Serene Mysteries

Sometimes it's the things in plain view that get overlooked. For example, early telescopic Moon explorers were so fixated on the tiny crater Linné that they didn't seem to notice the vast mare it lay upon. Indeed, few classical observers commented on the curious dark border surrounding much of Mare Serenitatis or the odd bright ray stretching clear across its smooth surface.

The Serenitatis dark ring (L18 in the Lunar 100) contrasts nicely with the rest of the mare when the Moon is nearly full. Look carefully and you'll see a rim 50 to 70 kilometers (30 to 40 miles) wide along all of the mare's eastern edge and most of its southern shore. During the 1960s, scientists at the US Geological Survey in Flagstaff, Arizona, made detailed maps of the Moon in preparation for the Apollo missions. At the time, dark lavas were thought to be younger than lighter ones, so USGS scientists concluded that the light-hued material filling the basin was older than the dark rim.

When lunar samples and high-resolution orbital images were returned by Apollo astronauts, our understanding of many aspects of lunar history changed. Apollo 17 orbital images of Serenitatis showed more impact craters on the dark border than on the lighter interior. Since more craters means older terrain, the dark edge of Serenitatis must be older than the rest of the mare.

Multispectral images from several sources, including the Clementine spacecraft, show that the border of Serenitatis is not only darker, but also a different color. By calibrating these images with Apollo samples, scientists were able to deduce the compositions of the mare lava flows. They found that Serenitatis's dark border is rich in the element titanium, while the lighter-hued regions in the mare's interior are relatively titanium poor.

Thanks to the crater Bessel, researchers also deduced that the lighter material is only a thin layer lying atop darker lavas. The impact that formed Bessel excavated some dark, titanium-rich material from below the mare surface. Since the crater is quite small (only 16 km across) it didn't penetrate very deeply, so the layer of light-hued material must be quite thin.

### The Lunar 100

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<td>Mare Serenitatis dark edges</td>
<td>Distinct mare areas with different compositions</td>
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When to View Them

April 24th to May 7th;
May 23rd to June 5th;
June 22nd to July 5th.

This Apollo 17 orbital view shows the two-toned region of southern Mare Serenitatis, just north of the crater Plato. The largest crater in this photograph is the shallow 9-kilometer-wide depression known as Brackett.
This enhanced color view of Mare Serenitatis emphasizes the tonal differences between the mare's edge and center.

Careful Moon observers will also note that Serenitatis has a number of fine rilles along its southern shore. These are concentric with the curved margin of the Serenitatis impact basin and occur only in the dark border lavas.

All this information allows us to piece together the geologic history of the region. After the Serenitatis basin formed, high-titanium basalts erupted onto the surface. These deposits are probably a few kilometers thick — massive enough to have caused the center of the basin to subside, fracturing the surface at the mare edges and producing the circumferential rilles. Later, titanium-poor lavas oozed across the surface but were not extensive enough to cover the entire mare floor. As a result, older, darker lavas remain visible around Serenitatis's edges.

Serenitatis is also famous for the bright streak stretching across its surface from the crater Menelaus on the south shore, through Bessel, to the small crater Luther near the mare's north edge. If you trace the so-called Bessel ray (L41) back to its origin, you will find that it leads you to the crater Tycho. Yet the alignment isn't perfect, and no Tycho ray actually connects directly to the Bessel ray. In fact, most of Tycho's other rays extend only about 1,500 km, whereas the Bessel feature splashed some 2,000 km from Tycho. The other possible ray source is Menelaus. This crater has a relatively small set of rays that are most visible to the southwest. However, the Bessel ray is six to eight times longer than any of the Menelaus rays.

The same multispectral studies that helped explain the Serenitatis dark border also provide clues to the origin of the Bessel ray. The Bessel impact occurred on Mare Serenitatis, so the crater's rays should be made of mare material. Yet the mystery ray contains bright, highland rock, which rules out Bessel as the source. So what are we left with? Given that both Tycho and Menelaus excavated highland material, perhaps one of these could be responsible for the Serenitatis ray after all. Yet we still don't know for sure.