FORMATION OF A DOUBLE LAYER EJECTA CRATER IN THE NORTHERN HEMISPHERE OF MARS. C. B. Lee, Department of Geography, Seoul National University, Seoul 151-746, Korea., fareast7@snu.ac.kr.

Introduction: Martian impact craters typically display a number of characteristics which appear to have been fluidized at the time of emplacement. The layered ejecta surround 89% of the cataloged craters ≥5km diameter that display ejecta on Mars[1]. The various ejecta morphologies seen on Mars are classified into several types based on the appearance of the ejecta(e.g., single layer ejecta, double layer ejecta and multiple layer ejecta)[2]. Two major models exist to explain the formation of the layered ejecta morphologies: (1) vaporization of subsurface volatiles during impact[3] and (2) interaction of ejecta curtain with the martian atmosphere[4, 5, 6]. Some authors have proposed that a mixture of both models could explain the layered ejecta morphologies seen on Mars[1]. Recently, besides numerical modeling and laboratory experiment, some analyses of the thermal properties of ejecta layers of martian impact craters were reported[1, 10]. The purpose of this paper is to infer forming processes of a double layer ejecta crater in the northern hemisphere of Mars using THEMIS images and MOLA DEM.

Morphologic Characteristics: This double layer ejecta crater typically has an inner thick layer and much thinner outer layer, and shows terminal rampart at the edge of outer layer. The northern part of the inner layer has a flat top surface, whereas the southern part of the rim is surrounded by a depression or "moat"(fig. 1).

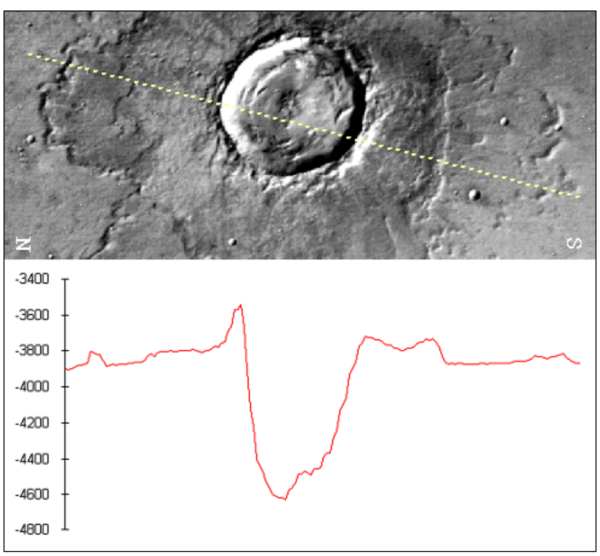

Figure 1. MOLA topographic profile of a double layer crater(THEMIS image I17338014).

While elevation difference between two layers at the northern part is relatively small, the difference at the southern part is larger. These morphological characteristics imply that the process to creat this double layer ejecta should accompany two separate flow events and the second flow forming the outer layer should have high velocity that could erode and/or blow off the inner layer. The moat of southern part of inner layer could be interpreted as a result of thrusting up by the second flow. The terminal rampart of outer layer could be explained by an elementary transport model[7].

Thermophysical properties: The THEMIS infrared images enable to observe the surface temperature variation and such temperature measurements can be translated into information about the thermal inertia of the materials comprising the surface of ejecta layers. Surface with higher thermal inertia are warmer at the end of the night before the sunrise, while they are colder during the afternoon[8, 10].

