VOLATILE-BEARING MATERIALS ON MARS BASED ON VOLATILE-RICH EARTH'S MINERALS.

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Introduction: Although detailed Martian atmosphere and surface data required for the next human (robotic) activity are not obtained in previous Martian explorations, recent study on surface materials including *volatile*-bearing materials on extraterrestrial bodies should be developed by direct sample collections with in-situ analyses and global distribution (by remote-sensing exploration) on the next Mars exploration [1, 2], which is main purpose of present paper.

Martian concept by mineral abundances: Volatile elements (H, He, C, N, F, P, S and Cl)-including minerals are significant to analyze Martian atmosphere and surface rocks. Water-rich planet Earth has the highest abundance of *hydrogen* (H)-bearing minerals (*i.e.* 48 % in 5,540 minerals [3], Fig. 1), though various Martian meteorites reveal lower mineral abundances and poor hydrogen (H)-bearing minerals (*i.e.* poor hydration by water-rich system). Characteristic volcanic gasses of S, F, C and Cl stored on various terrestrial minerals (*i.e.* 39 % in 5,540 minerals [3]) are not previously obtained in Martian atmosphere and surface rocks (*i.e.* inactive volcanoes on Mars), though global Martian survey with detailed collection sites is required in next Martian explorations. In short, Martian meteorites without clear Martian location data are poorly analyzed from cyclic formation of volatiles (and water).

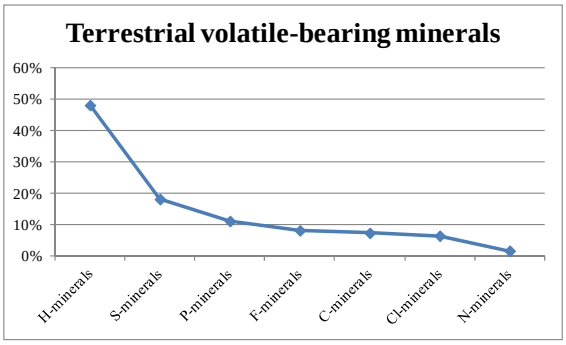

Fig.1. Abundances ratio (%) of 5,540 volatile-bearing (H, S, P, F, C, Cl and N) minerals on water-rich Earth [3] with the highest abundance of the H-bearing (water-related) minerals.

Compositions of volatile-bearing minerals: An active Earth shows 100% of *carbon* (C) and *sulfur* (S) (as solid minerals) [3] which are formed at *reduction* states of *shock waves* by volcano, earthquake and meteoritic impact, though solid minerals of 100% volatile elements are not clearly obtained at Martian rocks (*i.e.* little dynamic circulation on global Mars; in Fig.2).

Liquid range of volatile elements: Different from *wide* liquid range (*i.e.* temperature between melting and boiling points [3]) of C and S elements, *short* liquid range elements of the O, Cl, F and N elements (in Fig. 2) are widely found at atmosphere and surface rocks on active Earth, though Mars is not so active from various Martian meteorites, which should be checked by next Martian explorations of air and rocks.

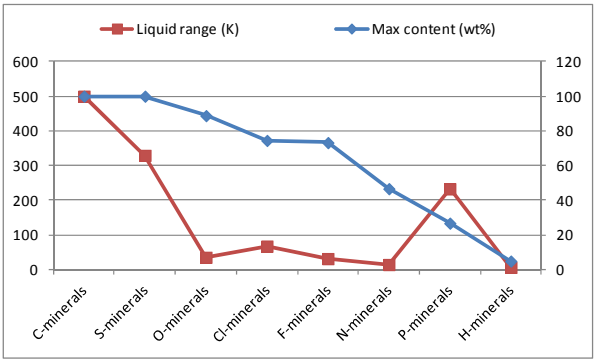

Fig.2. Liquid ranges and maximum compositions of volatile-elements (C, S, O, Cl, F, N and P) [3], showing 100% C minerals of C and S. Air and rocks easily include O, Cl, F and N with short liquid range.

Volatile storages in Martian interior: Water-rich planet of active Earth is transported volatiles into the interior by plate-tectonic movements [4]. However, Mars without water-rich system layer above rock layer, reveal volatile transportation by multiple impacts though *void-rich soils layer*, which is basically similar with *Venetian* and *lunar* surfaces [5]. Sandstorm on Martian surface is formed from porous regolith soils broken by cold windy air. Therefore, volatiles through porous regolith soils are degassed at Martian *volcanoes* pulled by tidal forces to form present carbon-rich atmospehere (without thick global water-system)[1, 4].

Summary: Compared with 5,540 terrestrial volatile-bearing minerals, more Martian minerals should be obtained to analyze Martian activity on air and surface, where Martian volatiles are degassed by pulling with tidal forces to air on planet without water-rich layer which is similar with Venetian air and lunar surface.

References: [1] MEPAG ND-SAG (2008): Astrobiology, 8(3), 489-535. [2] Miura Y. (2012): *ELS-2012* (DLR, Germany), 76-79. [3] Web mineral (2012): http://www.webmineral.com/chemical.shtml. [4] Ernst W.G. (1990): The Dynamic Earth (Col. Univ. Press), 280pp. [5] Miura Y. (2012): *LPSC XXXXIII* (LPI), Abstracts #1203, #2920.