The ejecta of Martian DLE craters in Utopia Planitia: First report on the study of thermal properties and new methods for measuring volume ratio. A. Suzuki[1](ayako@eri.u-tokyo.ac.jp), D. Baratoux[2] and K. Kurita[1], [1]Earthquake Research Institute, University of Tokyo, Japan, [2]UMR 5562 / CNRS / GRGS, Observatoire Midi-Pyrénées, Toulouse University, France.

Introduction: Characteristic morphologies of ejecta around Martian craters suggest that ground-hugging flow occurs during its deposition due to unique properties of Martian environment [4]. These Martian craters are classified into several subclasses by some features of ejecta morphologies [1], which would be reflected by properties of target surface and/or subsurface, materials that cause ground-hugging flow, and flow regime. Examining the formation processes and criteria of each subclasses of Martian craters would contribute to illustrate Martian surface/subsurface properties.

Double Layered Ejecta (DLE) is one of major subclasses of Martian ejecta morphologies. DLE are composed of two lobes: a thick and concave inner lobe with deep moat at near the rim [3] and a faint outer lobe without distal rampart. The inner and outer lobes of DLE craters obviously differ in their facies, which suggest that (at least) two different processes of ejecta emplacement would be generated in single impact event. The radial lineations, which cross the margin of the inner lobe [6], which indicate a late-stage radial flow that scours the inner lobe after its emplacement [5]. The radial flows could be gas-dominated because large boulders and masses of materials at the terminus of the lineations are not observed. In addition, DLE craters are localized in mainly northern lowland [2], which might relate to the formation processes of morphologies of DLE. In the abstract, we would like to report on two aspects of our current study of DLE. Our first objective is to achieve a database of DLE craters including new observations like thermal properties and occurrence of superficial lineations. The second objective is to develop a new method to derive ejecta volumes and determine the accuracy of these estimations.

Database of DLE craters:

Entries of the database. We are now making the data base focusing on the DLE craters in Utopia Planitia. This database includes some important parameters for examinig the formation processes of DLEs, such as thermal properties of inner/outer lobes in comparison, presence or absence of lineations, and diameter of inner/outer lobes, and lineations.

Thermal properties. Although there are several exceptions, the outer lobes of the DLE craters in Utopia Planitia appear to be warmer than the surrounding terrain which is also warmer than the inner lobe (Fig.1). The surrounding terrain in the northern plains has a low thermal inertia. This thermal properties could result from post-impact processes and different erosional history of the inner lobe and outer lobe. In that case, this thermal signature should be correlated with the ages of the craters. In order to test this hypothesis, few large craters presenting different thermal contrasts between inner lobes, out lobes and surrounding terrain are currently dated by crater counting methods on the

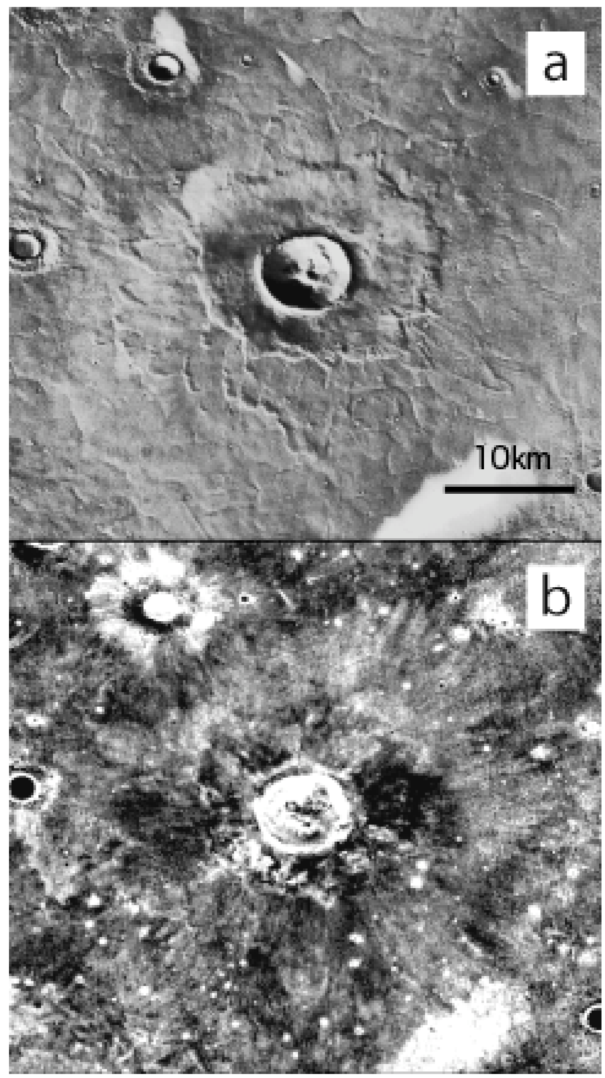

Fig.1: An example of DLE craters located at 34.0N, 101.3E. a) THEMIS day time image, b) THEMIS night time image. The outer lobe appear to be warmaer than the surrounding terrain and the inner lobe

