

Formation of Craters

Mark Linick 

Long Beach, CA, USA

Email: marklinick@mindspring.com

How to cite this paper: Linick, M. (2026)
Formation of Craters. *Journal of High Energy Physics, Gravitation and Cosmology*,
12, 757-761.

<https://doi.org/10.4236/jhepgc.2026.122039>

Received: December 13, 2025

Accepted: March 22, 2026

Published: March 25, 2026

Copyright © 2026 by author(s) and
Scientific Research Publishing Inc.

This work is licensed under the Creative
Commons Attribution International
License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

The origin of craters is one of the final arguments in a series explaining solar system formation. Moons begin in a molten state when placed in orbit. Then craters form from boiling and mares form from an external heat source (Earth), keeping the surface liquid longer.

Keywords

Craters, Mares, Liquid, Impacts, Boiling

1. Introduction

If you are not satisfied with explanations concerning the origin of objects and behaviors in space, you are not alone. The origins of planets, moons and rings are a few. Or any topic designated as “an area of active research”. My favorite in school was the origin of spin. There is no obvious mechanism in space that makes things spin.

The formation of craters could be another, although the common assumption is that craters are formed from impacts. And it is certain that impacts will form craters, or types of craters. But differences can be discerned in **Figure 1** between the lunar crater on the left and the terrestrial crater on the right. We claim a different mechanism produced the crater on the left and simply note the impact process assumes a solid surface. For an explanation on the process of impact cratering, see [1].

The formation of craters is one of the last arguments in a series explaining solar system formation (the origin of rings and tidal locking are the others). As explained earlier, solar systems are believed to have a liquid phase early in development. A liquid phase provides a better foundation for the objects and behaviors we observe.

Consider a moon in a liquid (or molten) state when placed in orbit. Then we claim crater formation is a thermal process (boiling)—not mechanical (impacts)—at least in the beginning.

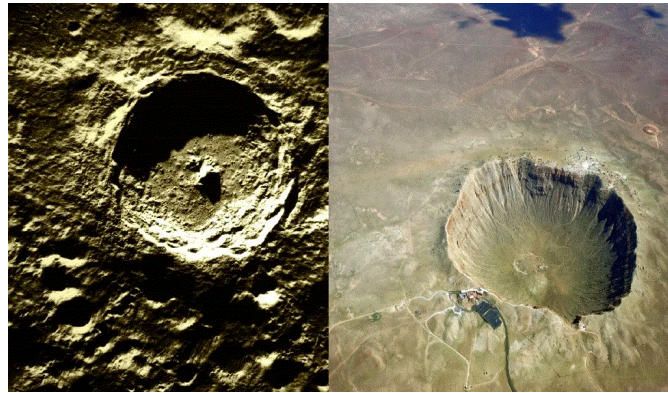


Figure 1. Crater types.

The picture in **Figure 2** below, shows the pattern of craters as viewed from the lunar south pole. Impacts should be less common at the poles and more common on the face of the moon (in the plane of the planets). What would be the source for impacts out of the plane? Answer: There isn't one.

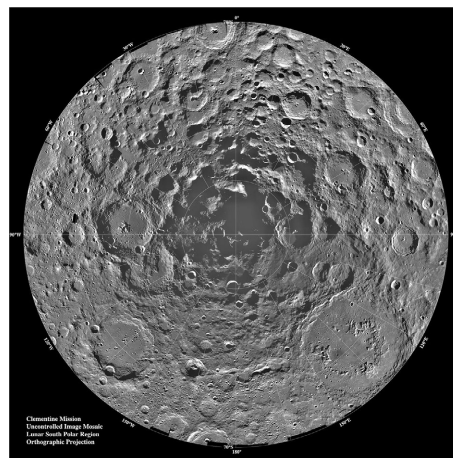


Figure 2. Lunar South Pole.

We want to find a mechanism that places craters uniformly over the entire surface, similar to the picture above. Now consider a liquid moon at a temperature high enough to boil. With gravity as a central force, the moon will boil uniformly over the entire surface—similar to water boiling uniformly over its surface when contained in a pot. If imprints remain from boiling, this would match the pattern shown in the picture above.

Let's see how this mechanism may work for individual craters.

2. Formation of Craters

As a demonstration, let the liquid (molten) moon cool and form a crust. Assuming the crust is buoyant, it will displace the liquid at the surface. On achieving a thickness, cut away a portion of the crust to expose the liquid below, similar to a hole cut for ice fishing (a nice analogy). The process is shown in **Figure 3**.

