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Quick Views of Big Advances

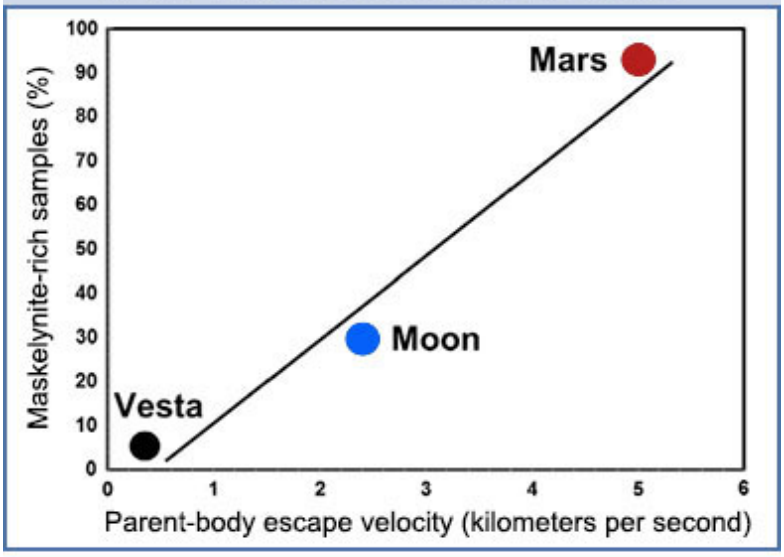
The Shocking Price of Escape Velocity

Glass can form from minerals without melting when a rock is subjected to extreme shock pressures during impact cratering events. Glass known as maskelynite forms from ***plagioclase*** at shock pressures of ~20-30 ***GPa***. Alan Rubin (UCLA) used the presence of maskelynite in a variety of basaltic meteorites to better understand the correlation between the proportion of maskelynite-bearing samples in a group, the escape velocity of the parent body from which the rock launched, and the relative shock pressure exerted on the ejected rock.

The energy required to blast rocks into orbit during an impact event scales with the size of the parent body—the larger the body, the more energy is needed for the ejecta to exceed the escape velocity. The plot below (left) compares maskelynite-bearing basaltic meteorites to the escape velocities of three different parent bodies, Vesta (smallest), Moon, and Mars (largest of the three). Rocks ejected from larger parent bodies were subjected to higher shock pressures. A larger proportion of maskelynite-bearing meteorites come from Mars (~93% of the Martian meteorites) than from the Moon (~30% of the lunar meteorites) or from asteroid Vesta (~5% of eucrite meteorites). The column below (right) compares the percentage of a variety of samples that have been identified to contain maskelynite. Maskelynite occurs in ~1% of Apollo basalts, which, of course, were never launched by impact off the Moon (rather rocketed off the Moon along with the astronauts who collected them).

Interestingly, the L chondrites are relatively high on the list, with ~11% of these meteorites containing maskelynite. This may correlate with what cosmochemists consider the catastrophic breakup of the L chondrite parent body, possibly the largest impact in the asteroid belt in the last few billion years (see **PSRD** article: ***Tiny Traces of a Big Asteroid Breakup***).

Correlation Between Basaltic Meteorites Containing Maskelynite and the Escape Velocity of the Three Different Parent Bodies



(From Rubin, A. E., 2015, *Icarus*, doi:10.1016/j.icarus.2015.05.010.)

Percentage of Samples Containing Maskelynite

BASALTIC SAMPLES	
Mars Meteorites	~93%
Moon Meteorites	~30%
Eucrites	~5%
Apollo Missions	~1%
Angrites	none
CHONDRITIC SAMPLES	
L Chondrites	~11%
LL Chondrites	~4%
H Chondrites	~1%

(From Rubin, A. E., 2015, *Icarus*, doi:10.1016/j.icarus.2015.05.010.)

[LEFT] Correlation plot between the percentage of maskelynite-bearing samples in a basaltic-meteorite group and the escape velocity of their three parent bodies, Vesta, Moon, and Mars. **[RIGHT]** Table showing all the different types of samples included in the work by Alan Rubin. The numbers represent the percentage of samples in the known collections that contain maskelynite.

See:
Rubin, A. E. (2015) Maskelynite in Asteroidal, Lunar and Planetary Basaltic Meteorites: An Indicator of Shock Pressure During Impact Ejection from their Parent Bodies, *Icarus,* v. 257, p. 221-229, doi: 10.1016/j.icarus.2015.05.010. [***abstract***]

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