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# Within Ancient Thebit

The Straight Wall isn't a single, continuous feature.

Is there an amateur astronomer who hasn't enjoyed looking at **Rupes Recta**? Commonly known as the Straight Wall, as the Latin name implies, the 110-km-long (68-mile) feature is relatively straight, and its shadow reveals its nature as a wall, cleft, or scarp. Even small telescopes can show the Straight Wall's shadow gradually diminishing as the Sun rises over the feature. From full Moon on, the Wall reflects the Sun's rays and appears as a bright line etched on the lunar surface.

Measurements reveal that the eastern side is about 400 meters higher than the mare-covered western side.

Although correctly interpreted as a fault scarp for many decades, the Straight Wall escaped modern analysis until 2015, when Amanda Nahm (then at the Lunar and Planetary Institute) and Richard A. Schultz (formerly of ConocoPhillips) applied modern techniques developed to study terrestrial faults. Their analysis characterizes the fault orientation, depth, and material



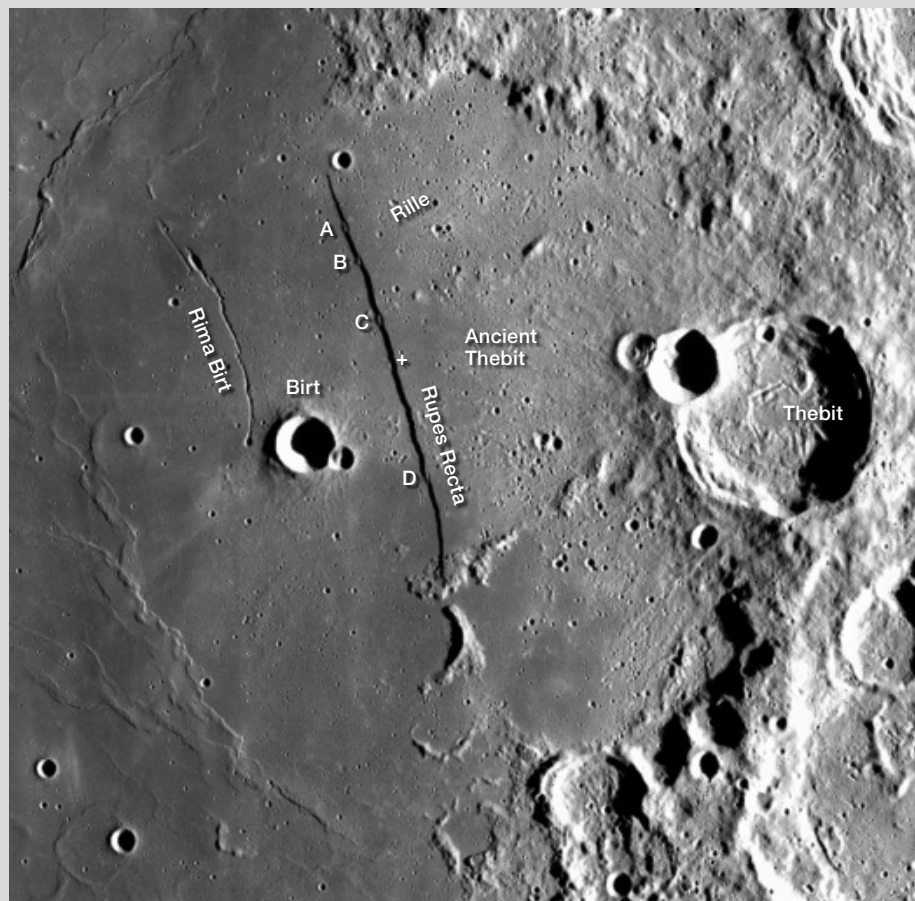
▲ Grazing illumination at sunrise reveals the point west of the Straight Wall where the ancient crater's floor abruptly becomes level.

strength to help determine the forces and processes that created the feature.

Nahm and Schultz began by noting that the Straight Wall isn't a single fault but rather five segments, each slightly concave in the direction of the west side. Where the segments meet, there are minor knicks or offsets. Observers with 8-inch or larger telescopes using high magnification can detect these small offsets. Nahm and Schultz labelled them A, B, C, D, from north to south. Lunar Reconnaissance Orbiter Camera images provide closeup views, with offset D being especially interesting. The segment to the north of D ramps down to the base of the fault just where the next segment begins. The ramp would be the easiest place for astronauts to travel from the elevated east side, down 400 m to the west with its access to Mare Nubium.

Craters and large, displaced masses of rock at the segment boundaries along the Straight Wall show only vertical movement, so the scarp is what's known as a *normal* fault. This vertical displacement is verified with readily available height measurements, and the length of the fault requires only a ruler and a scaled photograph to measure. The depth of faulting was obtained by comparing changes in topography across the fault and the

◀ The large, flooded crater seen here is informally known as Ancient Thebit.



surrounding area to a mathematically calculated topography model that uses the fault's vertical height and length as given values.

Nahm and Schultz find that the best fit to the measured scarp length and 400-m height implies that the fault initiated about 42 km below the surface and fractured its way upward. They conclude that the faulting started near the Straight Wall's highest point (marked + in the bottom image on the facing page). Additional fault segments initiated north and south of the main one and grew until they linked together, producing the noted segment boundaries. The estimated 42-km depth at which the fault originated is roughly where the crust meets the mantle, as determined from NASA's Gravity Recovery and Interior Laboratory (GRAIL) orbiter lunar gravity measurements. The crust on the east side of the fault is 35-to-40-km thick and abruptly drops to 25-km thickness west of the fault.

