

Curious Vents, Cracks and Other Signs of Recent Change on the Moon

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1.1 What do we Mean by Recent Changes

- Anything that has happened in the last million years is deemed to be geologically very young
- Changes may occur due to landslides, outgassing from beneath the surface, re-distribution of dust due to surface dust particle electrostatic charging, or new impact craters
- New impact craters are difficult to find though without comparing new LROC images with images taken decades ago – so we will not attempt to hunt for these just yet – however there are some large examples, such as the 2.2 km diameter [Linne](#) crater that is thought to be less than 10 million years old
- The younger something is on the Moon, the fewer craters it will have on it per square km. So any very young surface will pretty much have no craters visible over its discernable area
- We will not see evidence of recent lava outpourings from the Moon, as the Moon does not do this kind of activity any more, however there may be evidence of past outgassing though cracks or vents – this could explain some Earth-based telescopic Transient Lunar Phenomena (TLP) reports

2. What Images to Use?

- The higher resolution the better as any near-side permanent changes larger than 2 km across would have been visible through Earth-based telescopes long ago
- Areas of fresh surface disturbance may best be detected using colour ratio imagery, as the exposed soil has not had long enough to be space weathered. However colour ratio imagery is of low resolution, and is not easily useable until this is made available in map projected mosaic form
- Here are a list of possible image sets:
 1. [Lunar Orbiter](#) Images (varying image scales)
 2. Apollo 15,16 & 17 [Metric camera](#) images
 3. Apollo 16, 16 & 17 [Panoramic Camera](#) images (higher resolution than Metric)
 4. Clementine [UVVIS](#) mosaic (100 m/pixel scale)
 5. Clementine [HiRes](#) mosaic (10 m/pixel scale)
 6. [Kaguya](#) images
 7. LRO [LROC](#) images (50 cm/pixel scale)

3. Ways to Go About a Search

- It may be best to work in teams to avoid people looking at the same image several times, and to help peer review each others discoveries before officially telling the MoonZoo forum
- Teams could be made up of family, friends, colleagues at your local/national astronomical society, or other on-line MoonZoo forum members
- Searches could be:
 - **“Systematic”**, one set of images after the other in the NASA catalogues, gradually going through images in order of ID number.
 - **“Regional”**, concentrating on areas of volcanism or known TLP sites
- If you wish, please let others know what regions or range of image IDs you have examined so that duplication of efforts is avoided

4. Examples Found by MoonZoo Users and Others

- The following should not necessarily be regarded as sites of recent change, at least until they have been investigated thoroughly by lunar geologists
- However they might give you ideas of what to look for, and where people are looking
- Even if they prove not to be recent change sites, then at least they may interest other lunar geologists in understanding the complex nature of the Moon

4.1 “Lava Tube Sky Lights”

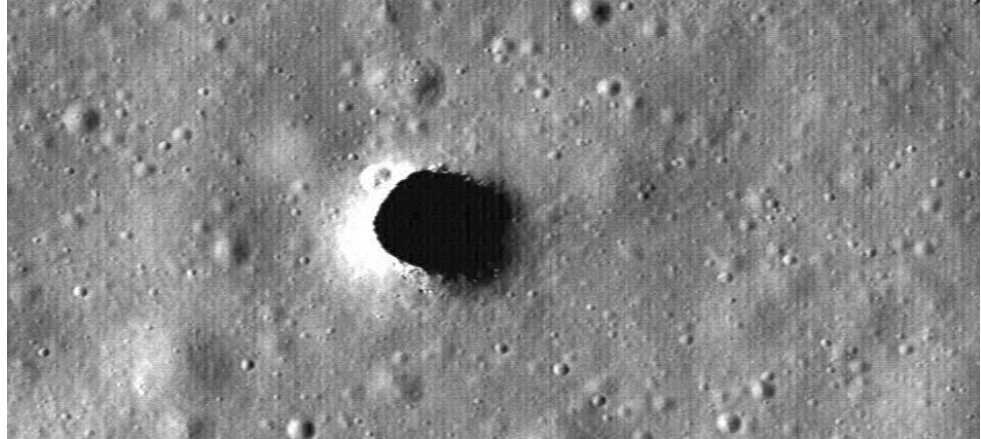
Location: Site 1: Marius Hills (56.8W, ~14N).
Site 2: Mare Ingenni (166.06E, 35.95S).

Images: Site 1: NAC [M114328462RE](#). Site 2: NAC [M128202846LE](#).

