THE ROLE OF BASE SURGE IN THE FORMATION OF MARTIAN LOW-ASPECT-RATIO LAYERED EJECTA (LARLE) CRATERS. N. G. Barlow[1], J. M. Boyce[2], and L. Wilson[3]. [1]Dept. Physics and Astronomy, Northern Arizona Univ., Flagstaff, AZ USA 86011-6010 (Nadine.Barlow@nau.edu). [2]HIGP, Univ. Hawaii, Honolulu, HI 96822 USA (jboyce@higp.hawaii.edu). [3]Lancaster Environment Centre, Lancaster Univ., Lancaster LA1 4YQ, UK (l.wilson@lancaster.ac.uk).

Introduction: Low-Aspect-Ratio Layered Ejecta (LARLE) craters are an unusual feature characterized by a thin but radially extensive deposit surrounding some Martian impact craters. LARLE craters are typically fresh enough to be surrounded by a normal layered ejecta morphology in addition to the extensive outer deposit (henceforth called the LARLE layer) (Fig. 1). LARLE deposits are characterized by extending much further than a normal layered ejecta blanket (up to ~20 crater radii (R_c)) but being extremely thin (typically less than 10 m). We propose that LARLE layers are primarily base surge deposits, like those developed in near-surface nuclear and high-explosion crater experiments conducted on land [1-4].

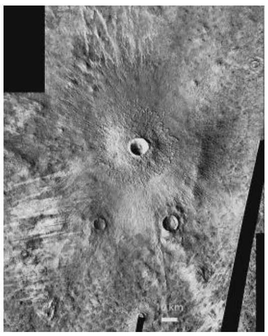

Figure 1. 10.3-km-diameter Lonar crater (72.99°N 38.30°E) is one of the largest and youngest LARLE craters.

Characteristics of LARLE Craters: We have conducted a survey to identify all Martian LARLE craters ≥1-km-diameter in the ±75° latitude zone [5]. Our survey reveals 139 craters which satisfy the LARLE criteria of maximum deposit extent of ≥6.0 R_c, sinuous "flame-like" terminus, and inability to be classified as any other Martian ejecta morphology [6]. LARLE craters range in diameter from the cut-off limit of 1.0 km to 12.2 km, with a median of 2.8 km. Most (97%) are found poleward of 35°N and 40°S, with the remainder concentrated in the equatorial Medusae Fossae Formation deposits. All LARLE craters form in regions covered by relatively thick fine-grained mantles. The average radius of the LARLE deposit (R_d) shows a linear relationship with R_c and the median R_d is 7.44R_c. The outer perimeter of the LARLE deposit has a sinuosity about twice as high as normal layered ejecta deposits. The surfaces of the freshest LARLE layers commonly exhibit radial, curvilinear ridges and dune-like landforms and a few fresh LARLE craters exhibit long, narrow, ray-like deposits of ejecta that extend outward for over 20 R_c. The LARLE deposit typically drapes over pre-existing terrain.

Formation of LARLE Craters: The thinness, large radial extent, sinuous perimeter, and morphologic characteristics of the LARLE deposit indicate that this layer is deposited in a different manner from the normal Martian layered ejecta blankets. We propose that impact into the relatively-thick fine-grained mantles results in production of a base surge that is deposited after formation of the inner layered ejecta blankets. This base surge is similar to the density-driven, turbulent cloud of suspended fine-grained particles produced by impact erosion and mobilization of the surrounding surface material by ejecta from shallow-depth-of-burst nuclear and high-explosion craters (Fig. 2). We have used the model of [7, 8], adjusted to Martian conditions, to predict the runout distances of a base surge deposit for two LARLE craters (10.3 km Lonar and 4.2 km Farim) and find the predicted runout distances are within 99% of the observed values [9, 10]. We suggest that while nearly all Martian impact craters should produce base surges, the reason for the production of the obvious LARLE layers is due to their formation in relatively thick fine-grained sedimentary deposits which are the source of the extra particulate debris.

Figure 2. Image of the Sedan nuclear explosion. Note the secondary impacts producing the base surge cloud along the surface.

References: [1] Nordyke M. and Wry, G., (1964), *JGR*, *69*, 675-689. [2] Nordyke M. and Williamson M. (1965) *PNE-242F*, 103 pp. [3] Oberbeck (1975) Rev. Geophys. Space Phy., 13, 337-362. [4] Knauth et al. (2005) *Nature*, *20*, 1123-1128. [5] Barlow N. G. and Boyce J. M. (2013) LPS XLIV, Abstract #1196. [6] Barlow N.G. et al. (2000) JGR, 105, 26733-26738. [7] Dade W. and Huppert H. (1995) *Nature, 381*, 509-510. [8] Dade W. (2003) *JGR*, *108*, B4, 2211. [9] Boyce J.M. et al. (2012) LPS XLIII, Abstract #1081. [10] Boyce J.M. et al. (2013) *LPS XLIV*, Abstract #1004.