GEOLOGICAL STUDY OF MARTIAN RAMPART CRATER YUTY USING HIGH-RESOLUTION REMOTE SENSING DATA. Ramdayal Singh, Mamta Chauhan, Koyel Sur, Nirmala Jain and Prakash Chauhan, Space Applications Centre, Indian Space Research Organisation, Ahmedabad – 380 015, India (prakash@sac.isro.gov.in)

Introduction: Impact craters are one of the consistent geological process that shapes the surface of planets and complex craters are important landforms for understanding the geology of any area. As during cratering, the high velocity impact excavates materials and generates ejecta deposits that provide fundamental information regarding the sub-surface lithology as well as nature of the underlying substrate [1]. Martian impact craters are characterized by peculiar and unusual ejecta blanket morphology not observed in volatile-free, airless lunar surface [2].The ejecta of Martian Rampart craters occurs characteristically in form of layers having lobate pattern, terminal low ridge (Rampart) and surface striations [3]. This layered and fluidized ejecta blanket morphology is either resultant of atmospheric effect or due to volatile rich materials or both [4,5,6]. These Rampart craters have formed over a significant time interval on the Mars and therefore, reflect the ground ice depths at a given time [7]. Present study is attempted to examine the morphology and mineralogy of Rampart crater Yuty, to understand the geology of the area. This ~18km diameter complex crater (22.4°N, 34.2°W) was earlier imaged by Viking Orbiter (003A07) and characterized by presence of a notable central peak, raised rim and double layered lobate ejecta pattern. Its less degraded nature related with its relatively young age (~2.2 b.y) [8] was one the reason for its selection for the study.

Geological setting: Crater Yuty, is located at SW edge of a shoal inbeween two valles and south of Wahoo crater within Chrysie Planitia region of the Mars. Chryse Planitia is a topographically low indentation in the dichotomy boundary and locus of convergence of the largest martian outflow channels [9] and hypothesized to be a standing body of water [e.g.,10].

Data sets and Methodology: High Resolution Imaging Science Experiment Data (HiRISE) images having spatial resolution of 25cm/pixel with image swaths of 6x20 km along orbit track [11] provided certain specific portions of the crater Yuty. These data alongwith CTX (context camera) data having spatial resolution of 6m/pixel [12] were used for morphological investigation and generating geological map of the area.For topographical variation, data from MOLA (Mars Orbiter Laser Altimeter) onboard MGS (Mars Global Surveyor) [13] and for determination of thermal properties and mineral distribution multispectral (6.8-14.9 μm) data of THEMIS (Thermal Imaging Emission system) onboard Mars Odyssey in IR region having resolution of upto 100 m/pixel have been used [14].

Results and Discussions: **C**rater Yuty is characterized by a prominent conical-shaped central peak spread in ~7km area and covered mostly by sand. Towards the western rim of the crater terraced concentric ridges are present while on the east side their subdued nature mostly covered by sand can be inferred.

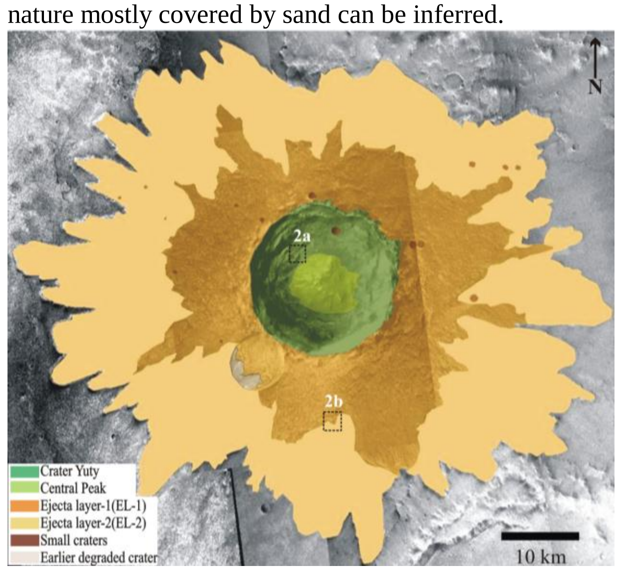

Figure 1. Geological map of crater Yuty

Sequence of aeolian depositional landforms could be seen within (Figure 2a) and outside the crater, present mostly inside small craters and along the ridges.The crater displays sharp rim and a striking double ejecta blanket that terminates with pronounced lobate ridges that are well developed for outer ejecta layers (EL-2) whereas inner layers (EL-1) shows some collapsed and bearched edges.The inner ejecta layers are topographically higher and appears to cover the outer layer. The surface of the ejecta layers is marked by sublinear ridges and furrows (Fig.2b) that are more prominent over the inner ejecta layer while feeble or almost subdued over the outer ejecta layer.These structures are more pronounced towards the west side of crater than towards its east where they appears to have been faded by later activity. The ejecta from inner layer overrides a 7km pre-existing crater just outside crater rim whose visibility indicates that these ejecta deposits are relatively thin. The Ejecta Mobility (EM) ratio calculated [15] for the inner and outer ejecta layer is ~1.5 and ~3.15 while the value of lobateness (L) [15] comes

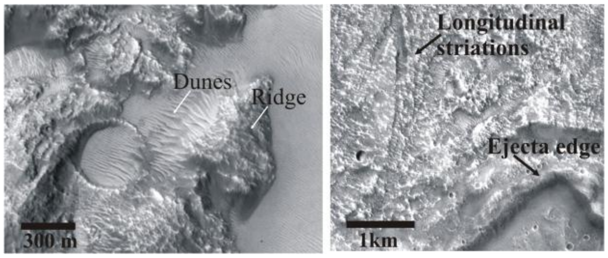

Figure 2. (a) Subset of HiRISE image from central floor of crater showing ridges and sand deposition **(b)** Subset from CTX image from the first ejecta layer showing stiriations.