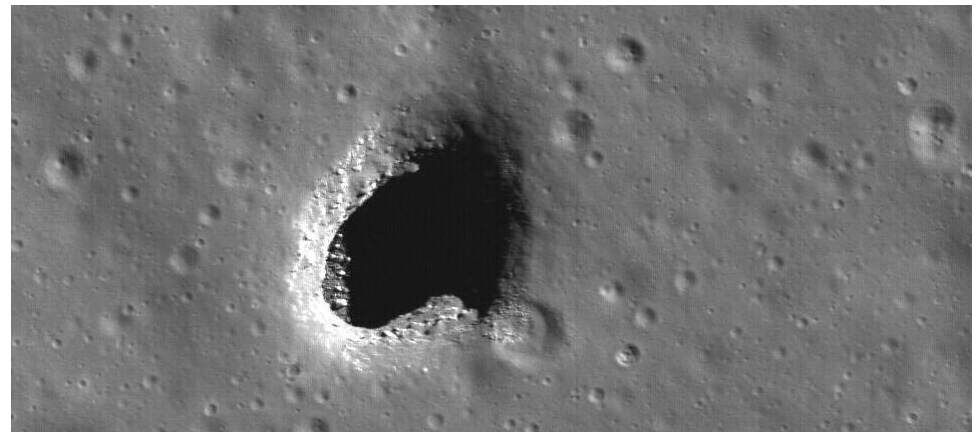
Discovery: Site 1: JAXA Kaguya team. Site 2: (LRO team?)

Description: Appears as a small crater, but could be irregular and non-circular. Unlike a crater though it is very deep and will be nearly completely shadow filled, even when there is little shadow elsewhere in nearby craters. On the interior edges there maybe signs of rock debris?

Interest: A lava tube is present somewhere beneath the surface and something has made part of the ceiling collapse. The lava tube may have contained an accumulation of volcanic gas seepage. Or it could be a conduit through which deep seated gas pockets could be released periodically during moonquakes. This could in theory kick up some dust or lead to gas ionisation in sunlight. So far, only two skylights are known on the lunar surface. A good excuse to monitor such areas from orbit and from Earth for TLPs.



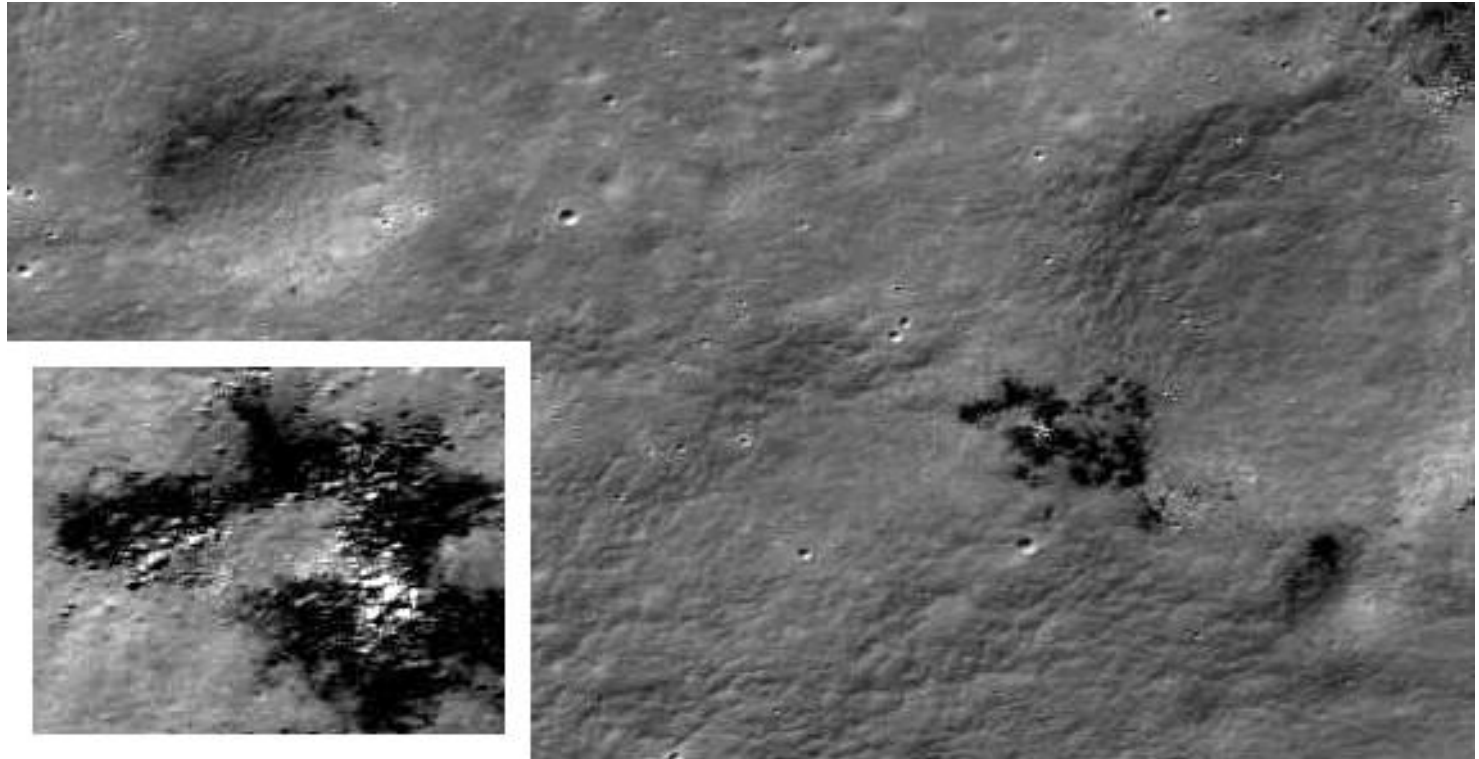
Marius Hills Lava Tube Sky Light – 65 m wide



