KOROLEV CRATER, MARS: CHARACTERISTICS AND ORIGIN OF VOLATILE-RICH DEPOSITS IN THE CRATER INTERIOR: James W. Head[1] , Patrick Russell[1], Michael Hecht[2] and James B. Garvin[3], [1]Dept. of Geol. Sci., Brown Univ., Providence, RI 02912 USA, [2]Jet Propulsion Laboratory, Pasadena, CA, USA, [3]NASA Headquarters, Washington, DC 24450 USA.

Introduction: Korolev is one of a few craters in the northern lowlands that contain a smooth-surfaced deposit filling much of the interior volume. These deposits are likely volatile-rich and their mode of emplacement and subsequent modification remain uncertain [1, 2]. Here we characterize the setting, morphology, and fill of Korolev crater, then discuss two classes of mechanisms that may have filled the crater with ice-rich material: 1) air-fall deposition from above, and 2) groundwater effusion from below [3].

Description of Setting, Crater, and Fill: Korolev Crater (Figs. 1-4), 79 km in diameter and centered at 73° N, 195° W, is superposed on Amazonian mantle material that blankets the northern portions of the northern lowlands, between Amazonian polar cap materials to the north and Hesperian sediments to the south [1].

While the crater is circular, rim height, ejecta, and fill are not (Figs. 1, 2). The highest part of the rim is in the northeast, at -3.4 km elevation, and the lower parts in the west, at -4.2 km (Figs. 2, 4). The lowest elevation of exposed floor is in the southwest, at -6.2 km, 2.8 km below maximum rim height and 1.5 km below the average level of the surrounding plains (Fig. 2). Ejecta is lobate, extending in thin sheets > 1 crater diameter to the north, east, and south, but terminating abruptly less than 0.5 crater diameters to the west (Figs. 1, 2). Lack of ejecta in the west and higher rims in the east suggest the impact may have been oblique, from the west.

The smooth-surfaced, roughly circular fill deposit within Korolev does not extend completely to the interior sides of the crater, leaving a trough ring between it and the sides (Figs. 1, 2). This ring is not of uniform width as the fill is displaced to the north and east relative to the crater's center (Figs. 1-4). The top of the deposits is roughly equivalent to the elevation of the plains surrounding the crater, -4.7 km, giving it a maximum thickness of ~ 1.5 km (Figs. 3, 4). The margins of the deposit are steep and abrupt, abutting closer to and higher up on the rim in the north and east, and are more gradual towards the upper surface in the south and west.

The rim-to-floor depth expected at a fresh, unfilled crater of Korolev's diameter, based on morphometric relations of fresh martian craters is 2.3 km [4] to 2.9 km [2]. This range corresponds well with the range of max. and min. rim-to-floor depths (2.8 km and 2.0 km, respectively) calculated at Korolev using a floor elevation from the greatest exposed depths and the max. and min. rim elevations. This consistency in observed and predicted fresh depths suggests that the actual deepest point of the crater is not much deeper than the observed elevation, -6.2 km. However, extrapolation of the crater's shape along a parabola would suggest that the center floor elevation should be lower [2].

Emplacement of Fill Deposits: There are two classes of models for the emplacement of crater fill material in the northern lowlands as observed at Korolev crater. The first, traditional view, is that the deposits are composed of ice, mixed with an unknown fraction of dust, that was deposited over time from above [1, 2]. In such a scenario, presumably similar to the deposition of similar polar cap terrains, the deposits may be remnants of a once-large polar cap [5] or be isolated from the cap in local crater cold traps. [2] estimate that it would take 45-180 My to build up interior deposits ~1.5 km thick by this method. An alternative view is based on theoretical considerations that a frozen cryosphere kilometers thick may confine groundwater under hydrostatic pressure beneath the lowlands of mars [6]. Thermal and physical disruption of the cryosphere due to impact could release this groundwater [7] to effuse into, and possibly over-spill, the crater cavity resulting in a massive plug of ice in the crater interior [3].

A survey of large (> 45 km diameter) craters in the northern lowlands reveals that only the two northernmost, Korolev and one at 77° N, are largely filled [3]. This latitude-control of fill occurrence suggests that latitude-dependent temperatures may be controlling the filling process, not impact-release of groundwater, which should be independent of location. In either model, volatile-rich deposits would be modified due to insolation and re-radiation from crater walls [8]. The difference in fill evolution between the two models is that filling from below should occur relatively quickly, such that only erosion has occurred since, but that filling from above may have occurred continuously with modification. We are currently examining other filled craters in the circum-south polar and equatorial regions to determine similarity of processes and are developing a thermal model of modification of ice-rich deposits to determine if observed profiles/morphologies of fill deposits can be reproduced in the context of either of the two models discussed above.

