BARATANG ISLAND MUD VOLCANOES, INDIA: A POTENTIAL CANDIDATE FOR MARTIAN ANALOGUES STUDY. Goutham Krishna Teja Gunda[1, 2*], Mamta Chauhan[1], Prakash Chauhan[1], and R. Sudhakar Goud[2], [1]Indian Institute of Remote Sensing-ISRO, Dehradun-248001, Uttarakhand, India. [2]Department of Geo-informatics, Telangana University, Telangana, India. *Corresponding author: krishna.g366@gmail.com

Introduction

Analogue studies are one of the most possible approach and are important sites on the earth to understand the behavior of extraterrestrial planets. Volcanoes, the natural phenomenon that occurs in all terrestrial planets have believed to be playing a very important role in creating the landforms and life cycle on planet Earth. Initially, the mechanism and features of volcanoes in the world are very much complicated to characterize their structures and behavior. But recent developments in geosciences made it easy in understanding the formations and characterizing the volcanoes. The various geomorphological features of volcanoes will determined the types of volcanoes i.e. active volcanoes; dormant volcanoes; extinct volcanoes; mud volcanoes. These volcanoes are directly or indirectly reveals the nature of tectonics associated with them. In recent decades, planetology communities in the world are taking up the challenges to understand the formation and life in other terrestrial planets through various techniques especially in case of planet Mars. The most common landforms on the Mars surface are pitted cones, mounds and lobate flows which are mostly deciphered as having formed through a variety of overlapping processes like periglacial, glacial, volcanic, and/or impact processes [1, 2] . A crucial component in Martian analogy for the mud volcanoes is what a potential Martian mud volcano's morphometry/morphology reveals about it's the formation conditions [3]. On Earth, the studies divulge that mud volcanoes most are geomorphologically variable and are finely exaggerated by several overlapping process and conditions. Most of the terrestrial mud volcanoes form proximal to paleo-depo-centers within structurally-controlled sedimentary basins that are experiencing active deformation. As a consequence, mud volcanoes are mostly situated along the major geological structures (faults and fold axes) that related to deformation of the sedimentary sequence. In case of extra-terrestrial studies, we are strictly limited to depend on the remote based observations to interpret geologic processes and history.

Study area and Initial results:

In India, Andaman and Nicobar Islands (ANI) territory is well known for their complex tectonic setup and their associated volcanoes. ANI region are hotspots for the volcanoes, which consists of two sub-aerial volcanoes (Barren Island (active volcano) and Narcondam Island (dormant volcano)) [4],

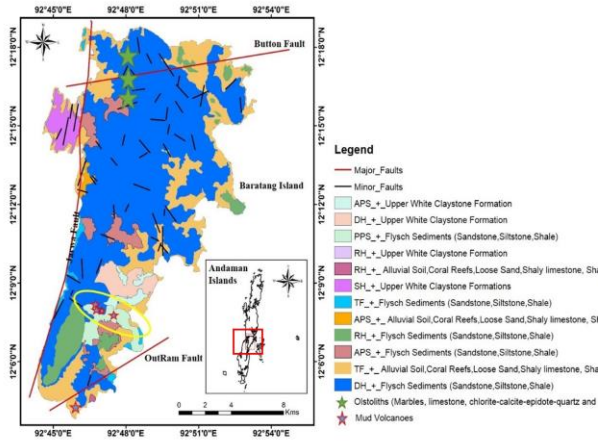

Figure 1: Location of Mud Volcanoes on the geological map of Baratang Island, Andaman (Modified after Geological survey of India map)

Twenty-two (22) submarine seamounts [5], and along with eleven (11) active mud volcanoes [6] which provides a unique opportunity to study and understand all varieties of volcanoes. Barren Island Volcano (BIV) is a confirmed young and only active stratovolcano of South Asia, situated ~138 km far away from Port Blair, with an elevation ~354 m above m.s.l.. Currently, this active volcano emits the pyroclastic materials cum lava at low to moderate scale and this eruptions may have relation with local/regional seismicity [7]. In Andaman Islands, there are eleven (11) mud volcanoes in which six (6) are found in the Middle Andaman [6]. Baratang Mud volcanoes (locals called "*Jalki*") (12°07'46.505"N-92°47'31.742"E) of Middle Andaman Island (Figure 1) are significant signature for seismic-triggered mud volcano. After 9.3 M earthquake on 26th December, 2004 (which is associated with the great Sumatra-Andaman tsunami) this mud volcano erupted for several hours to days along with methane flaring [8]. These mud volcanoes are associated and controlled by tectonic features namely faults zones trending mainly in Northeast-Southwest. This aligned faults (NE-SW) are part of thrust sheets that parallel to trench axis of the subduction zone and also these faults are maybe from the continuation of East Margin Fault and further stretched towards north as Jarawa Thrust Fault [8]. The ejecta of Baratang mud volcanoes through these faults is assumed to be from compressional forces resulting from over thrusting [9] and enhanced by the seismic pumping as a main factor. The morphological features of the Baratang mud volcanoes varies from few centimeters to

several meters and predominantly situated at tectonic compression i.e. subduction zones. Therefore, we considered all the favorable conditions for identifying the potential candidate for Martian analogy in India n Territory. So, in our current research, we are aimed to understand the morphological features of Baratang mud volcanoes of Andaman Islands.

Figure 2: Field photographs of clusters of mud volcanoes at Bartang showing the different types of mounds, with their bubbling muddy vents and associated flow features with varied textures.

The present study is therefore intended to carry out detailed and systematic geological and geomorphological investigation of the mud-volcanoes of Baratang Island using remote sensing (including spectroscopic) & geochemical approach and by comparing their morphometries with Marian examples. The volcanoes have been mapped and selected samples have been analyzed for spectral characterization. The morphological features of the Baratang mud volcanoes varies from few centimeters to several meters and predominantly situated at tectonic compression i.e. subduction zones. The ejecta materials contains mixture of angular and subrounded rock fragments of the reported lithology that includes sandstone, red and green shale fragments, serpentine and ophiolite's. In addition, presence of Methane CH_4 (55.7%), N_2 (32.2%), and CO2 (2.0%) have important astrobiological implications. The preliminary results suggests that the investigated different morphometries at Baratang Island mud volcanoes are promising analogues sites to study Martian mud volcanoes.

References: [1] Dickson, J. L. et al. (2008) *Geology, 36*, 411-414. [2] Garvin, J. B. et al. (2000) *Icarus, 144*, 329-352. [3] Skinner, J. A and Kenneth L. Tanaka (2007) *Icarus (1), 186*, 41-59. [4] Bandopadhyay, P. C. (2017) *Geol Soc of London, Memoirs, 12*, 167-192. [5] Sachin, T., et al. (2018) *Ind J. of Geosci, 71(3),* 451-470. [6] Chaudhuri, H. et al. (2012) *J. Asian Earth Sci, 46*, 52-60. [7] Gunda, G. K. T. et al. (2021) *J. Earth Sys Sci, 130* (162). [8] Curray, J. R. (2005) *J. Asian Earth Sci. 25 (1),* 187-232. [9] Badve, B. M. et al. (1984) *Curr, Sci., 69*, 211-234. [10] Vignesh, A. et al. (2016) *Oil Gas Res*, 2:111.