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Locations and formation-mechanisms of hollows on Mercury

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Hollows on Mercury are sub-kilometre scale shallow, steep-sided rimless pits. Seemingly a result of loss of material to space, they are among several lines of evidence suggesting that the volatile budget of Mercury is higher than previously thought. They tend to occur in clusters and are associated with relatively high-albedo blue material ('bright crater floor deposits'). To further investigate the source and release mechanism of volatiles in hollow formation, we have surveyed hollowed areas within several pole-to-pole strips on Mercury. The majority of hollows occur in impact craters: on the walls and rims of simple craters and on the terraces, peaks and smooth floors of complex craters. Where they occur on only a part of a smooth crater floor, they cluster close to and concentric with the walls and peaks. Hollows that are not in craters are often associated with crater ejecta. Craters with hollows have a morphology that suggests a Calorian age or younger, however a few are very degraded and much older. In these older craters, hollows are observed associated with smaller superposed craters and the hanging wall of thrusts crossing the crater, in addition to tectonic lines of weakness such as crater walls and peak rings.

A preferred slope aspect for hollows occurs in about one-third of cases. This is always towards the south in the northern hemisphere and towards the north in the southern hemisphere. The majority of hollow clusters superpose either low-reflectance material (LRM) or intermediate terrain (IT). Very few are observed on smooth plains except within large impact craters. This may be because smooth plains are not a good source of hollow-forming material and/or because they form a barrier to the release of volatiles.

The occurrence of hollows in curved clusters following the walls and rims of impact craters, within slumped material from their walls and in uplifted central peaks suggests a structural control on their formation. However, hollowing is not observed near thrust faults on Mercury except where they cross old, degraded impact craters. These observations could suggest that the hollow-forming volatiles are located below the reach of low-angle thrusts, but can be accessed by higher angle impact-faulting.

The presence of hollow-clusters on crater walls and rims does not support a source within differentiated komatiitic crater infills. Their presence in old craters does not support the theory that their source is differentiated impact melt unless the differentiated volatile-rich material was initially emplaced at depth and only later brought to the surface where it could lead to hollow formation.

The tendency for hollow formation on sun-facing slopes suggests that insolation influences hollow formation, and supports sublimation as a mechanism for volatile loss to form hollows. However, the 'hot poles' receive more insolation than other areas of Mercury's surface, and yet fewer hollow clusters were observed at that longitude than at other study sites. Factors other than insolation appear to play a strong role in hollow formation.