Mare Ingenni Tube Sky Light – 130 m wide

4.2 "Black Stuff"

Section of LROC NAC image M122218486RE, with an enlargement in the bottom left. The Sun is 37° above the local horizon so there should not be too much shadow except in deep areas. Illumination is from the bottom right.



Location: Site: Montes Alpes, NW of Vallis Alpes (3.6W-1.4W, 48.9N-50.1N).

Images: [M122218486RE](#), [M122218486LE](#), [M122232056LE](#), [M122232056RE](#)

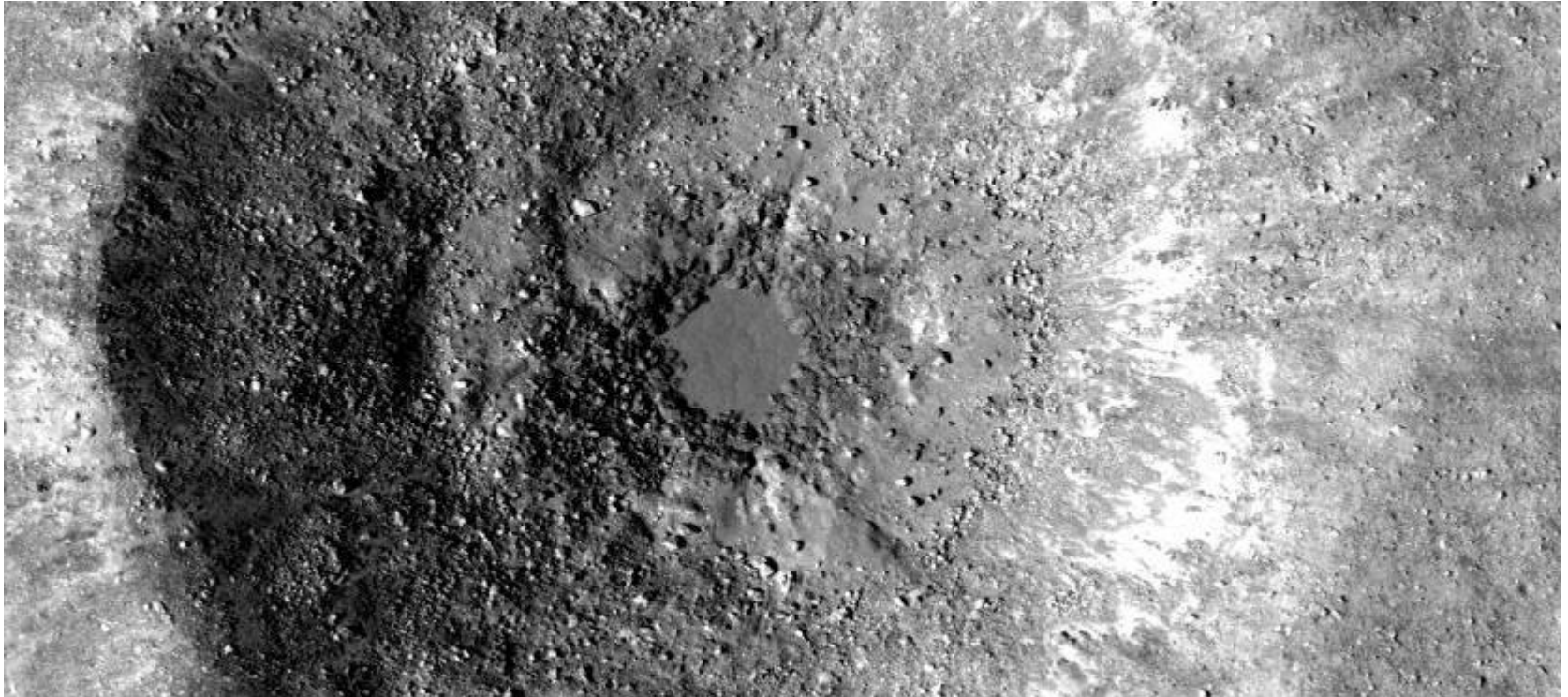
Discovery: Anthony Cook and Moon Zoo Forum Moderator: Jules, on 6 Jul 2010