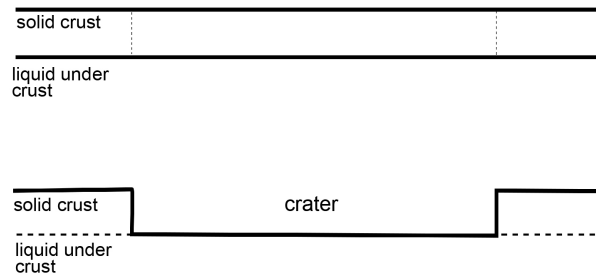


Figure 3. Idealized crater formation. above) formation of solid crust. below) Crust artificially cut away exposing liquid below—think ice fishing.

Like the level of water under the ice, the level of the liquid under the crust, is the level of the floor of each crater produced over the entire surface. As the moon cools, the floor of the craters becomes solid, all at the same depth.

Now, instead of cutting a hole in the newly formed crust to make our crater, we present a mechanism that removes the crust as it forms. A bubble breaking through the surface will accomplish this—boiling.

A liquid moon will form a crust gradually. Bubbles breaking through the surface will push material radially out, making circular imprints, *i.e.* craters. Outside, between craters, the crust thickens. Inside, the floor remains liquid at the same level as the liquid beneath the crust, as shown in **Figure 4(a)**.

As the moon cools, the sides taper and the floor thickens, shown in **Figure 4(b)**.

When the floor becomes heavy, bubbles open small cracks, sometimes near the center, releasing the gas as a jet, as shown in **Figure 4(c)**. Liquid escaping with the gas will fall back down and accumulate, forming the central peak. If the bubble is not strong enough to open a crack, or the stream of bubbles simply stops due to cooling, then no central peak appears.

Craters come in different types—lone, overlapping or inside one another. Some have small peaks that are centered, off-centered or none at all. Most variations can be explained by the bubbles that create them. But most craters are 1) circular, 2) with flat floors of the same depth, and 3) containing a central peak.

There would be a difference between impact craters and craters produced from boiling. The floor of a crater produced by boiling is the true bottom of the crater. The floor of an impact crater is a false floor made from the melt produced at impact. The true bottom is below this melt. This means the theory can be tested.

3. Formation of Mares

Mares are an unusual feature, not seen on other moons (or not as dramatic). If an external source was heating the near side of our moon—like the Earth—the surface of the near side would stay liquid longer. Keeping the surface liquid will prevent crater formation as the moon cools and the boiling subsides. Then mares will form—not craters. And this is what we see in **Figure 5**.

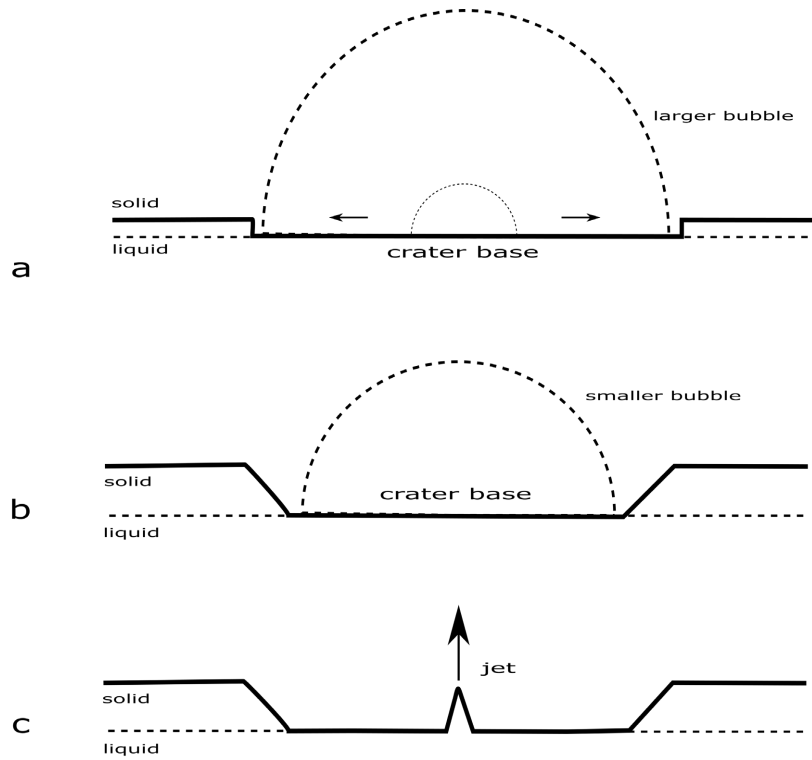


Figure 4. Crater Formation. (a) Bubbles push crust radially, forming an elevated ridge at the circumference. (b) Decreasing size of bubbles from cooling will taper the sides. (c) Bubble cause heavy crater floor to crack, releasing gas as a jet and forming a peak.

