Volcanology Targets for Future Exploration at Mercury [#6002]

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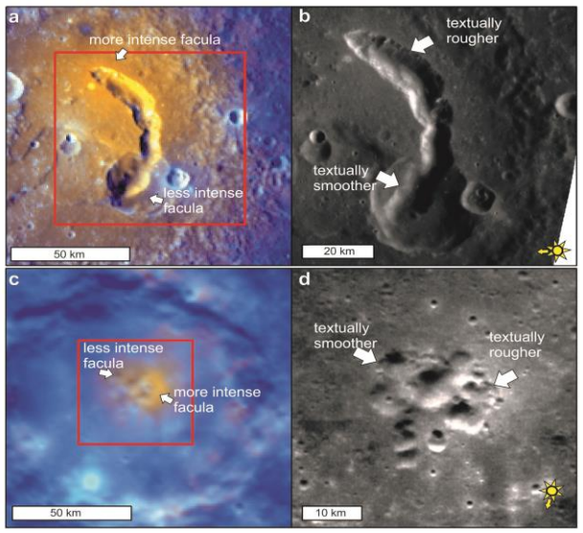
Volcanic issues

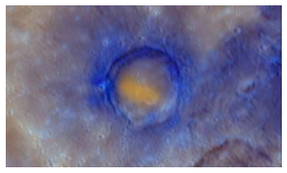
Most of Mercury's surface is volcanic. Plains were emplaced effusively. Explosive volcanism punctured both plains and crater floors, evidencing Mercury's volatile richness. Until the compositions of more than just the largest single explosive deposit have been measured we remain unsure what the volatiles are. The best-imaged and geochemically best-characterized examples make us anxious to learn more from the anticipated fuller documentation when BepiColombo starts its orbital science at Mercury in 2026.
Here we illustrate some of the types of feature where higher imaging resolution of a greater number of cases will be particularly valuable, especially when coupled with BepiColombo's enhanced elemental and geochemical mapping capabilities.

Faculae

Faculae are high albedo, spectrally red surficial deposits. Most have a volcanic vent ('pit') within them, from which the facula material was erupted explosively on presumed ballistic trajectories.



Many faculae are asymmetric about their source vent, including the largest, Nathair Facula, where the conduit may have been inclined. Here are two other examples: At the top, the unnamed facula in Picasso crater, associated with a compound vent in the shape of an elongated crescent. The greater intensity of the northern part of the facula suggests that the northern end of the vent was the most recently active, but image resolution inside the vent is inadequate to confirm this eruption sequence. Bottom, an unnamed facula -6.5 E, 48.4 S, that is more intense in its eastern part. Together with the fresher texture in the eastern parts of the compound vent at its source, this suggests an eastward migration of the seat of eruption

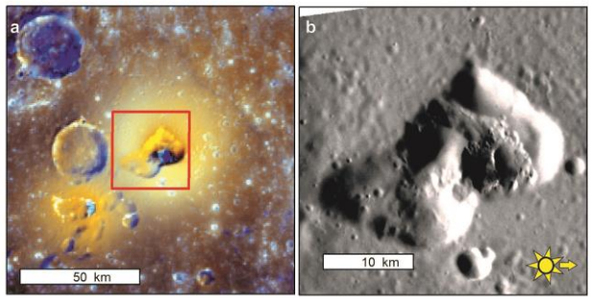


Zmija Facula (267.7 E,37.3 S), of which we need better images to determine its relationship with the fissure or crater chain that crosses the floor of its host crater.

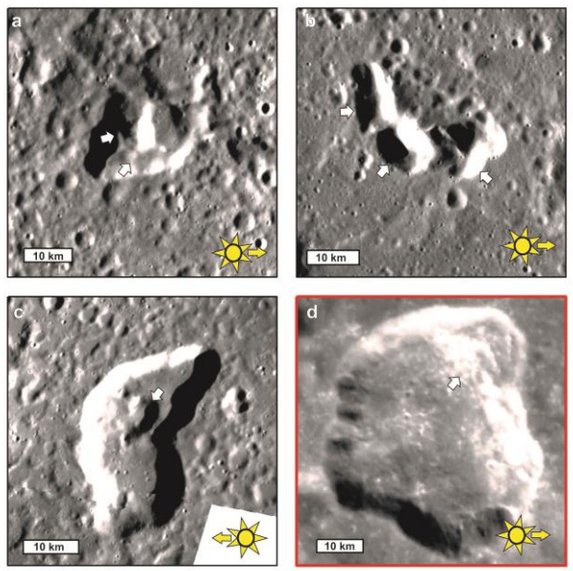
Yinshe Facula (192.2 E, 46.3 S), another that BepiColombo's improved imaging will help us to interpret. Does it have a vent, or are those all impact craters?