Description: Dark slightly branching features, often on the shaded side of slopes.

Boulders associated with these. Also appears as an exposed strata layer in a nearby rill rim.

Interest: Is this "dark stuff" an exposed dark material black volcanic glass, a deep branching crack with shadow, dark boulders, or a combination? Either way we need to find more of these and their geographical distribution. Could be worth monitoring these from orbit and at different sun angles to see if the darkness is related to shadow.

4.3 “Boulder Repellent”



Location: Small ray crater NE of Reiner Gamma: Marius Hills Original LROC Image centre at 57.5W, 7.9N).

Images: [M111972680LE](#)

Discovery: Anthony Cook (April 2010)

Description: This appears to be a flat featureless circular area at the floor of a boulder filled bright ray crater.

Interest: Why have the numerous boulders within this crater avoided filling the centre of this crater? Why is the central area so featureless – presumably it is younger than the main crater? Or is it that the solar altitude of 56° is preventing us from seeing craterlets on the floor of the flat patch. Is this central patch the reverse of a central peak, perhaps a central dimple and was filled with impact melt? Please look out for similar examples elsewhere on the Moon.

4.4 “Notched Cavities in Lava”



Location: Site: Hyginus crater floor (6.3E, 7.8N).

Images: [M104476560LE](#)

Discovery: Anthony Cook (April 2010)

Description: Irregular sunken depressions on the floor of Hyginus crater that sits astride the Hyginus rille. Places which seem to be voids in the surrounding solidified lava. These depressions have rough floors and seem devoid of impact craters.

Interest: Are these areas where some explosive outgassing has occurred and removed the top soil, or simply places where the lava has not managed to cover? The depressions show a rough floor and no signs of craters, so might be geologically young. On the other hand, it might be the case that attempts to see craters on rough terrain is always going to be difficult.

4.5 “The Landslides of Birt”

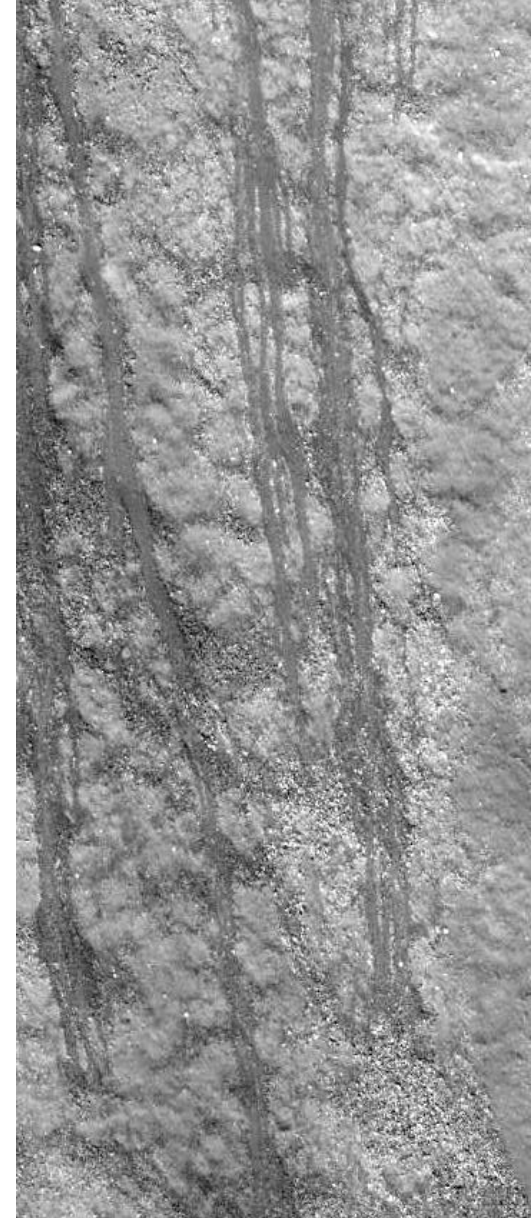
Location: Site: Birt Crater (~8.5W, ~22.4S).

