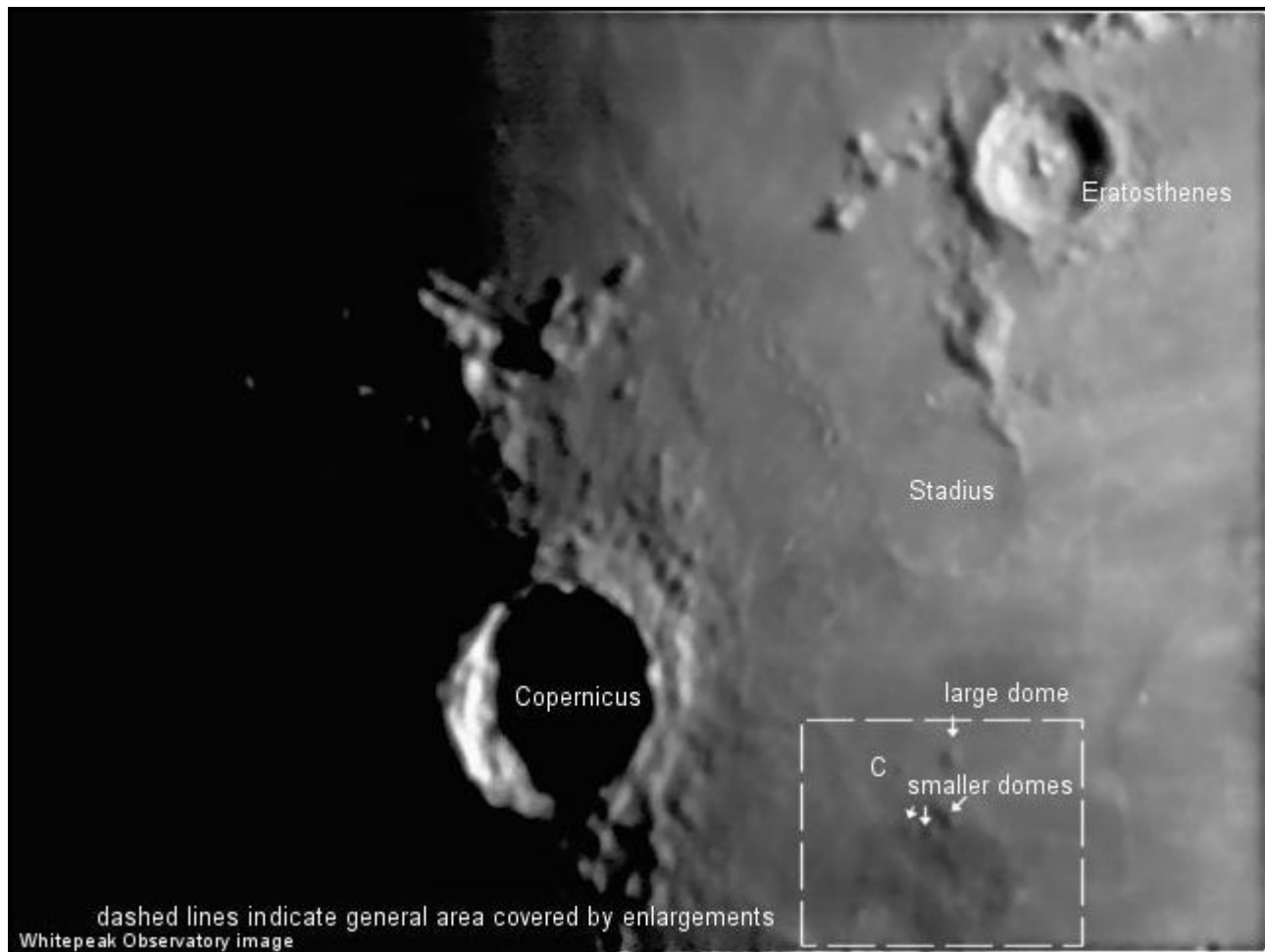




Whitepeak Observatory, Tacoma, WA

## Copernican Volcanoes

I was examining an image I took Wednesday evening of the Copernicus area (it was --as you can see--beautifully situated right on the terminator) and i noticed some positive elevation features in the dark area situated east of Copernicus and south of Stadius. I was unaware of any mention of domes/volcanoes in this area so decided to see what exactly these features were. Turns out they are lunar volcanoes allright and it's a mystery to me why they are not more well-known? (If anyone has a reference to these features in the literature please do mention where you found it!) Here's the image of the area in question:



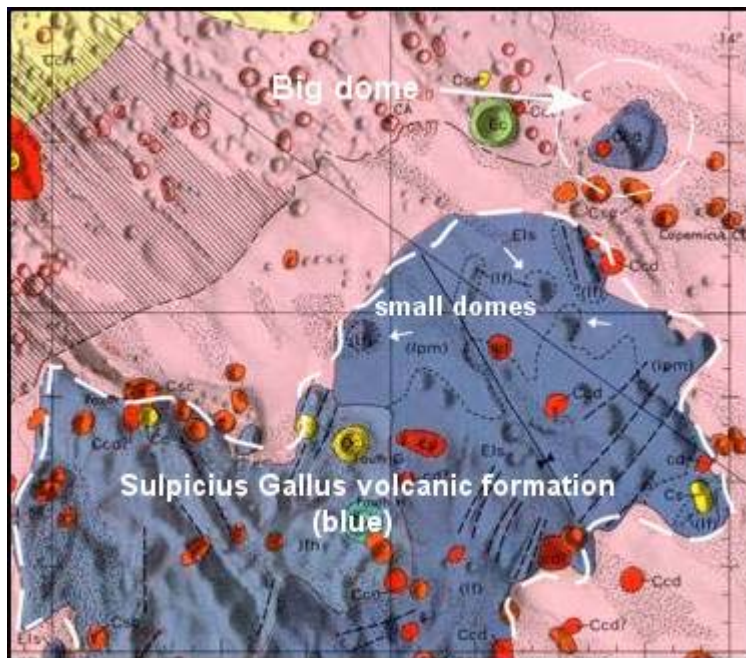
Here (dashed box) you can see the dark patch deliniating the volcanic province, which the geologists call the Sulpicius Gallus formation, quite clearly. Copernicus C is located in this image just to the right of the 'C' (unresolved dot) and is the reference point for the following images. The domes/volcanos in question are also marked with small arrows.

Now, the resolution of this image is quite poor, nonetheless these features are quite obvious! I've looked through my references and can find no mention of them any where...perhaps Copernicus itself steals all the attention in this area? Then are these features [i]really[/i] overlooked examples of lunar volcanos? Let's take a closer look...



The above image contains the 'smoking gun'. This is an enlargement of the printed page out of the Bower & Hughes Lunar Orbiter atlas. The relevant features (crater pits) are unfortunately too small to show clearly on the digitized version that the Lunar and Planetary Institute hosts so I had to resort to taking a photo enlargement of the page of the actual atlas instead to show them to you. This image is still less clear than it is under a magnifying glass.

At any rate, you can see three of the domes possess summit crater pits and the second & fourth have what looks to me to be an enlarged flank blow-outs typical of a cindercone type feature. The second also has a summit crater. The first looks very similar to the Gruithuisen domes, Gamma & delta.



Above is the USGS Geological quad for this area delimiting (in blue) the extent of the volcanic provinces in the immediate area and the corresponding location of the features in question.

Factors which lead to classification of these features as lunar volcanoes: 1) These features appear in a well-known volcanic province, evidenced by extensive surrounding areas of dark pyroclastics (ash etc). 2) All possess summit pits and/or conspicuous negative features (flank craters) congruent with volcanic cones. 3) These craters appear isolated in size & frequency in this area, reducing the possibility to virtually zero that they are merely coincident impact features.

The summit pit of #1 is only about 800 meters in diameter..quite a challenge for an observer with a larger scope to see under the best of seeing conditions.

I later found the age of the volcanic areas, at least partially, \*predates\* Copernicus. I examined high sun ray images of the area and there are indeed rays that cross these provinces. Also I later looked at the new geological quad of this area that Paul Spudis et al are working on and evidently, other than pre-dating Copernicus, the exact age of these volcanic provinces has even them stumped as they list these on their new map as of indeterminate age (bracketed by question marks! ;) ) [link to the new geo-quad](#)

