Evolution of surface environment of Mars: geochemical constraints from in-situ isotopic measurements

Shogo Tachibana[1]; Yayoi N. Miura[2]; Keisuke Nagao[3]; Takashi Mikouchi[4]; Nobuo Geshi[5]; Sho Sasaki[6]; Yutaka Abe[7]; Hideaki Miyamoto Discussion Group for the Lander of MELOS Mars Exploration Mission[8]

[1] Earth and Planet. Sci., Univ. of Tokyo; [2] ERI, Univ. of Tokyo; [3] Lab. Earthquake Chem., Univ. Tokyo; [4] Dept. of Earth & Planet. Sci., Univ. of Tokyo; [5] GSJ, AIST; [6] RISE, NAOJ; [7] Earth Planetary Sci., Univ. Tokyo; [8] -

MELOS (Mars Exploration with a Lander and OrbiterS), the next Japanese Mars exploration mission, is planned to consist of two orbiters and one (or more) lander. A geochemical instrumental package, [GM]2, has been proposed for the lander in order to clarify the formation and evolution of the Martian surface system (or sub-systems). The proposed instruments for [GM]2 are a mass spectrometer, XRF, XRD, LIBS (laser-induced breakdown spectroscopy), and a furnace for extraction of volatile components from rock samples (Miura et al., this meeting).

The main scientific goals of [GM]2 and required geochemical analyses are as follows. [1] Formation and evolution of martian atmosphere. The precise determination of isotopic composition of Ne is crucial to understand formation and evolution of the atmosphere. Neon is the second lightest noble gas, and its mass and chemical inertness are suitable to use as a constraint for atomospheric escape. However, the isotopic composition of atmospheric Ne has not been precisely determined by in-situ analyses in previous missions, and it has been poorly constrained by noble gas analyses of martian meteorites. [2] Igneous activities of Mars. The surface environment would have been (or has still been) affected by igneous activities via input of volatiles to the atmosphere. Determination of K-Ar ages of volcanic rocks that are supposed to be young and measurements of volcanic gases such as SO2 and CH4 will provide us some insights on igneous activities and thermal history of Mars. Age determination of surface rocks can also be used as the first time anchor for the Martian crater chronology. [3] Evolution of surface environments. Evidences of surface environmental conditions and their temporal changes are recorded in isotopes of surface materials. For instance, sulfur isotopic compositions of surface sulfate may be used as a useful tool to constrain the origin of surface sulfates and a sulfur cycle on the ancient warm and humid Mars. If surface sulfates show mass-independent isotopic fractionations (MIF), it will also put a strong constraint on the origin of sulfur-MIF found in Archean sulfur-bearing minerals on the Earth.

More details will be presented at the meeting.