Images: Site: NAC [M114010282R](#)

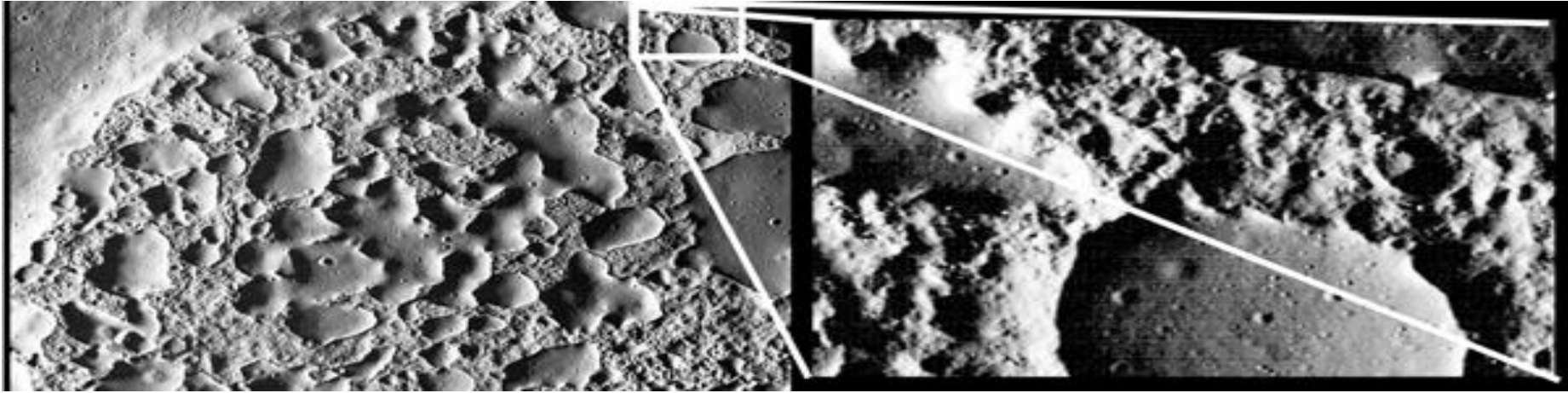
Discovery: Anthony Cook (Jul 2010)

Description: Highly structured, almost dendritic filament-like debris flow down hill and no obvious signs of boulders at their ends.

Interest: It is always difficult to estimate the age of surfaces on slopes because crater impacts are not preserved well. However slopes are precisely where we would expect to see recent change because material has a greater tendency to fall down hill than on gentler slopes. What we are interested here is not isolated boulder tracks (it is difficult to tell if these are old or young), but more detailed structures that presumably would be wiped out or disturbed if they had been there a long while. So any complex patterns, such as these, are worth looking out for, especially on steep slopes of other craters.



4.6 “Ina Crater”



(Left) Part of Ina. (Right) enlarged view of floor and lava extrusions. In both cases the illumination is from the right

Location: Mare Vaporum (5.3E, 18.6N).

Images: [M113921307RE](#), [M106841323RE](#) etc

Discovery: From the Apollo era

Description: A semi-circular depression filled with an irregular rough floor, peppered with blob-like lava extrusions, often surrounded by a shallow moat.

Interest: For many years after the Apollo era, this formation proved a mystery. One idea was that based upon the apparent lack of craterlets on the floor, it was formed geologically recently, perhaps due to explosive outgassing where the top soil had been blown away leaving underlying bedrock. However LROC scientists have since shown that craters are present in the irregular floor area, so it is no longer deemed to be geologically young. Nevertheless it would be a good idea to keep a look out for similar features elsewhere, just in case some were caused by outgassing.