Now let's take a broader look at the region. Notice that the Straight Wall is near the center of a half crater informally known as Ancient Thebit, which is defined by a curved, mountainous rim to the east. The 57-km-wide crater **Thebit** cuts across the destroyed crater's eastern rim. What happened to the western half of Ancient Thebit? When the rising Sun illuminates the area (as the Moon's phase waxes), the buried western rim is revealed as a set of semi-circular mare ridges that extend the truncated northern rim of Ancient Thebit and continue the curved outline back towards the less distinct southern rim. This 220-km crater formed on the edge of Mare Nubium. The Straight Wall marks where the ruined crater's relatively flat floor east of the Straight Wall suddenly drops 400 m and then gradually declines another 450 m westward.

Northwest of the 16-km-wide crater **Birt** is **Rima Birt**. This rille generally mimics the slight curve of the Straight Wall, suggesting that the geologic stress that caused the collapse and created the enormous scarp also allowed magma to fracture its way to the surface, produc-

ing a 20-km-wide dome at Rima Birt's north end. In addition to the curve, the Birt rille is also offset at its midpoint, similar to the segment boundaries of the Wall. The rille looks like a series of short faults but has no detectable offset. Rather than moving up or down, it widened and was filled by rising magma at its north end. The 1-km-wide rille contains roughly 30 collapse pits, though none shows evidence of eruptions.

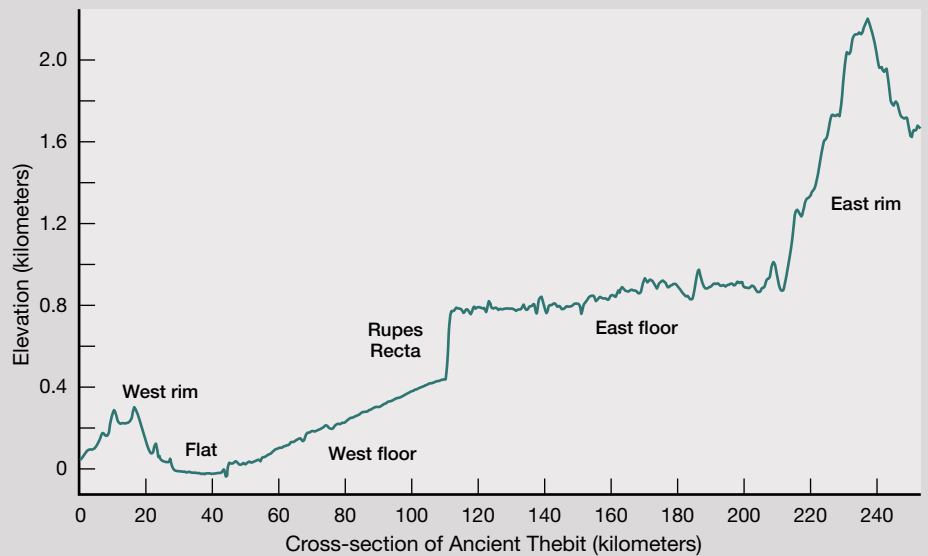
Grazing sunlight photos like the one on the facing page (and confirmed in cross-section measurements shown below) reveal another linear feature that isn't noted in scientific papers. There's a crease where the gradually sloping land 60 km west of the scarp abruptly becomes level. It's unknown how the change in slope occurred.

There's one more subtle linear fea-

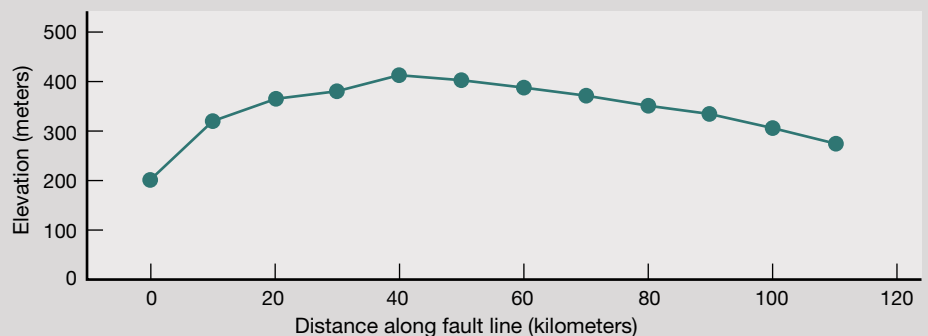
ture within Ancient Thebit. A shallow, inconspicuous rille originates from the northeast and intersects the Wall at B. As with the crease, it's unclear how this apparently older rille relates to the formation of the Straight Wall.

So how did the Straight Wall form? Ancient Thebit was originally carved out of the western rim of the Nubium Basin. Later, the basin was inundated with lava, and the accumulating mass caused the basin floor to subside, triggering a powerful moonquake and the sudden, catastrophic collapse of the western half of Ancient Thebit. The Wall is the dividing line between the two halves.

■ Contributing Editor **CHUCK WOOD** thanks Richard Schultz for an invigorating discussion on this wonderful fault.



▲ The graph above shows the southwest-to-northeast topographic profile across the center of the ruined crater informally known as Ancient Thebit.



▲ This graph plots the height of the Straight Wall from north to south.