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South Pole Crater Chains: Searching for Just the Right Crater

Formation of Lunar Catena

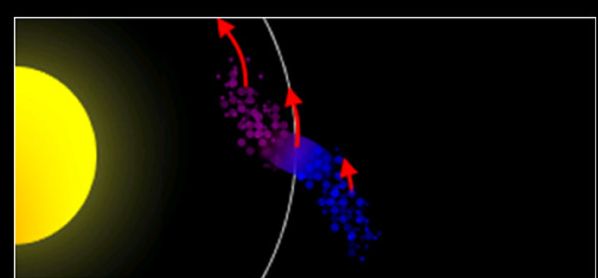


Figure 1: Roche Limit of Given Body

As a loosely held body (such as an asteroid or comet) gravitates towards another body of larger mass and crosses the Roche limit, the tidal forces from the larger planet serve to accelerate different portion of the object at varying rates resulting in the breakup of the loosley held body into smaller parts that move in linear chains. Once these particles impact a celestial body, they form a crater chain. This is exemplified by Comet Shoemaker-Levy 9 seen below.

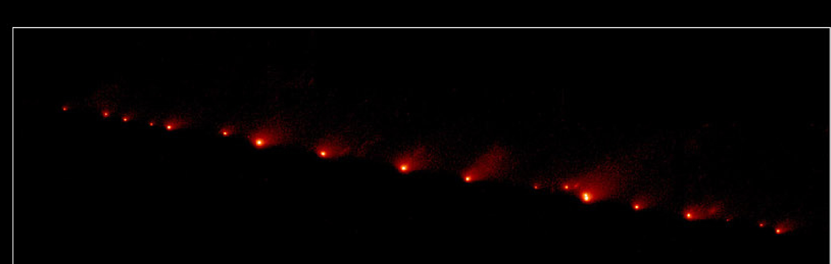


Figure 2: Comet Shoemaker-Levy 9 Particles in Chain

Lunar catena can also be formed by ejecta following impact. After a large comet or asteroid strikes the surface of a celestial body, the displaced matter cascades back to the surface in a radial manner. This results in smaller crater chains that radiate away from a central impact point of much larger magnitude as can be seen in the image below.