References: [1] Tanaka, K.L., and Scott, D.H. (1987) USGS Map I-1802-C. [2] Garvin, J.B. et al. (2000) *Icarus, 144*, 329-352. [3] Russell, P.S., and Head, J.W. (2002) This Volume. [4] Pike, R.J. (1988) in *Mercury*, F. Vilas et al., eds., Univ. Arizona Press, 165-273. [5] Fishbaugh, K.E., and Head, J.W. (2000) *JGR, 105*, 22455-22486., 2002. [6] Clifford, S.M. (1993) *JGR, 98*, 10973-11016. [7] Russell, P.S., and Head, J.W. (in press) *GRL*. [8] Hecht, M.H. (2002) *Icarus, 156*, 373-386.

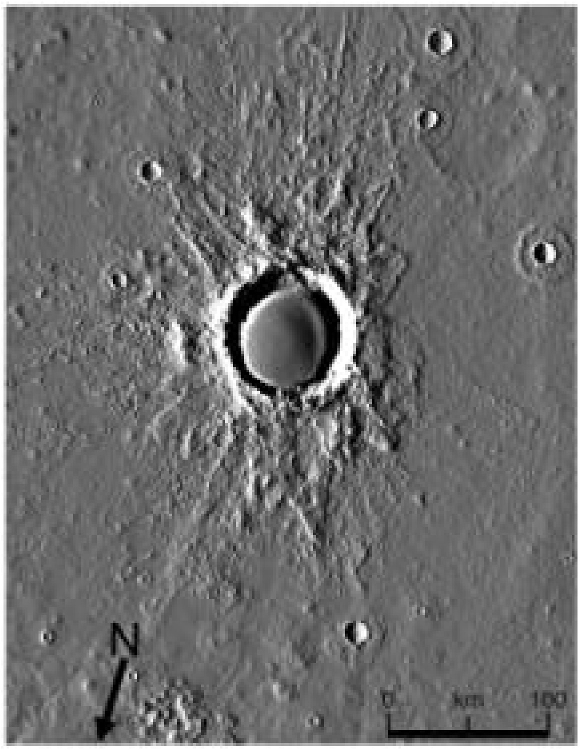

Figure 1. MOLA gradient map of Korolev Crater, illuminated from E to simulate shaded relief.

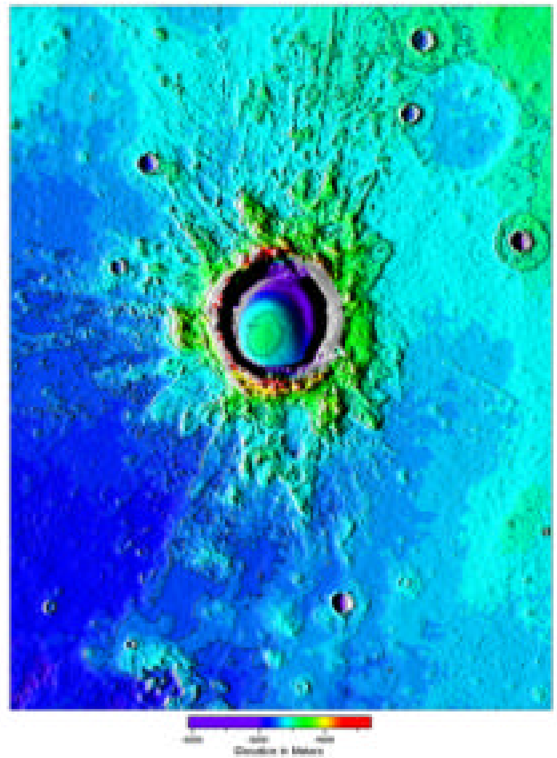

Figure 2. Gridded MOLA topography of Korolev Crater.

Figure 3. Altimetric profile of Korolev Crater from south to north.

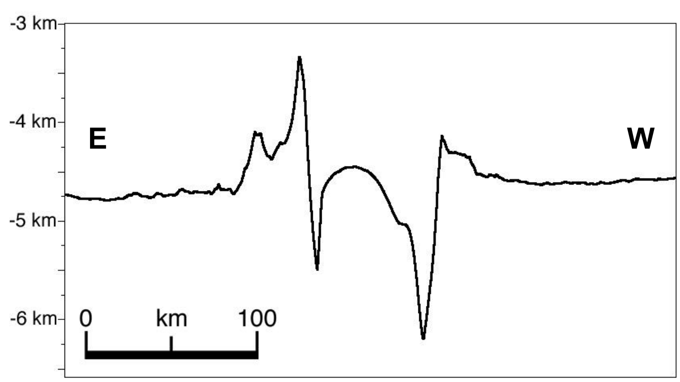

Figure 4. Altimetric profile of Korolev Crater from east to west.