near 1.6 and 1.72, respectively.Their high values indicates probably ice and volatile rich target, or due to interaction of ejecta plume with Martian atmosphere and emplacement through a base surge process [16]. Night IR and decorrelation stretch images (DCS) of THEMIS acquired from JMARS interface (Fig.3) indicates concentration of coarse particle near the crater rim (red colour) and fine particle more towards the edge of second ejecta layer (blue colour). Band combination of different DCS images shows specific colour over specified mineral absorption [17]. Results (Fig.4) shows that Magenta colour in 642DCS combination indicates high Si deposits and that corresponds to sand cover in eastern part of the crater. Cyan colour in 642DCS indicates basaltic composition corresponding to the exposed ridges near crater rim while Blue, green and yellow/orange colour in 875, 964 and 642DCS respectively indicate chlorides, if any. As such the eastern part of the crater is dominated by silicic lithology in forms of dunes while the ridges are indicating basaltic lithology. Thermal inertia images are derived from MARSTHERM web processing interface using single temperature measurement described by [18]. The value of thermal inertia shows significant variation over the study region (Fig.5). For loose material with particle diameters between 1 mm and a few cm thermal inertia should be limited to 420 J m^{-2} $K^{-1}s^{-1/2}$ [19]. The eastern portion of Yuty crater surface can thus be interpreted as average soil.

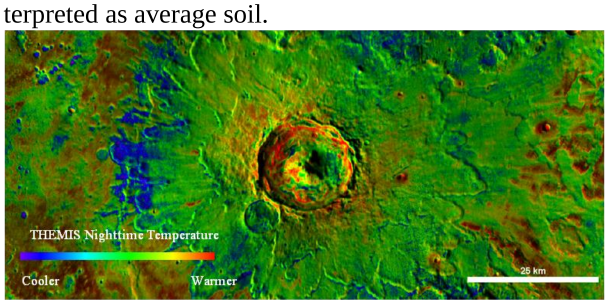

Figure 3. Night time temperature variation over the crater Yuty derived by combining THEMIS Day IR 100M Global Mosaic (v12.0) and Night IR Global Mosaic (v14.0).

Conclusion: The morphological features within the crater as well as ejecta are relatively more exposed and

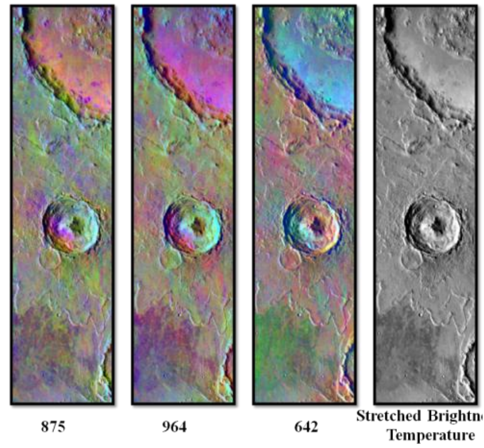

Figure 4. Decorrelation stretch images (DCS) in band combination 875, 964 and 642 (THEMIS) over Yuty Crater for Day time

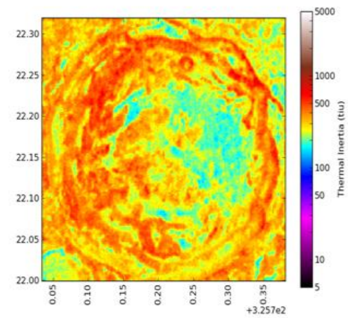

Figure 5. Thermal inertia map of the crater Yuty.

fresh towards the west than the east being mostly covered by sand.The surface morphology of ejecta, nature of distribution ejecta layers and their thermo-physical properties, are consistent with the evolution of the crater in volatile rich substrate.The calculated parameters of ejecta mobility and lobateness further supports them.

References: [1] Osinski G.R., et al. (2011) *EPSL*,. 310, 167–181 [2] Head J.W. and Roth R. (1976) *Symp. LPI*, 50-52. [3] Mouginis-Mark P. J. (1978) *Nature* 272, 691- 694. [4] Schultz P. H. and Gault, D. E. (1979) *JGR* 84, 7669-7687.[5] Carr M. H. et al. (1977) *JGR* 82,4055-4065. [6] Barlow N. G. et. al. (2005) *EOS* 86, 433.[7] Squyres S. W. et al. (1992) *Mars*, Univ. Arizona Press, 523-554.[8] Reiss D. et al. (2005) *LPS XXXVI* Abstract # 1725. [9] Carr M. H (1996) *Oxford Univ. Press*, 229p.[10] Moore J. M. et al. (1995) *JGR* 100, 5433-5447.[11] Mc Ewen A.S. et.al (2007) *JGR* 112, 1-40. [12] Hobbs S.W. et. al. (2010) *Icarus* 210, 102–115.[13] Zuber M. T. et al. (1992) *JGR*, 97, 7781-7797.[14] Christensen P. R. et al. (2004) *Space Sci. Rev*. 110, 85-130. [15] Barlow N. G.(1994) *JGR* 99, 10927-10935.[16] Barlow N. G. (2006) *MAPS*, 41, 10, 1425–1436. [17] Bandfield J. L. al. (2013) *Icarus* 226, 2, 1489-1498. [18]Mellon M. T. et al. (2000) *Icarus* 148, 437-455 [19] Jakosky B. M. (1986) *Icarus* 66, 117–124.