False Volcanoes on the Moon

For most of the past 200 years the view that lunar craters were some kind of volcanic manifestation prevailed. Many astronomers earnestly asserted that these features were the result of gigantic eruptions or huge bursting blisters of volcanic rock. Others suggested that they were simply collapsed volcanoes. Only in the 1950s and '60s did extensive research and experimentation change the tide in favor of an impact origin for lunar craters.

Nonetheless, proponents of volcanism pinned their hopes on a handful of features that seemed incontrovertibly volcanic. In particular, craters that have central peaks with small pits at their summits offered hope for the volcanists. Surely, they reasoned, it would be very unlikely for a random impactor to strike a mountain precariously at its peak! Once high-resolution spacecraft photography became available, however, most of the suspect peak pits proved not to exist.

But there was one notable exception: the crater Regiomontanus (L46 in the Lunar 100). This large, old crater in the southern highlands has a pit 5.5 kilometers (3.4 miles) wide on its central peak. But is it a volcanic crater? Central peaks form when the compressed ground directly under an impact site rebounds and material from below the surface is thrust upward. Multispectral images obtained by the Clementine spacecraft suggest that Regiomontanus's peak is composed of typical highland material and is nothing like mare lavas. This implies that the peak pit is indeed, unlike as it may seem, a random impact. This is consistent with the relative freshness of the pit, contrasted with the old, eroded look of the host crater.

The volcanists also pointed to the strange crater pair of Sabine and Ritter (L38). These 30-km-wide neighbors in Mare Tranquillitatis lie just west of the Apollo 11 landing site. But unlike fresh impact craters of similar size—such as nearby Kant—Sabine and Ritter are shallow (only 1.3 km deep) and lack significant central peaks and wall terraces. The interiors of both craters have concentric ridges, though those in Ritter are indistinct. These features are hard to understand as part of the normal impact process, but in 1976 Peter Schultz (now at Brown University) argued that Sabine and Ritter had been modified by volcanism. In a theory that is now widely accepted, Schultz proposed that rising magma pushed up the floors of some impact craters that lie near the edges of mare basins. Posidonius and Gassendi are two of the most famous floor-fractured craters, but there are at least 200 others, including Ritter and Sabine.

Another favorite example of a potentially volcanic feature is Crüger (L52), a 46-km-wide dark-floored crater near the Moon's western limb. Unlike most impact craters, Crüger is

The Lunar 100

<table>
<thead>
<tr>
<th>L</th>
<th>Feature name</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>Sabine &amp; Ritter</td>
<td>Possible twin impacts</td>
</tr>
<tr>
<td>46</td>
<td>Regiomontanus central peak</td>
<td>Purported volcanic peak</td>
</tr>
<tr>
<td>52</td>
<td>Crüger</td>
<td>Purported volcanic caldera</td>
</tr>
</tbody>
</table>

See Sky & Telescope, April 2004, page 113, or point your Web browser to SkyandTelescope.com/lunar100.

When to View Them

Sabine and Ritter:
June 2nd and 16th;
July 2nd, 16th, and 31st.

Regiomontanus:
June 4th and 18th;
July 4th and 18th.

Crüger:
June 10th and July 8th.

Illustrated dates indicate when these features are favorably illuminated.
This Lunar Orbiter spacecraft view is dominated by the shallow craters Ritter (left) and Sabine, located along the southwestern shore of Mare Tranquillitatis.

(and about 30 other similar features) has narrow, smooth interior walls. Such craters also tend to have roughly polygonal outlines. These characteristics caused some researchers to propose that Crüger and the other smooth-walled craters might be collapsed volcanic calderas. This was a viable hypothesis until it became apparent that virtually all lunar craters resulted from impacts. So if Crüger really isn’t volcanic, what accounts for its unusual appearance? Nearly two decades ago B. Ray Hawke, Cassandra Coombs, and Paul Lucey at the University of Hawaii used multispectral studies to demonstrate that at least part of Crüger’s rim is typical highland material, as would be expected for an impact crater. After its initial formation, the next event that affected the crater was the cataclysmic impact that produced the Orientale basin. Ground surge and ballistic debris surround Crüger and must have partially filled it. Later, explosive eruptions of volcanic ash (pyroclastics) coated part of Crüger’s rim and the surrounding Orientale debris (notice the dark smudge south of Crüger, best seen at full Moon). However, no source vents for the ash eruptions are apparent, so perhaps these too were covered by the dark mare lavas that erupted onto Crüger’s floor.

Regiomontanus, Sabine, Ritter, and Crüger all boast complex and interesting histories, but they are, after everything, just impact craters.

Charles A. Wood maintains the Lunar Photo of the Day Web site (www.ipod.org) and is the author of The Modern Moon: A Personal View and the Lunar 100 Card (both available from Sky Publishing). He is decidedly not of volcanic origin.