Geophysical Research Abstracts
Vol. 19, EGU2017-251, 2017
EGU General Assembly 2017

Evidence of mud volcanism rooted in gas hydrate-rich cryosphere linking surface and subsurface for the search for life on Mars

Barbara De Toffoli (1,3), Riccardo Pozzobon (1), Francesco Mazzarini (2), Matteo Massironi (1,3), and Gabriele Cremonese (3)

(1) University of Padova, Padova, Italy (barbara.detoffoli@gmail.com), (2) Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy, (3) INAF, Astronomical Observatory of Padova, Padova, Italy

We mapped around 6000 mounds in three different portions of the Martian surface on an average area of about 90.000 Km2 for each region. The study areas are located in Hellas basin, Utopia basin and a portion of the Northern Plains lying north of Arabia Terra, between Acidalia and Utopia Planitia. The aim of the study was to understand the nature of the observed features, particularly if they could be interpreted as mud volcanoes or not, and improve our knowledge about the Martian mound fields origin. The analysis of Context Camera (onboard Mars Reconnaissance Orbiter) images showed circular, elliptical and coalescent mounds with central and/or distal pits and flow features such as concentric annular lobes around the source pits and apron-like extensions. We produced DTMs and then high-to-diameter morphometric analysis on two groups of mounds located in Utopia and Hellas basins to enhance the geomorphological observations. We inferred, by means of cluster and fractal analyses, the thickness of the medium cracked by connected fractures and, consequently, the depths of reservoirs that fed the mounds. We found that the fields, which are seated at different latitudes, has been fed, at least partially, by reservoirs located at the base of the gas hydrate stability zone according to Clifford et al., 2010. This evidence produces a meaningful relationship between the clathrates distribution underneath the Martian surface and the occurrence of mound fields on the surface leading to the assumption that the involvement of water, ostensibly as a result of gas hydrate dissociation, plays a key role in the subsurface processes that potentially worked as triggers. These outcomes corroborate the hypothesis that the mapped mounds are actually mud volcanoes and make these structures outstanding targets for astrobiology and habitability studies. In fact, mud volcanoes, extruding material from depths that are still not affordable by our present-day instrumentations, could have sampled and brought to the surface with the sediments a putative extinct or extant deep biosphere. In conclusion, on the base of this study, emerged that: (i) mud volcanoes are the best terrestrial analogs for the considered Martian mounds, (ii) there is a recurrent specific subsurface environment where the phenomenon may be triggered and it is the base of gas hydrate-rich cryosphere for all the study areas and (iii) mud volcanism seems to be, at least partially, a geologically recent event in terms of planet thermal evolution timespan. In light of these results, the CaSSIS camera, onboard the Trace Gas Orbiter ExoMARS mission, will provide new images of these features to improve and widen the understanding of the mechanisms that lie behind this phenomenon.