Volcanic vents (pits)

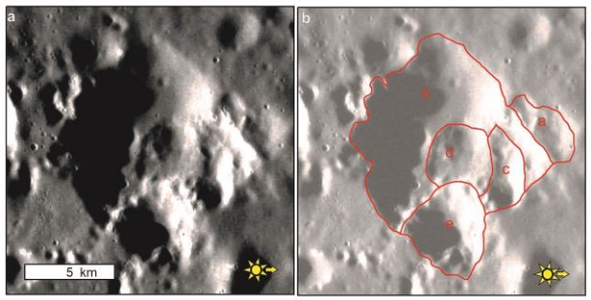
Most 'pits' on Mercury appear to be explosive volcanic vents. >70% of these are compound vents, where multiple eruptions have occurred.



This is the archetypal compound vent on Mercury, surrounded by Agwo Facula (in the SW of the Caloris basin). The several depressions on its floor, some of them separated by narrow septa, each represent a vent of a different age. Cross cutting relationships, superimposed impact craters, and roughness of the surface give consistent clues to the age sequence. MESSENGER image quality is rarely so good in other vents, as the following examples show.



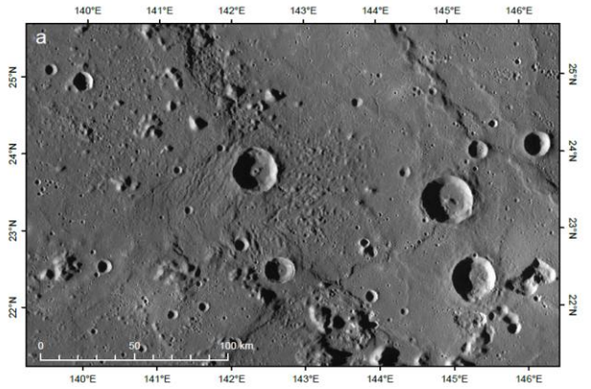
None of the four examples above has a simple vent shape. Examples (a)-(c) show evidence of eruptions at different sites within them (and so are compound vents), whereas the shape of (d) could be just a result of mass wasting at its walls.



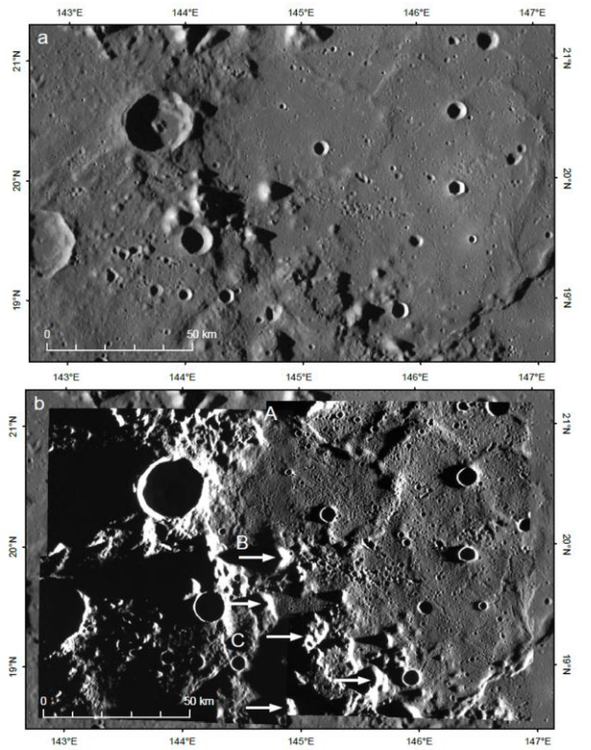
The compound vent at the source of Ejo Facula, in the south of the Caloris basin. A lettered age sequence can be inferred, but shadow might hide a lot of detail within the area labelled b.

