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'Traffic Jam' from Collapsing Ring May Have Carved Saturn Moon

A collapsing ring may have formed the unusual ridge on Saturn's walnut-shaped moon, Iapetus.

New simulations reveal that a slow-falling ring of debris may have scoured the moon's surface, creating the peaks, whose origins have long puzzled astronomers. Such a dramatic pileup would have built up the ridge, a unique feature in the solar system.

When NASA's Cassini mission arrived at Saturn, the probe revealed a continuous series of peaks along Iapetus' equator. Viewed from the right angle, these ridges, which give the moon a walnut appearance, prominently protrude along the edge. Figuring out how the mountains formed has puzzled scientists since the features' discovery.

Now, a new model suggests that a giant ring around the moon fell to the surface, creating the ridge. If the crash was slow and gradual, and the angles low enough, the material would have slid across the icy surface, gashing it before coming to a halt. As successive impacts of debris followed a similar path, they would have been caught in the gouges from previous falls, piling up on the surface to create the ridge.

"This behaves somewhat like a traffic jam," Angela Stickle told Space.com. Stickle, a planetary scientist at the Johns Hopkins University Applied Physics Laboratory (APL), and her colleague James Roberts, simulated the slow collapse of a ring around Iapetus. They found that the resulting "infall" could create features that would explain the walnut ring. "As the entire disk collapses, this traffic jam grows and can leave a raised ridge behind.

A slow-falling disk

Although it is Saturn's third largest moon, Iapetus is only about an eighth as wide as Earth. The massive ridge follows the moon's equator, with peaks as high as 12 miles. The soaring heights on the small moon make the ridge the tallest mountain range in the solar system relative to the body it's on.

Over the years, scientists have proposed a range of solutions, from tidal bulges to fault thrusting to a warmer interior in the past. Each of these potential explanations has its own faults, and many of them require very specific initial circumstances.
"An issue with these sorts of models is that we don't know how likely those necessary starting conditions are to have occurred," Stickle said.

Some studies have proposed that something outside of the moon birthed the striking ridges. An object slamming into Iapetus could have created a debris disk — and perhaps a lost natural satellite, or "submoon" — that would have orbited around Iapetus' equator. Tidal interactions could have pulled the ring debris inward, while Saturn would have stripped off the submoon.

With this possibility in mind, Stickle and Roberts simulated what would happen as a ring of debris fell onto the moon. How the ring itself formed didn't matter as much as what happened once it was in place. The disk is likely made up of fragments of material from a large, earlier impact into the surface of Iapetus. The particles are most likely ice, though there might be some rocky material mixed in.