Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PCG30-15 Room:A02 Time:May 26 17:15-17:30

A future perspective for Japanese explorations of small solar system bodies: The value of Martian moons

WATANABE, Sei-ichiro[1*] ; TACHIBANA, Shogo[2] ; SEKINE, Yasuhito[3] ; USUI, Tomohiro[4] ;
PROGRAMATIC MARS EXPLORATION STUDY GROUP, Japan[5]

[1]Nagoya University, [2]Hokkaido University, [3]The University of Tokyo, [4]Tokyo Institute of Technology, [5]JAXA/ISAS

Background: The main theme of solar system (SS) explorations in the next decades will be focused on the elucidation of prebiotic environmental evolutions. In Japan, along with lunar landing missions and Mars landing missions, we should promote explorations of small bodies, utilizing the sample return (SR) technologies succeeded in the *Hayabusa* series, for constraining the evolution and supply of life substance in the early SS. Following to the near Earth asteroids Itokawa (S-type) and 1999 JU_3 (C-type), the candidates for SRs from more primitive bodies may be comets or main-belt or Trojan asteroids. Though these SR missions would be possible within Japanese capabilities, it takes long time ($>$10 years) to bring back samples from these bodies. Thus, Martian moons are worth noting because of the shorter periods for SR from them. Further, for Japan being behind to USA and Europe in Mars explorations, the Martian moon mission has strategic values for constructing an original exploration program for Mars toward the landing.

Except for the Earth's moon, Martian moons Phobos and Deimos are the only two satellites of terrestrial planets. Both are low-albedo small bodies with surface reflectance spectra like D/C-type asteroids and have circular equatorial orbits. As to their origin there is still a controversy between capture of primitive asteroids and accretion in a possible circummartian debris disk. Past fly-by observations are insufficient to reveal surface material owing to their featureless optical and NIR spectra. There have been no missions succeeded in the rendezvous or landing.

If the moons have captured, the surface material are not only primitive but also less thermally altered by harsh solar radiation, because they have kept away from the Sun. The density of the moons are low, so that they may have icy material inside for the capture scenario or volatile-depleted highly porous material for the disk accretion scenario. From the view of comparative theory of satellite formation, collaboration with science community interested in the formation of the Earth-Moon system is expected. Anyway, the moons have a key role in clarifying life substance supplied to Mars.

Mars moons SR mission: We propose a SR mission from one of the two moons considering the international circumstance. The mission includes high-resolution remote-sensing observations of surface material and internal structure. The objectives are to constrain (1) the origin and history of the moons (early SS information for the capture scenario and planetary growth and alteration processes for the disk accretion scenario) and (2) Mars collisional and atmospheric escape histories that determine the surface environment.

The mission will solve the controversy of the origin of the moons by measuring oxygen isotopes of returned sample and comparing with those of Martian meteorites and future returned samples of Mars. The dating of possible Mars material on the moon and isotope measurements of implanted Mars escaping atmospheric atoms should be done by returned sample analyses. The same side of the moon always faces Mars, so that multiple sampling enabling comparisons between near and far sides or leading and trailing sides is desirable. We can determine the initial value of the D/H ratio for the Mars environmental evolution from measurement of the moon's material originated from ice.

High-level international collaborated mission: There are several exploration plans on Phobos: Russian and ESA's *Phootprint* SR mission candidate and *PADME* fly-by mission candidate for the next NASA Discovery Mission. Is it too late for Japan to participate in the race? The answer is no, because Mars has two moons. If Europe chooses Phobos as the SR mission target, then Japan should target on Deimos, the less recognized outer satellite. Then the both missions will provide a synergy effect on deciphering the origin of the moons and the Mars environmental evolution through the comparative approach.

Keywords: Asteroids, Planetary exploration, Sample return, Phobos, Deimos, Prebiotic environmntal evolution