INVESTIGATION OF MUD VOLCANOES OF ELYSIUM PLANITIA (MARS) AND THEIR COMPARATIVE ANALYSIS WITH INDIAN ANALOG SITE. A. Gaur¹, G.K.T. Gunda², M. Ansary², M. Chauhan³, R.S. Chatterjee¹ and R.P.Singh¹ ¹Indian Institute of Remote Sensing (IIRS), I.S.R.O. Dehradun, ²Telangana University (mamtachauhan@iirs.gov.in)

Introduction: Mud volcanoes are meters to a kilometer wide sedimentary cones/mounds, oozing fine-grained sediments and rocks. They are found extensively on Earth, exhibiting diverse forms controlled by various factors that influence their eruption and erosion processes[1][2]. On Mars, Mud volcanoes have been observed as mound features at several locations such as Utopia Planitia, Acidalia Planitia, Isidis Planitia, Chryse Planitia [3]. This study attempts to investigate in detail mud volcanoes reported in Elysium Planitia region of Mars based on their comparative morphological and morphometric analysis with terrestrial analogue site in India. Clusters of Mud volcanoes reported from Baratang island, Middle Andaman [4] with all the favourable conditions have been selected as the potential candidate for Martian analogy.

Data and Methods: The present study attempts to characterize the Mud Volcanism in Elysium Planitia using data from Mars Odyssey’s THEMIS IR(230m/pixel), Mars Reconnaissance Orbiter’s (MRO) CTX(6m/pixel), HiRISE(0.3m/pixel), CRISM (362-3920nm), Mars Express’s HRSC (12.5m/px-25m/px), Mars Global Surveyor’s MOLA DEM (~463 m/px). For Baratang Island, ALOS-PALSAR RTC DEM (12.5m), Sentinel-1A (HV polarization with 10m resolution) and field samples collected from the selected locations have been used for observation and analysis. The optical and DEM/DTM dataset of Mars are mosaicked and analyzed to map the various volcanic and structural features. For Baratang Island, Sentinel 1A image were preprocessed for terrain visualization followed by topographical and morphometric analysis using DEM and its derivative for the location where the Mud volcanoes has been reported by previous researchers. Further, geological map of the area have been generated followed by field visit.

Initial Findings: The basemap generated using THEMIS IR data for Elysium Planitia, Mars (Figure 1) reveals that the major volcanic vents present in its north namely Elysium Mons, Hecates Tholus, and Abor Tholus have both volcanic and/or sedimentary origin. The Elysium Mons volcanic activity dominates the whole region with an average elevation of Elysium Planitia varying from -2600 to -1800m as analyzed from MOLA-DEM. In contrast, the elevation of the three summits (Elysium Mons, Hecatus Tholus and Abor Tholus) ranges from 35 to 4300m.

Number of volcanic origin features have been observed using HiRISE and CTX images in the proximity of Abor Tholus. These includes volcanic fissure vents, subsided mud flow in association with polygonal mud cracks, flow lines, pitted cones and mounds etc. (Figure 2). The cluster of pitted cones has been observed over ~1600km south of Abor Tholus, near Wafra crater showing characteristic structure of pitted mounds exhibiting high reflectance at the mouth of the cone with respect to surrounding and associated mud flow showing relatively smoother texture than the surrounding rugged terrain. The average diameter of the pitted cones is observed as ~250m and the expansion of mud flow is ~3-5km from the cone with distinctive polygonal cracks. Similar features have been observed in Baratang Island, present at Jarawa creek Middle Andaman region where Seismicity- induced MV are found erupting the fine grain argillaceous sediment of Eocene-Oligocene age, as a result of megathrust Earthquake of Magnitude 9.3 occurred on 26th December 2004 [5][7].

Figure 1: Basemap of Elysium Planitia generated using Mars Odyssey THEMIS night-time IR data. The red square box is indicating the location of pitted mud volcanic cones.
Figure 2: Major Feature observed at various locations of Elysium Planitia analysed using HiRISE images A) complex volcanic fissure vent and B) its close-up view, C) and D) low-lined mud flow with characteristic flow lines and associated polygonal mud cracks, E) Pitted cones and its emanant flow in relatively rugged terrain and F) unique type clustered cones showing flow path.

Figure 3: (a) Mound of the mud volcano of Baratang, Middle Andaman with its muddy bubbling vent (b) Mound of the mud volcano oozing slurry and pebbles.

Figure 4: (a) Field photographs of the mud volcano of Baratang, Middle Andaman with its outlet/vent and cone which is in the developing phase (b) Cone of the mud volcano with slurry and pebbles (c) Mud volcano with its bubbling muddy vent and oozing slurry deposition.

Future scope of the study: This study further aims to analyze the mud volcanism of Baratang island, Andaman in detail using samples of the Mud volcanic vent for the compositional characterization of various minerals associated and other morphometric parameters in order to establish the relation between the volcanic activity found in the region for better understanding of subsurface energy flow.