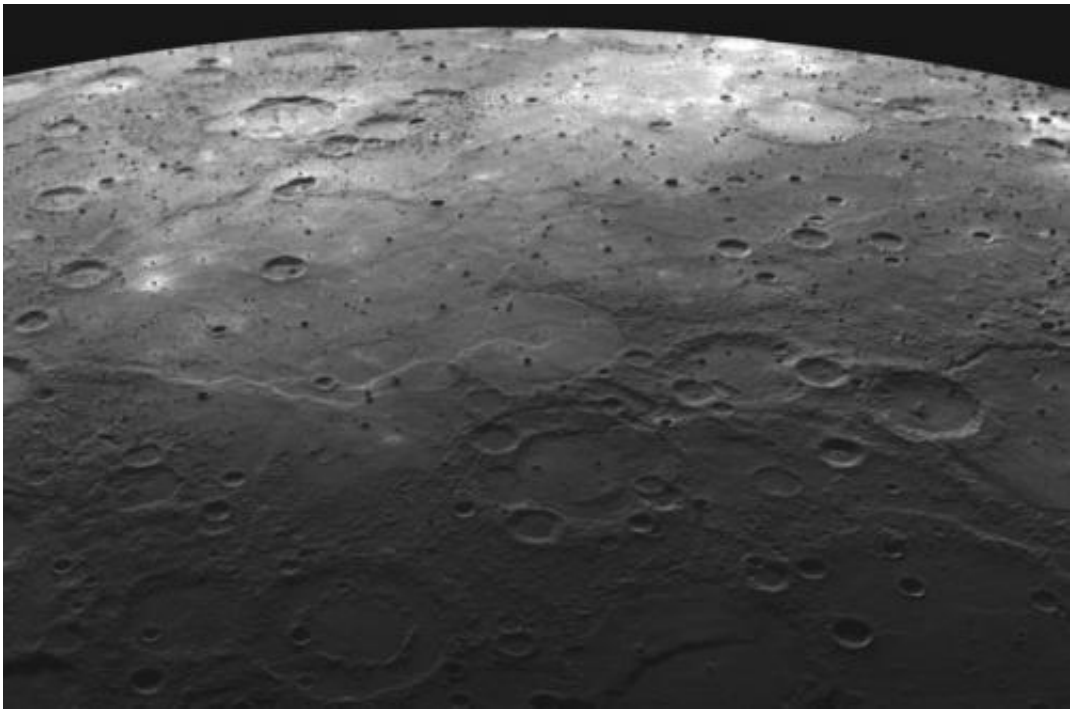
Explosive volcanoes light up Mercury's deep past

January 31 2014, by Robin Wylie



Lava-flooded craters and large expanses of smooth volcanic plains on Mercury's surface. Credit: NASA

Mercury has long been a mystery to scientists. Until recently, knowledge of the planet was limited to the grey, patchy landscape revealed by the Mariner 10 probe, NASA's first mission to Mercury in the mid-1970s.

Mariner 10's photographs showed little detail of how the surface was formed. Like Venus, Earth and Mars, it was clear that Merucy's rough

crust reflected millions of years of aerial bombardment by comets and meteorites. Gaps in our understanding of the innermost planet have included some basic knowledge such as the planet's geology, how it was formed and evolved, and whether its interior was still active.

But now NASA's return mission, MESSENGER, is allowing scientists to confront the full complexity of Mercury's surface. Amid the countless craters caused by meteor collisions, the landscape has marks that were not made by such collisions. Using the increased resolution of MESSENGER's cameras, scientists have identified previously hidden volcanic activity, which changes what we know about the planet's formation, and even the history of our solar system.

The detailed pictures showed that Mercury seemed to have smooth, rimless depressions that were obviously not produced by meteor impacts. They were surrounded by bright, reddish material, believed to have been left by pyroclastic flows – indicating that the depressions were volcanic vents.

The presence of pyroclastic material – which is composed of volcanic ash – showed that the eruptions had been explosive. In some cases, the debris had been ejected more than 50km from the volcanic vents themselves. This is a remarkable distance, as it means that Mercury's volcanoes must have been much more powerful than previously thought.

The force of an eruption is determined by volatile gases beneath the planet's surface. Initially dissolved in magma, as they reach the surface, these gases rapidly swell and shred the magma into tiny shards called pyroclasts. This means that, in general, the more volatiles there are in the magma feeding an eruption, the more explosive it will be.

To shoot debris so far, the magma in Mercury's crust would need to have been brimming with volatile gases. The latest signs of volcanic deposits

from MESSENGER suggest that nearly 1.5% of the parent magma may have been occupied by volatiles. For gases this is a large fraction, because as they rise towards the surface their volume increases dramatically.

Mercurial nature

Before its explosive nature surfaced, experts assumed that, having formed so close to the sun, Mercury would have been stripped of its volatile gases early on in its life. So future theories of Mercury's genesis must now take into account how the planet kept its fizz hidden. They will likely now invoke ideas of ancient collisions with volatile-rich "planetesimals" – balls of rock and dust that are thought to have formed the inner planets – which could have topped up Mercury's levels.

All of this puts a new spin on the first rock from the sun, and its place among the others. The crushing atmospheric pressure on Venus means that volatiles cannot easily escape from emerging magma, so exploding volcanoes can't exist. On Mars, most recent studies of volcanoes report that, just like on Earth, both explosive and effusive (less gassy, lava-producing) eruptions seem to have been prevalent in its past.

With the discovery of widespread explosive activity so fresh on Mercury, it is too soon to speculate on its overall volcanic character. Vast plains of lava have elsewhere been observed on its surface, showing that a great deal of non-explosive volcanism has also taken place there. But there are tentative signs that it might be exceptional amongst the volcanic planets: at least one of the vents uncovered by MESSENGER may have been entirely explosive, which could be a unique planetary feat.

The word "mercurial" – meaning volatile – reflects the character of the Roman messenger god which gave Mercury its name. As researchers

continue to study its still-obscure surface, it will be interesting to see just how fitting the name might yet prove to be.

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