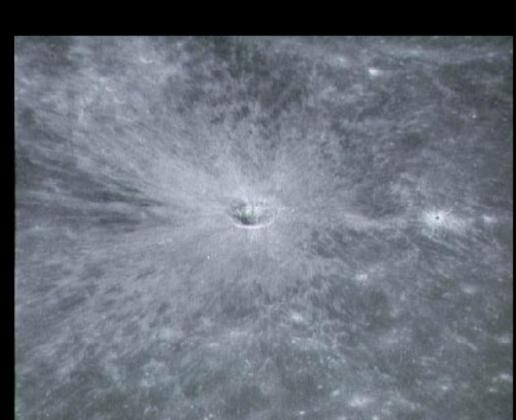
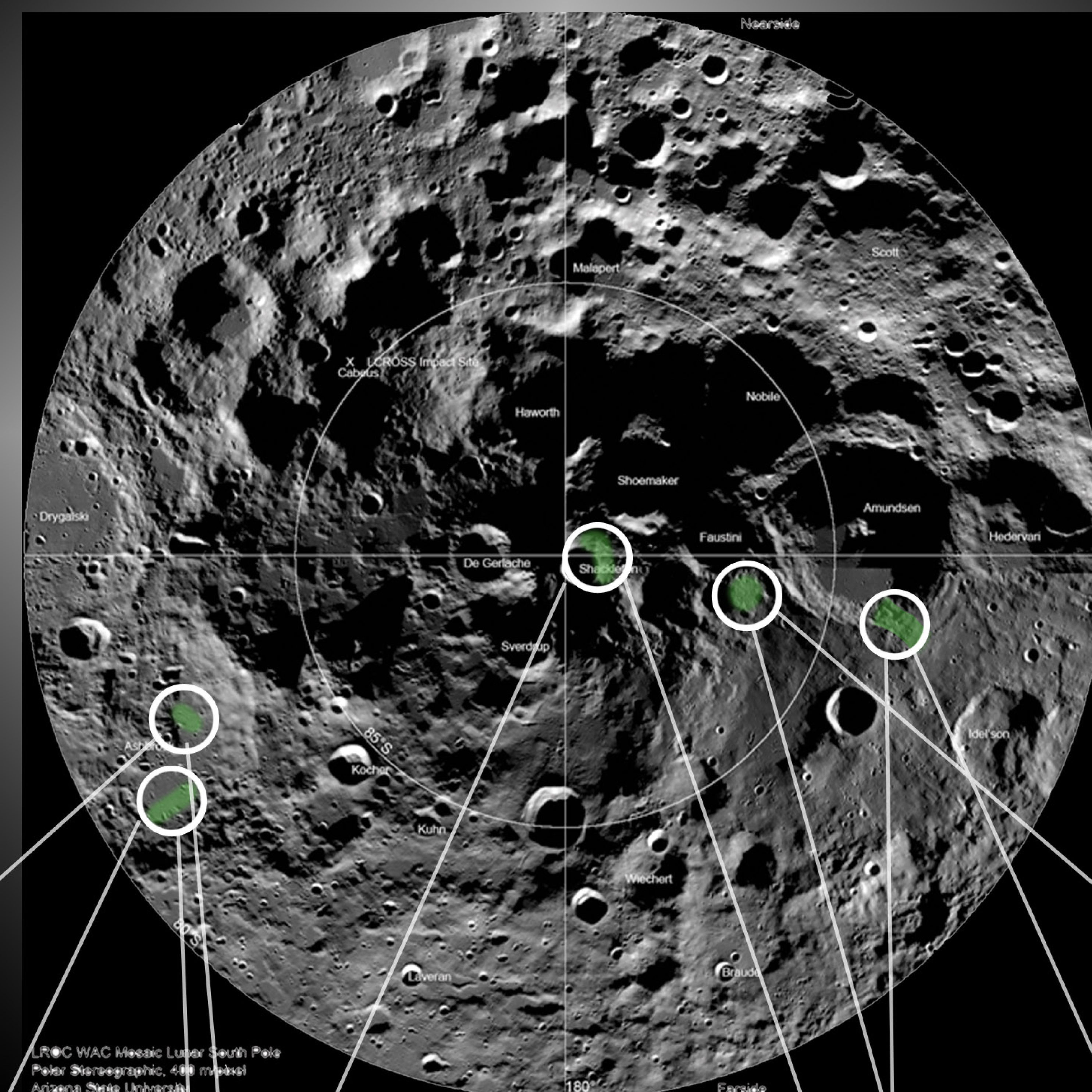
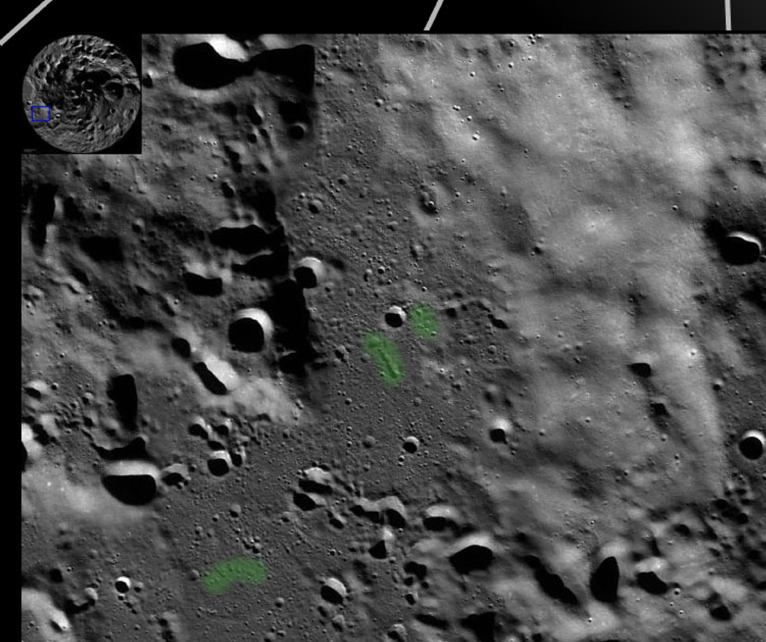


