

SVC051-P03

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A proposal for future rover exploration targeting volcanic activity on Mars

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We are proposing geologic studies of martian volcanism using a rover in a future Japanese mission to Mars, MELOS. In MELOS mission, three exploration plans are currently argued; (1) two orbiters to observe magneto-electric field and ion escape flux from martian upper atmosphere, (2) a climate orbiter to monitor atmospheric motion and gas distribution, and (3) lander(s) and/or a rover aiming to understand internal structure of the planet, geologic evolution of the surface environment, and a search for life.

The third plan is further divided into four proposals; (3.1) seismic and geodetic observations, (3.2) rover geology, (3.3) astro-biological search, and (3.4) atmospheric sample return. In this talk, we introduce (3.2), and in particular, geologic exploration of martian volcanoes.

Ultimate scientific goal of Mars exploration is, needless to say, a search for extra terrestrial life. After a series of Mars explorations since 1970's by orbiters, landers, and rovers, it became clear that sudden climate change from wet and warm weather to cool and dry weather took place on Mars billions years ago, and that a presence of life in a current martian environment is unlikely. Then ongoing mission plans led by NASA and ESA (European Space Agency) are focusing on analysis of sedimentary rocks aiming to reveal a history of surface environment on Mars. Here we propose a different strategy to study an evolution of the surface environment.

In order to understand sudden climate change in early martian history, it is very important to evaluate both input and output of atmosphere. The former is likely influenced by massive volcanoes such as Tharsis rise and Olympus Mons, and the latter is controlled by atmospheric escape processes. Recently Bibring et al. (2005) have proposed that large amount of volcanic degassing during late Noachian and early Hesperian radically changed oxidized state at the Mars surface and caused martian climate change. This hypothesis, whether true or false, suggests that volcanoes played a key role in climate change of the planet.

We propose to land a rover on Mars in early 2020s to study (i) development of volcanoes and mechanism of eruption, and (ii) magma process. In the view of martian climate change, we are mostly interested in (ii). A rover that is under development by JAXA, Tohoku University, Chuou University, and Meiji University has a capability to move over a distance of 1 km or more in a nominal mission period. Robotic technology allows us to find and examine in detail outcrops of thick lava and volcanic rocks by using several instruments such as (i) multi-spectral camera, (ii) macro camera, (iii) laser induced breakdown spectroscopy, (iv) X-ray fluorescence densitometry, (v) mass spectrometer, (vi) magnetometer, (vii) ground penetrating radar.

Keywords: Mars exploration, Rover