90}) and silica (SiO_2). The shaded regions show the parts of the liquidus where An_{95} should float, which Big Lunar Magma (BLM) falls into.
(Walker, D., & Hays, J. F., 1977, pp 427)

- Magma ocean fractionation of the early moon resulted in floating plagioclase which crystallized in the upper most crust forming the heavily anorthositic composition
- The discrepancy in thicknesses of the far and near side of the moon was the topic of a recent study that suggested a smaller companion moon, possibly created during the same Earth-Theia impact event and thus composed of the same material, could have collided into the far side at a subsonic impact velocity and resulted in an accretionary pile rather than a crater
- Lunar breccias are most abundant near-surface rocks on the moon, most if not all were created by impact events

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