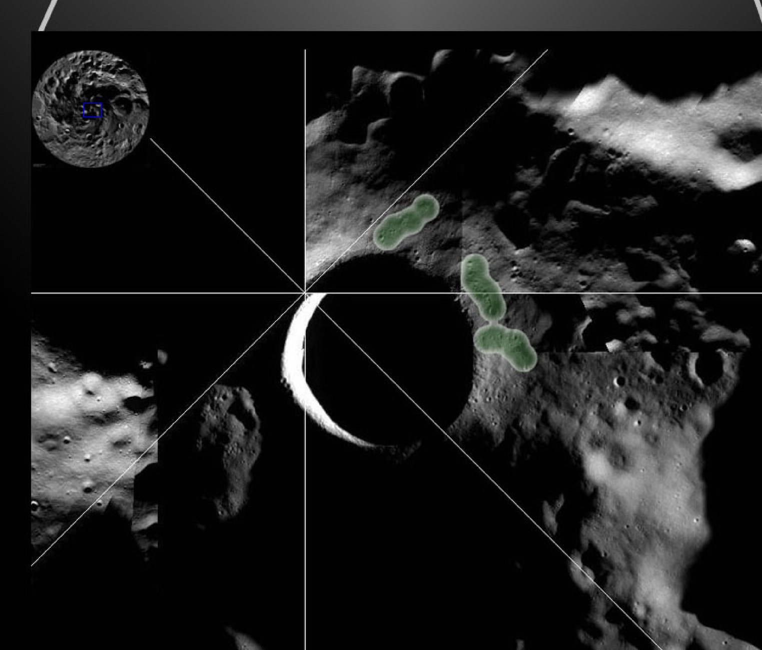
Figure 3: Crater with Ray System

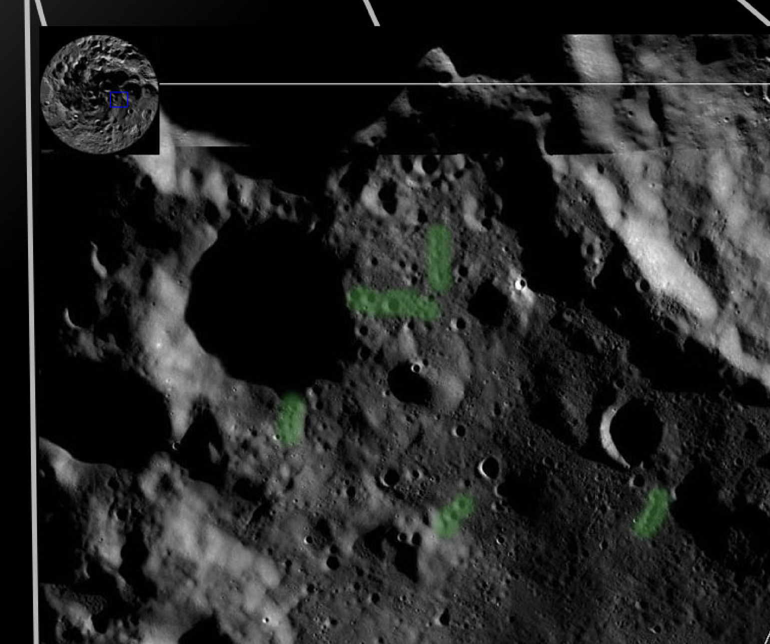
Because the gravitational pull of the Moon is less than that of the Earth and relatively miniscule in comparison to other celestial bodies, the chances of having a loosely held body split apart by the tidal forces of the Moon are not favorable. Thus, the more common type of crater chain on the Moon will most likely be the catena formed from the radial outburst of ejecta from a larger mother impact.