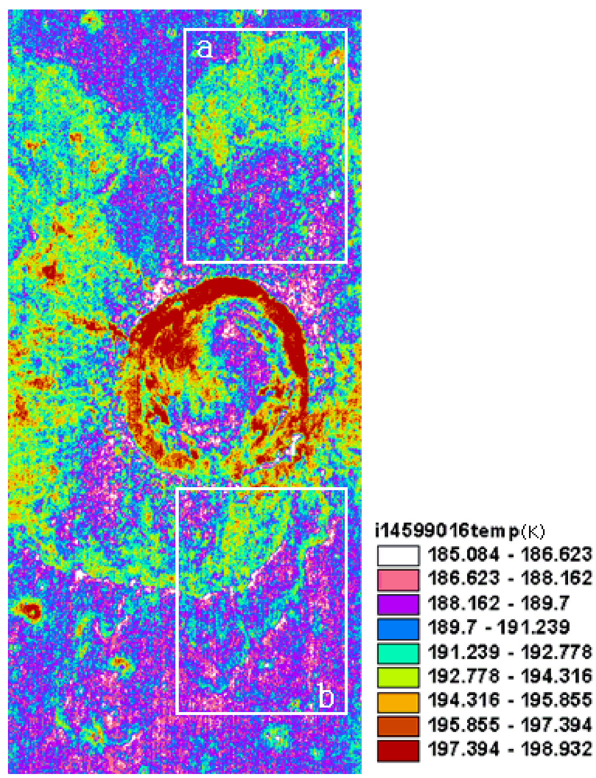

Figure 2. Temperature map of the same impact crater(THEMIS image 14599016). Temperature scale is in Kelvin.

The thermal inertia of a surface is generally related to properties such as particle size, degree of induration, and abundance of rocks[8]. Fine grained loosely packed material has a lower thermal inertia, whereas higher thermal inertia surfaces are composed of rock fragments and duricrusts[9].

According to models explaining the double layer ejecta crater, the inner layer should exhibit higher inertia than the outer layer because the outer layer should theorically be composed of finer grains[4, 11]. Since, however, the a box area shown in Figure 2 exhibits higher inertia in the outer layer than in the inner layer, other interpretations are required. This might be explained by the kinetic sieving process[10, 12]. During the emplacement of the inner layer by first flow, smaller particles accumulate at the base of the flow because of gravitational attraction and percolation, while large particles accumulate at the top of the flow and at the flow front[10, 12]. When the second flow overrides the inner layer deposited previously, it erodes and transports larger particles at the surface and deposits them as the outer layer. The b box area that the second flow merely thrusts up the inner layer and is not able to transport its material into the outer layer exhibits higher inertia in the inner layer. This is consistent with the results of models.

Mineralogy: Variations in the emissivity are useful for geologic studies since these relate to the difference in surface composition and provide a means for remote mineralogic mapping[13]. THEMIS daytime image covering the crater was used to determine the surface emissivity of ejecta layers. Each spectrum shown in Figure 3 is the average of at least 250 pixels. Emissivity spectra indicate that the two layers have the same type of mineral composition. These results also imply that the mineralogy of the target area is not varying with depth. The emissivity shapes that have a primary absorption at band 5 and have a concave-downward shape between bands 6-8 are similar to TES Type 2 [14].

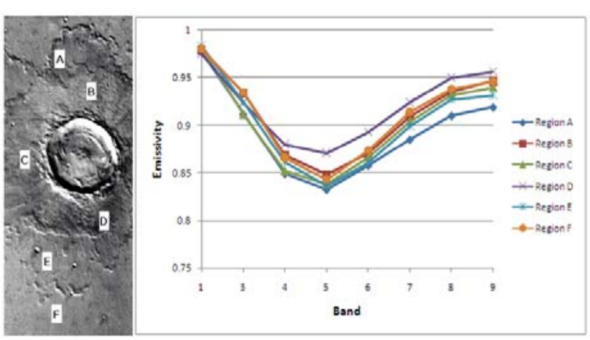

Figure 3. Average surface emissivity spectra of the ejecta layers(THEMIS image I17338014).

Conclusions: After the dense and coarse flow makes the inner thick layer, the second fine grained sparse flow overrides it and makes the outer thinner layer. The flat top surface and moat of the thick inner layer formed by the second turbulent flow derived from the vortex ring. Parts of the outer layer exhibiting higher inertia than the inner layer can be explained by the kinetic sieving process and the movement of large particles of the inner layer by the second flow. Emissivity spectra of the ejecta deposit show that there is no difference in surface mineral composition between the two layers. Subsurface volatiles may play a dominant role in the fluidization of the inner ejecta layer. But the formation of the outer thin layer is influenced primarily by the interactions of the ejecta curtain with the martian atmosphere.

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