4.7 “Lunar Swirls”

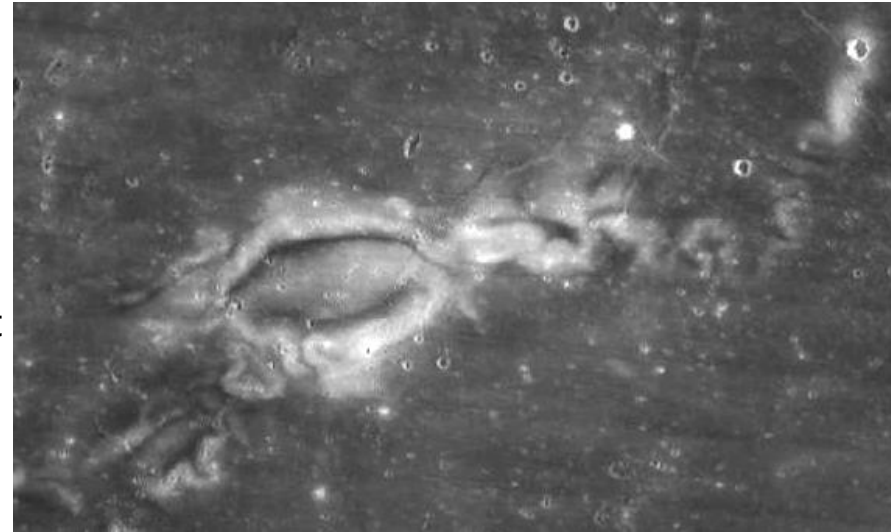
Location: Site 1: Reiner Gamma (56.8W, ~14N).
Site 2: Mare Ingenni (166.1E, 36.0S)., and other sites e.g. Mare Marginis.

Images: See the following [LRO image](#)

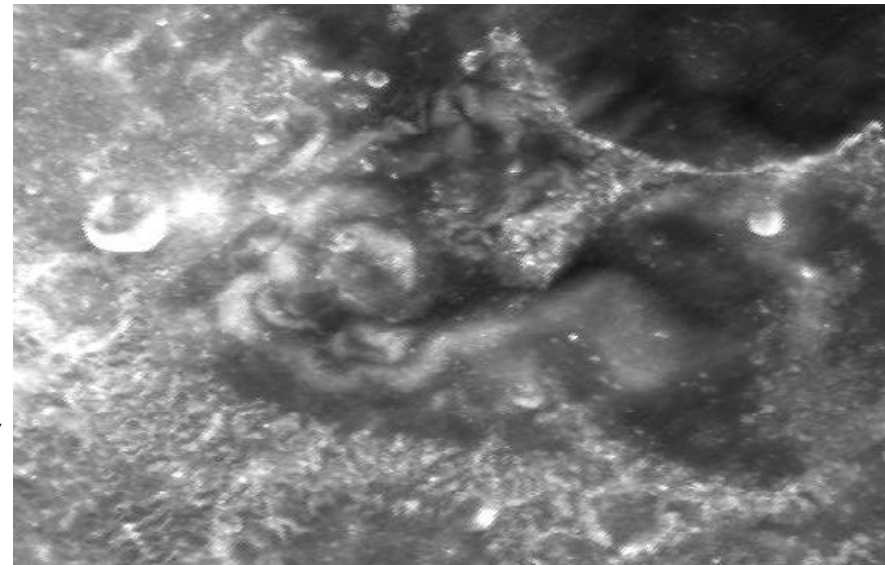
Discovery: Lunar Orbiter era and possibly earlier

Description: Light and dark adjacent broad curves, often described as swirls. Do not get confused with radial crater rays!. So far these are seen on dark mare with no discernable difference in surface texture when examined close up. To date all known swirls have been seen over large areas and not small km size regions. These are best seen in images with little shadow.

Interest: Each swirl site is believed to sit over a local magnetic field that sets up a mini-magnetosphere, strong enough to deflect at least some solar wind particles and reduce space weathering of the soil. The latest theory is that electric fields above the lunar surface help to sweep the surface clean of charged dust particles. It would be interesting to identify new candidate sites and to see what different sizes they come in, where they are located, are any in highland areas, and also to monitor them at different times to see if changes in dust deposits can be observed



Reiner Gamma Swirl



Mare Ingenni Swirls