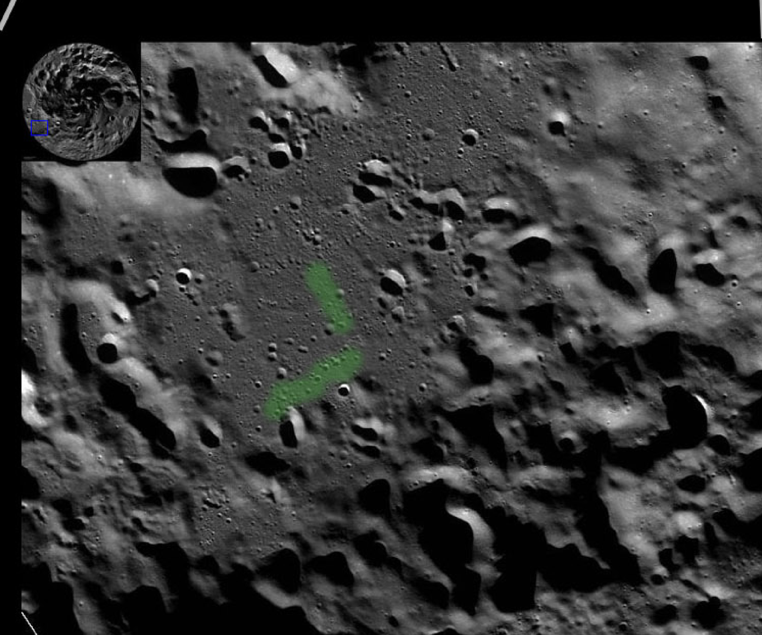
Wide Angle Camera South Pole Mosaic [80°S to 90°S]