Lava flow textures

Despite Mercury's abundance of smooth plains, no effusive vents have been definitively identified. Lava channels and tubes remain elusive, and contacts between flow units are generally obscure. The examples below in the SW of the Caloris basin show some limitations that BepiColombo may be able to overcome.



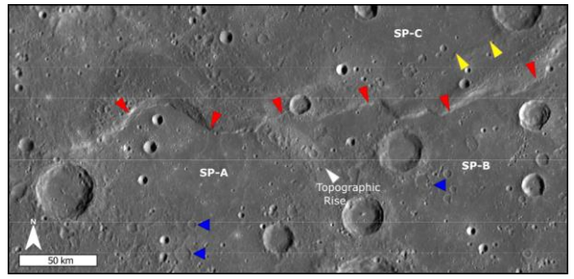
In the SW of the Caloris basin, the basin rim runs SSE across this view. Surface cracks in the flow surface are apparent where inward-flowing exterior plains lavas have descended a re-entrant in the basin rim. We need more examples at high Sun angles.



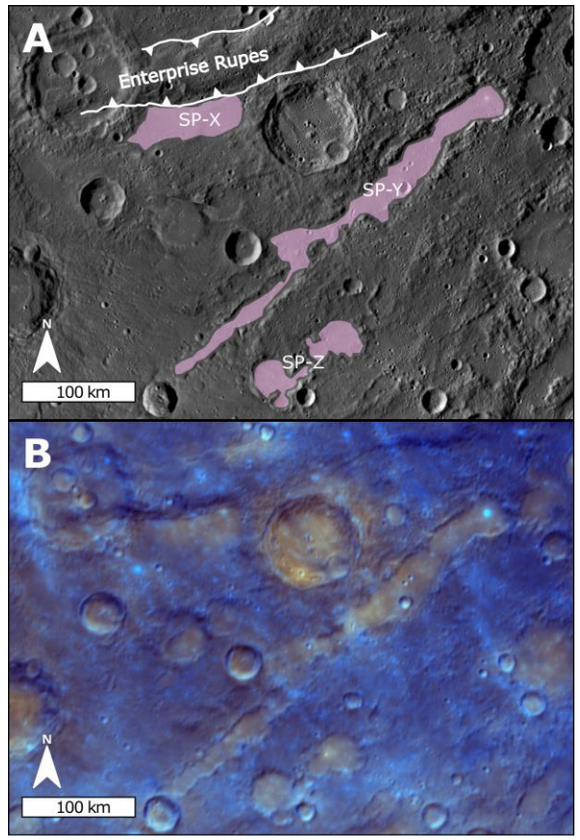
Also in the SW of the Caloris basin, the low west-facing scarp A-B may the flow front of west-flowing interior plains. Arrows indicate embayed blocks of detached rim material. Is the fine-scale pitting of the interior plains surface secondary impact cratering? The 'craters' look too dense and uniform in size for that. Is it a texture caused by volatile escape from below the advancing flow?

Small ponded patches

Although large scale effusive volcanism represented by most of Mercury's 'smooth plains' is accepted to have ended by about 3.5 Ga, there are many local occurrences, too small to date by crater counting, that are probably considerably younger. Some of these are smooth crater floor material too thick to be impact melt, and so interpreted as plains-forming lavas.



This NAC mosaic includes the thrust scarp Calypso Rupes (red arrows) which cuts through smooth plains. Two patches of especially smooth plains SP-A and -B appear to be ponded against the scarp, and a 3rd patch SP-C is in a depression behind the scarp. Note the subdued/flooded craters about 50 km south of the scarp (blue arrows) suggesting shallower flooding than adjacent to the scarp where such features cannot be seen.



Small ponded patches ponded against Enterprise Rupes (SP-X) and examples SP-Y and SP-Z on the floors of crater-chains (or pit-chains) of uncertain origin.

MESSENGER images courtesy of NASA/Johns Hopkins University APL/Carnegie Institute of Washington