SMALL VOLCANIC CRATERS AND PITS. R. A. De Hon, Department of Geography, Texas State University, San Marcos, TX, 78666, dehon@txstate.edu

Planetary Volcanism: Mafic lava flows dominate on rocky planetary bodies [1, 2]. Most lavas were emplaced as very fluid, flood basalts. They make up the surface that was pummeled by early saturated cratering, and they constitute large areas of plains-forming material which mask underlying cratered surfaces. As planetary datasets increasingly contain higher resolution detail, it becomes possible to examine increasingly smaller landforms. In addition to the large craters on volcanic cones and shields, a large variety of craterform features and pits are found in monogenetic volcanic fields and superposed on lava flows.

Three mechanisms are largely responsible for these volcanic landforms. They are 1) craters and pits formed over volcanic vents; 2) craters formed by interaction of surface flows and underlying water or ice saturated ground; and 3) crater like structures and pits formed by collapse. A compendium of volcanic craterform structures and pits— as seen in terrestrial volcanic fields—is provided for comparison with similar appearing planetary features.

Craters: The term *crater* as used for volcanic structures has a rather loose definition. Any depression atop an accumulation of volcanic material is called a *crater*. As such it may be formed by explosion or collapse. In contrast, *meteor craters* are formed by explosive release of energy at the surface by hypervelocity impact of a meteorite or comet.

Caldera: A caldera is volcanic depression formed by the collapse of the ground above a magma chamber, which empties during very large volcanic eruptions. The diameter of a caldera may be many times larger than the size of the individual vents. The caldera is part of a volcanic complex which may include many vents and smaller volcanic structures superposed both inside and outside of the caldera.

*Maar***.** Maars are steep-sided volcanic craters formed by venting magma-derived volatiles or magma-heated groundwater (phreatomagmatic eruption) surrounded by a raised rim of volcaniclastic material [3, 4, 5]. The rim may be composed of mostly accidental material, or it may be mixture of accidental and magmatic-derived material. Maars may have cinder cones situated in their floor by later eruptions.

Tuff ring: Tuff rings consist of a raised ring of volcanic tuff around a shallow crater. *Tuff ring* by this usage is the raised rim of the maar crater. Some tuff rings may be composed of volcanic cinder, and the floor may not be significantly depressed below the surrounding surface.

Craterform structures: Crater-like features may be formed by that are not associated with volcanic vents.

Pseudocrater. Pseudocraters, also called *rootless cones***,** are tephra-rimmed craters produced by a hot lava flow that crosses a water/ice saturated surface [6, 7, 8]. The resulting explosive steam that escaped through the overlying basalt produces one or more shallow craters in the flow.

Rootless shield. Rootless shields are small, shield-like domes of elastoviscous crust on active lava flows that are beached and allow underlying fluid lava to escape to the surface [9]. After lava has escaped, the shield is preserved as a small rise as a blocky lined pit surrounded by radiating lava channels on the surface of the flow.

Deflated Inflation Plateau. Deflated inflation plateaus are raised rings of blocky and slabby lavas surrounding wide, shallow pits [10]. The inner walls are blocky or slabby (like the outer rim), but the interior floors are relatively smooth lava like the lava flows on which the pits are found. The floor consists of the original lava crust that was inflated to form a lava plateau that receded to lower levels as supporting lava escaped. A raised rim of stretched and fractured brittle crust remains. The floor is often cut by large fissures. These crater-like structures can be easily misinterpreted as explosion craters because of their blocky rims. They may have highly irregular outlines in contrast to the circular or elliptical outlines of explosion craters, and they are surrounded by lava channels produced by escaping lava.

Pits: Rimless depressions are common in volcanic fields. They overlie vents, or they may form by other mechanisms.

Lava subsidence pit (drain-back craters). Some volcanic vents consist of pits that originally erupted lava to the surface, but in later stages of activity the lava drained back into the subsurface leaving a pit.

Fumarole. A fumarole is a vent or opening through which issues steam or other volcanically derived gases. Fumaroles many be small cracks, elongate fissures, or small holes.

Collapse pit. Collapse depressions form on basalt flows as fluid lava drains from beneath a solid crust. Variations range from a viscoelastic crust sagging into a void to blocky remnants of the overlying crust lining the depression. Collapse pits may be randomly scattered on a flow or aligned over lava tubes.

Inflation pit. Inflation pits are formed when thin, fluid lava flows encircle local high spots in the underlying surface. Subsequent thickening of the lava flow by inflation produces a steep-sided depression in the flow [9]. Inward facing slopes may be only slightly fractured if the lava crust is elastic and can stretch, or it may be highly fractured or broken onto slabs and blocks if the lava crust is brittle. Many pits on lava flows which were identified as collapse pits are, in fact, inflation pits.

Significance: Small impact craters are typically bowl-shaped depressions surrounded by a raised rim of fragmented target material. It may be difficult to distinguish between small impact craters and some volcanic explosion craters. Meteor crater placement is random, and rim components are limited to brecciated, local surface material. In contrast, rim materials of maar craters contain samples of subsurface materials which are traversed by the ascending gases. Some mare eruptions bring materials from the mantle. Correct identification of volcanic landforms is important in interpreting planetary thermal history. Eruptive vents often reflect structural control whereas faux craters have no such control. Pseudocraters indicate the presence of water or ice at the time of formation [11]. Collapse craters suggest the possibility of subsurface voids [12] that might provide might have provided habitats for primitive lifeforms [13] or shelter for future astronauts.

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