OUTER LAYER OF MARTIAN LOW-ASPECT-RATIO LAYER EJECTA CRATERS: EMPLACEMENT MODEL.

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Introduction: We proposed a model for the formation of the extensive outer layers of low aspect-ratio layered ejecta (LARLE) craters (Figure 1) by gas transport. While thin, this layer may extend outward for 20 crater radii from the rim of fresh LARLE craters. Based on the morphologic and morphometric characteristics of these craters [1, 2] we propose that the LARLE layer is emplaced by base-surge formed by similar mechanisms as those generated by explosive crater experiments and some volcanic eruptions

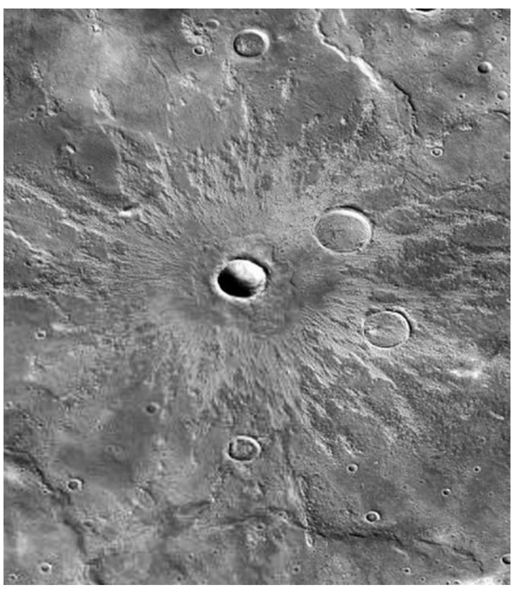
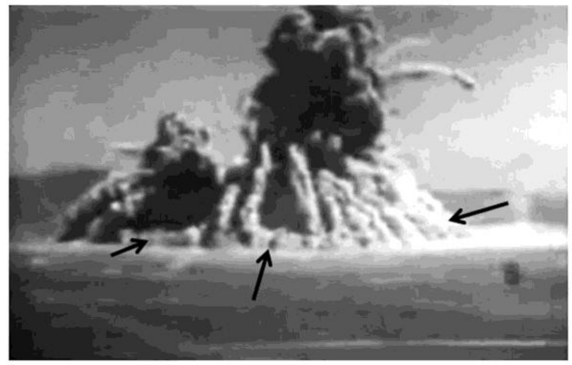


Figure 1. Vaduz is a 1.85 km diameter LARLE crater located at 38.2°N, 15.8° E.

(i.e., impact erosion and sedimentation, [3]) (Figure 2). We also propose a mechanism for the generation of the relatively large volume of fine-grain particles contained in these layers and explain why it appears to be relatively erosion resistant after deposition.

Background: The mechanism of emplacement of the LARLE ejecta layer is controversial. Wrobel et al., [4] proposed that this layer is not ejecta at all, but a "duricrust-like" erosion-resistant surface produced by



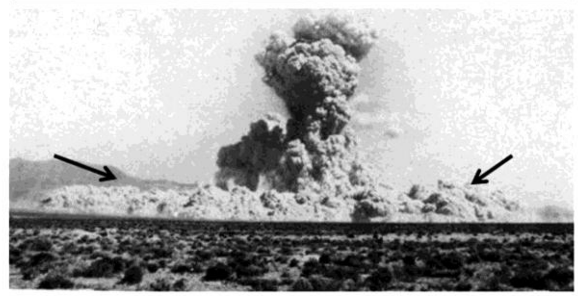


Figure 2. (a) Base surge (arrows) starting to develop around Sedan buried nuclear test crater. (b) Fully developed ground-hugging base surge (arrows) as the explosion cloums continues to ascend.

extreme winds, lingering high temperatures, and water vapor generated by the impacts. They suggested that this blast moves outward to melt near-surface volatiles, causing them to migrate upward through the regolith. However, this model requires that LARLE craters < 5 km (which are the majority of LARLE crater) form in pure water ice or water, and that all of that material be transformed to vapor in order to produce the required blast.

In contrast,while [5] also suggested that the LARLE outer ejecta layers was emplaced by base surge, they proposed that it was generated by ejecta column collapse. However, experimental evidence from explosion crater tests [3, 6, 7] suggests that this mechanism provides very little material to a base surge generated by impact craters forming in geologic materials.

Model for LARLE Outer Layer: We proposed that LARLE layers are produced by base surges, like the base surges of land-based, near-surface, and buried high-explosion and nuclear explosion craters. These base surges are produced dominantly by impact erosion as primary ejecta fall close to the crater rims, ejecting surface materials. Some of the ejected fine-sized particles are incorporated and suspended in the atmosphere (Figure 3). Winnowing of fine-sized particles

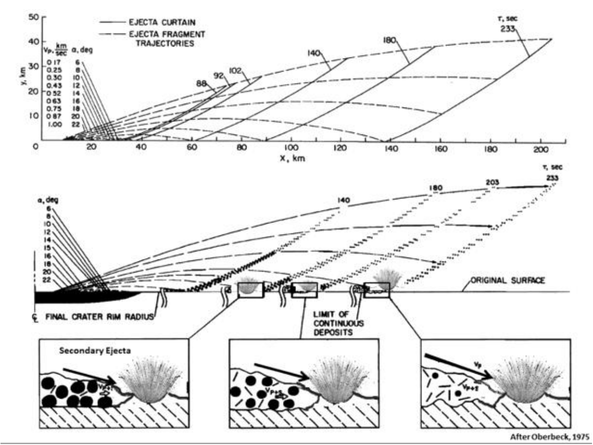


Figure 3. Generation of secondary ejecta with both horizontal and vertical velocity components. The vertical component lofts ejecta, some of which are fine particles that can be entrained and suspended in the atmosphere. If the surface is mantled by a thick layer of snow, ice and dust then substantial volumes of fine particles can be ejecta.

materials is added by collapse of the explosion column. These base surges are turbulent density currents that contain from the advancing ejecta curtain also added material to this dusty cloud, but little, if any relatively low concentrations of suspended particles. As a result of their low-concentration, interstitial gas controls the flow mechanics [8, 9]. Consequently, these surges flow as low-viscosity, Newtonian fluids that spread radially for great distance until they drop enough of their particle load so their density nearly equal that of the surrounding atmosphere. LARLE layers are comparatively more voluminous than base surge deposits from explosion craters, probably because they form exclusively in areas surfaced by easily eroded mantles of snow, ice and dust that contribute particles to the surges [10, 11]. LARLE layers appear to be relatively resistant to erosion. This probably is a result of cementation of sulfur-rich duricrusts produced as water vapor diffuses into and out of the deposits.

Conclusions: We suggest that the outer layers of LARLE craters are base surge deposits generated like those of large-scale explosion crater tests. These surges flow as Newtonian fluids because of their low-concentration of fine particles. LARLE layers are relatively thick because these craters form in regions mantled by thick deposits of fine-grain surface materials that are incorporated into the base surges. The LARLE materials are cemented by duricrust like that found across Mars.

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