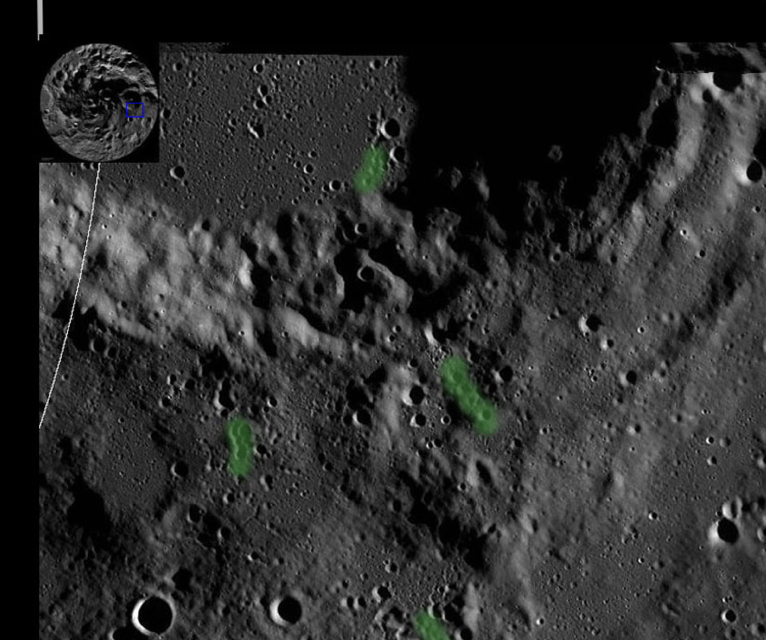












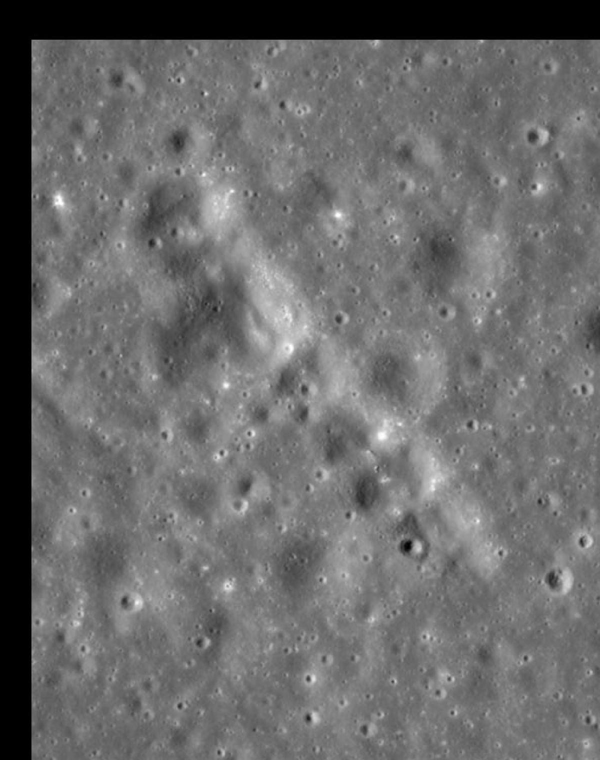


Figure 4: Possible Crater Chain Near Apollo 12 Landing Site

Methods of Locating

Possibly have a source of impact (secondary crater chains)

– trace linear path of crater chains and try and find a common, older, original crater that left radial ejecta crater chains

Appear to be continuous (occurs at once vs. series of craters)

– catena happen from a single body or a radial ejection so craters should be created at same time

Number of craters in chain

– common for chains to have multiple craters of more htan 3 craters

Linearity of craters

– both types of crater chains should be formed in a linear fashion resulting in a long line of craters

Connectivity of craters

– not uncommon to have crater chains on bodies of lesser gravitational pull to be melded together as the impacting body is not completely separated before impact

Matching age of craters in chain

– if chain of craters occurred at same time, then the adge features and other characteristics of the craters in the chain should be similar unless acted upon by outside influence

Possibility of outside influence interrupting original chain (younger impacts, volcanic activity, and more)

– cannot rule out possibility that crater chains were affected by something else after the crater chains initial formation

Conclusion: Now and Beyond

In this project, a suitable landing site and construction area was determined to propose a potential spot for the construction of the lunar base. After researching the history and formation of lunar catena, potential crater chains were identified. Identifying linear chains of uniformly sized craters, these sets were classified as possible catena. After analysis of crater spacing and radial ejecta from parent craters, the final crater chains were identified as possible sites.

These possible sites provide many benefits.
First, the sites are located near mountain peaks where there is constant sunlight allowing for solar arrays to constantly harness providing a steady supply of energy.
Second, these sites are close to deep craters where no sunlight ever reaches which have the potential to hold water, a vital resource on the Moon.
Third, the high crater walls will also serve as radiation shielding. Since the Moon lacks an effective atmosphere, radiation from the sun becomes an issue. The base itself can be built in the shadow of the crater walls allowing for radiation shielding. Additionally, the linear structure of the crater chains allows for ease of construction and expansion. Rail systems can be built as well as a modular design for the lunar base allowing for different craters to house different modules while a linear transport network can unify the system.

Finally, the craters will also be conducive to lunar research. Since most chains are actually formed by ejecta, the craters could be used to not only determine the geology of the immediate area, but could also be used to identify the geology of the area where the parent crater is located. Thus, there are a multitude of benefits from considering crater chains for constructing a lunar base.
After further study and focused imaging as well as site sampling, the most conducive crater chain can be identified and a lunar base can finally be established.