ejecta unit themselves. Alternatively, this thermal property may be inherited from the impact event, again suggesting different processes of emplacement for the inner lobe and outer lobe. In that case, large rocks fragments would be more abundant in the outer lobe.

Lineations occurrence. We report also on the geographic distribution and occurrence of lineations. The database allows us to investigate the relationships between the presence of the lineations and the thermal contrasts between the inner lobe, outer lobe and surrounding terrain, and the ejecta extents. We hope that these observations will provide new insights in the specific mechanism of formation of DLE.

3D structure of DLE and volume measurements:

Constraining the 3D structure of DLE. The volume of ejecta in the inner lobe and outer lobe are of primary importance to understand the formation mechanism and the environmental and/or target properties which result in the formation of a DLE crater. Usually, volume estimations are done by modeling the preimpact surface using few points around the crater fitted to a plane. Here, the outline of the inner lobe and outer lobe are manually selected on MOLA data. This set of points is used to constrain the preimpact surface. In this study, we evaluate first the degree of precision to which the preimpact surface has to be known and its implication to the accuracy on ejecta volumes estimation. Indeed, the ejecta thicknesses are often less than a few tens of meters. The approximation of the topography by a plane for scales of more than a few tens of kilometers could imply large errors in volume estimations. Different methods are tested to determine the preimpact surface (Fig.2), including plane, parabolic, or more complex geometrical surfaces fits and minimum curvature surfaces. The 3D structure of selected craters given by the different methods are compared. In particular, the consequences for the structure composed of an outer lobe formed after the inner lobe or composed of an inner lobe formed after the outer lobe are tested alternatively.

Estimation of volume ratio between inner and outer lobes. The inner lobe of DLE craters would apparently have the large volume ratio (volume of the inner lobe / volumes of both lobes). The steps of volume ratio estimation includes: 1) Selection of typical and fresh craters, 2) Derive the topography of the preimpact surface according to the results of method presented above, 3) calculate the volume ratio of the inner and outer lobe with uncertainties.

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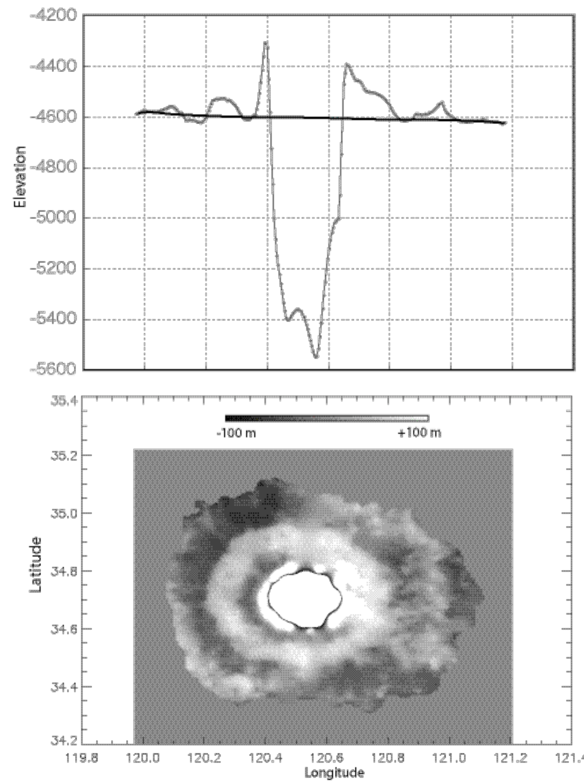

Fig.2: It shows the topography of the craters locate in 34.7N, 120.6E and its ejecta. (upper) The cross-sectional topography of the crater along the line of 34.7N. The black line indicates the preimpact surface (lower) The ejecta thickness measured from the preimpact surface which is estimated by the minimum curvature surface.