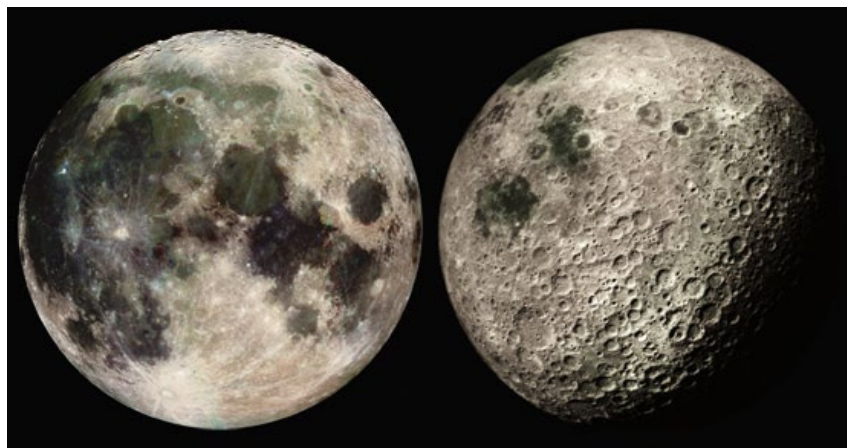


Figure 5. Near and far side of moon.

If the Earth is at least as hot as the moon, with a larger surface area, it will radiate heat to the surface of the moon. We can calculate the temperature by the Stefan-Boltzmann equation and equate the flux, resulting in

$$T_{\text{moon}} = \sqrt{R_{\text{earth}} / D_{\text{earth-moon}}} * T_{\text{earth}}$$

Figure 6 shows the temperature delivered to the surface of the moon for different temperatures on the surface of the earth. Boiling would indicate higher temperatures, *i.e.* the boiling points of iron, as would the distance of the earth to the moon.

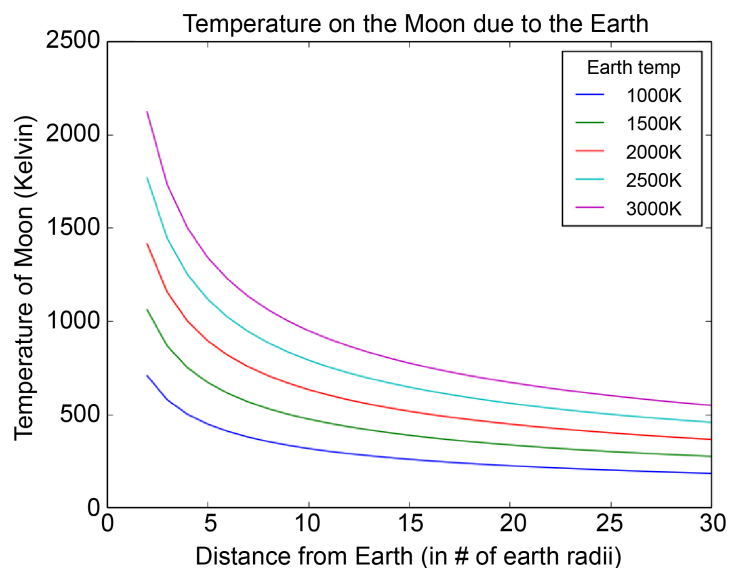


Figure 6. Temperature profiles on the near side of the moon.

Another effect the earth has on the moon by heating, is on the overall shape. If both sides cool equally, a liquid moon becomes more like a sphere the further it recedes from earth, due to decreasing tidal influence from the earth on the shape.

However, due to heat from the earth, the near side remains liquid much longer than the far side. Cooling will freeze in the tidal shape on the far side, sooner than the near side. The near side would be radially wider, while the far side would be more tapered. Along the line connecting the earth and moon, the radius on the near side is slightly shorter than the radius on the far side—with the near side probably more dense (wobble?).

4. Conclusions

We premise moons begin as a liquid. Then most craters form from boiling—not impacts. Solid impacts do form craters, but not for another million years, after cooling. Mares are formed from an external heat source (Earth), keeping the surface liquid longer.

This argument, meant more to persuade, aligns well with our argument on rings [2]. Both present a softer, thermal pathway to formations. Late bombardments, collisions and impacts are not necessary.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Melosh, H.J. (1989) *Impact Cratering: A Geologic Process*. Oxford University Press.
- [2] Linick, M. (2025) The Origin of Rings. *Journal of High Energy Physics, Gravitation and Cosmology*, 11, 19-27. <https://doi.org/10.4236/jhepgc.2025.111003>