

What is the mystery mass on the Moon?

Scientists have discovered a massive subsurface deposit of dense material – probably metal – beneath the largest crater on the Moon. Did it result from a huge asteroid impact or a former lunar ocean of molten rock?

What is hiding beneath the largest crater on Earth's Moon (in fact, the largest crater in our solar system)? That's what scientists said they'd like to find out after an unusual large mass of material was discovered lurking underneath the lunar South Pole-Aitken Basin. It's a lot of mass, too, according to Peter B. James, assistant professor of planetary geophysics in Baylor University's College of Arts & Sciences:

Imagine taking a pile of metal five times larger than the Big Island of Hawaii and burying it underground. That's roughly how much unexpected mass we detected.

The intriguing peer-reviewed findings were first published in the April 15, 2019, issue of the journal *Geophysical Research Letters*. From the abstract:

The South Pole-Aitken Basin is a gigantic impact structure on the far side of the Moon, with an inner rim extending approximately 2,000 kilometres in the long-axis dimension. The structure and history of this basin are illuminated by gravity and topography data, which constrain the subsurface distribution of mass. These data point to the existence of a large excess of mass in the Moon's mantle under the South Pole-Aitken Basin. This anomaly ... likely extends to depths of more than 300 km.

SO WHAT IS THIS MYSTERIOUS MASS?

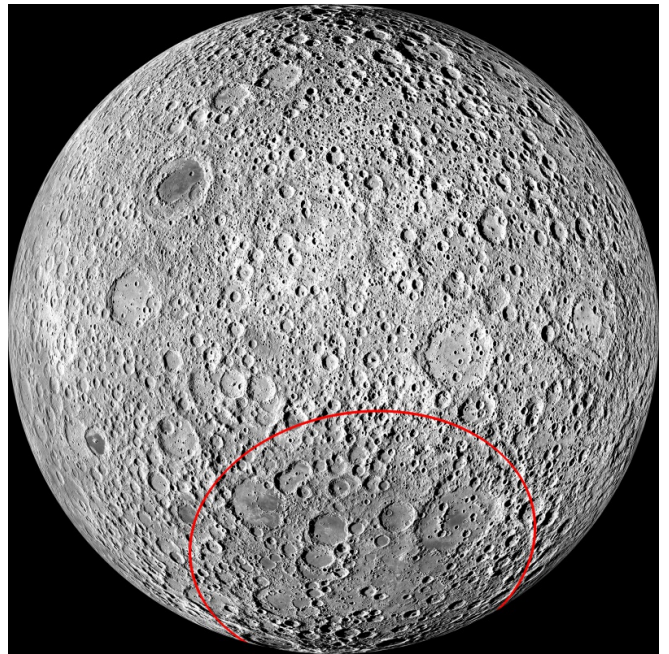
It is most likely metal of some kind, given its density and the fact that it is weighing the crater basin floor down by more than 0.8 km. An ancient asteroid impact would be a logical solution. Computer simulations of large asteroid impacts suggest that, under the right conditions, an iron-nickel core of an asteroid might be lodged into the upper mantle of the moon (the layer between the Moon's crust and core) during an impact, in this case the impact that created the South Pole-Aitken Basin.

Researchers analyzed data from spacecraft used for NASA's Gravity Recovery and Interior Laboratory (GRAIL) mission to measure very small changes in gravity around the Moon. The South Pole-Aitken Basin is estimated to have been formed about 4 billion years ago. The solar system was a very chaotic place back then, with collisions occurring between rocky and metallic bodies such as asteroids and young protoplanets – planetary embryos – on a pretty much regular basis. It seems quite feasible, then, that this is how the dense subsurface mass on the Moon got there.

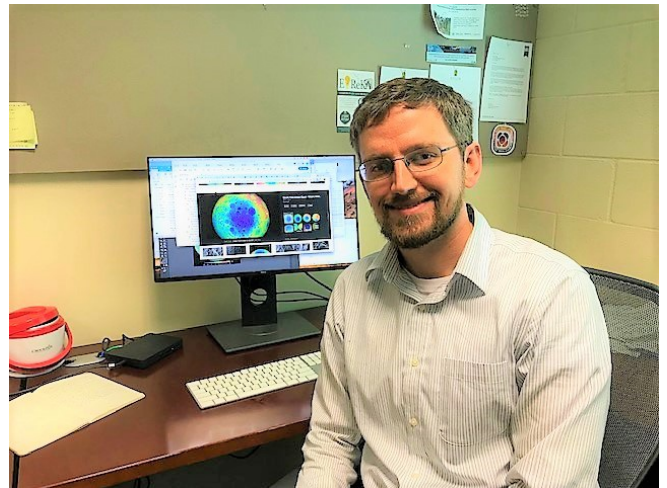
One other plausible theory, however, is that the mass might be a concentration of dense oxides associated with the last stage of lunar magma ocean solidification. It is theorized that the Moon once had an ocean of sorts – not of water, but of magma, or molten rock – which then cooled and solidified. In the process, the oxides could have been deposited in this region, forming the large mass.

These scientists say an asteroid impact is still the leading hypothesis, however, and James referred to the South Pole-Aitken Basin as one of the best natural laboratories for studying catastrophic impacts in the early solar system.

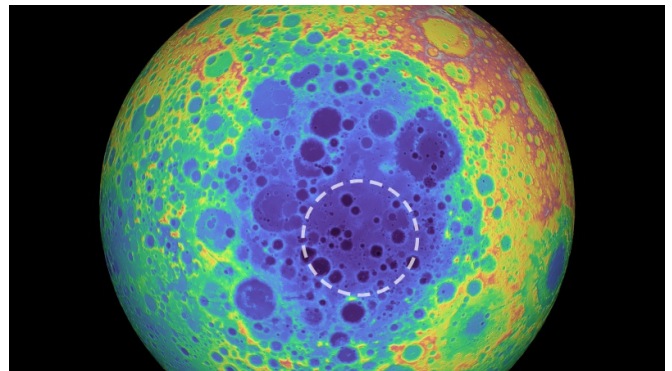
AK, with EarthSky and Wikipedia Notes



The South Pole-Aitken Basin (outlined) on the far side of the Moon. The unusual mass is beneath the surface area.



Peter B. James via Baylor University.



False-color map of the far side of the moon, showing the location of the unusual massive subsurface deposit beneath the South Pole-Aitken Basin.