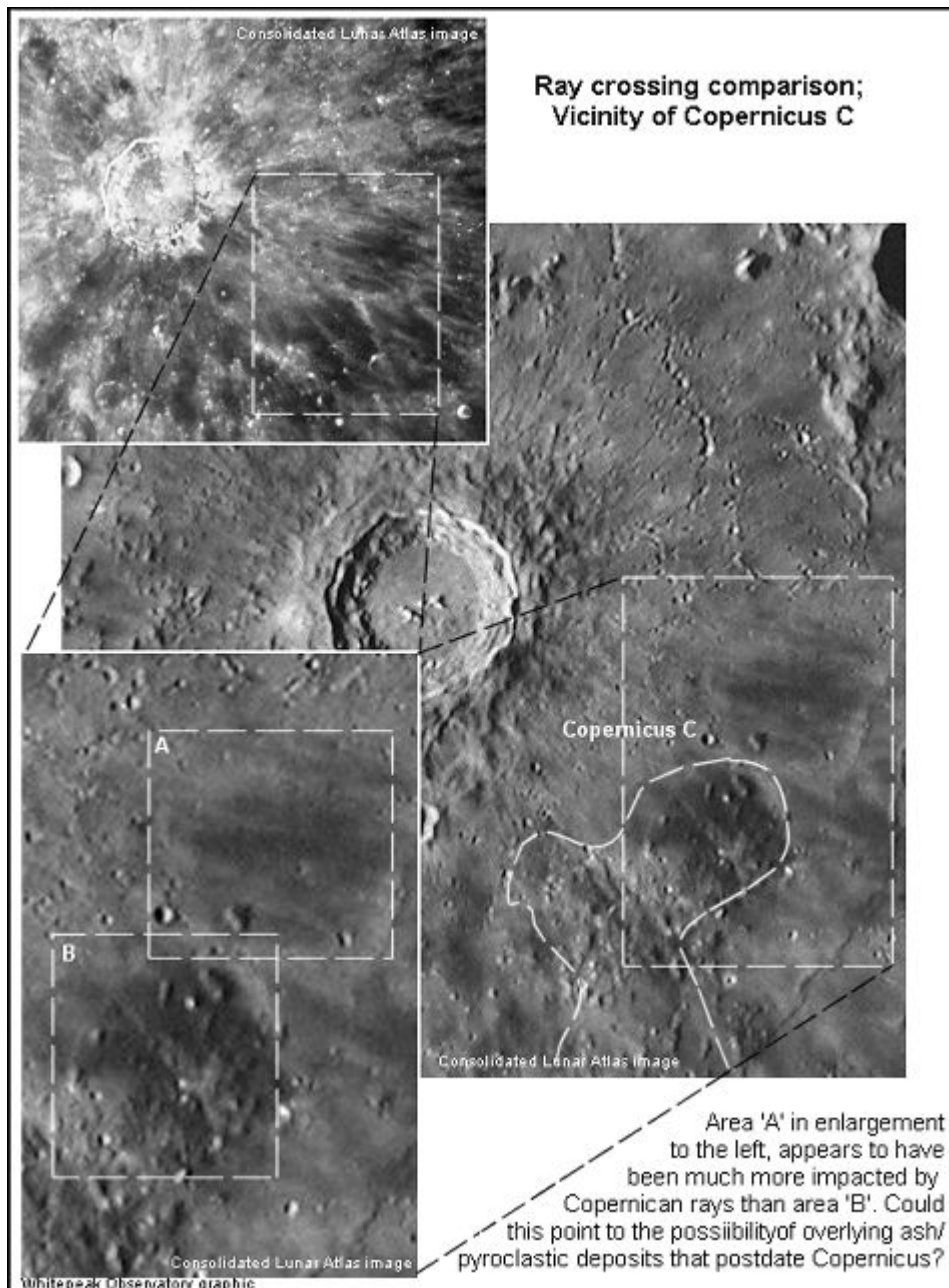
Another nice feature in this area is, of course, the wonderful and large crater chain situated midway between Copernicus and Eratosthenes. This chain, also un-named, is remarkable for being one of the only crater chains that can be easily resolved by smaller telescopes. Niice!

Recent studies of Clementine data suggest that the rays of Lichtenburg (and others) are older than previously thought--Eratosthenian, probably around 1.6-2BY old. [paper on this subject; ray maturity and dating](#)

There is, seems to me, still a possibility that there may have been limited activity within this volcanic province around Copernicus after Copernicus was emplaced.

Take a look at the examination of rays in the below graphic. Note that although the dark volcanic province south of Cop-C \*is\* crossed by rays, it shows as much less impacted by them than the dark maria above it and also less than the extension of this same volcanic province to the southward has been impacted by ray material. Why is this?





One explanation would be later Copernican era pyroclastic eruptions overlay some of the earlier Copernican impact rays. Also this entire volcanic province extends southward and slightly west of the upper dark area (outlined irregular area on graphic)--and the lower portion seems pretty heavily impacted by rays/ejecta compared to the same area to the north, despite their being purportedly the same, pre-Copernican, age.

One thing is for sure though--there are quite a number of lunar volcanoes and volcanic vents in this province. I counted 20 in [this enlargement](#) of LO image IV-121-H1:

At any rate this is a fascinating area--or, as Paul Spudis et al put it in their paper on this area with typical professional undersatement, "...curious stratigraphic relationships with highland and mare units make this an interesting region to study..." ;)

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