

Overview of explorations of Martian shallow subsurface and strategy for future missions

(火星の浅部地下構造に関するレビューと今後の探査戦略)

Hideaki Miyamoto¹, James M. Dohm¹, Ryodo Hemmi¹, Hiroyuki Tanaka²,
Akihito Araya², Toshiyuki Nisibori³, Atsushi Kumamoto⁴, Jyunichi
Haruyama⁵, Goro Komatsu⁶, Tomohiro Usui⁷, Takafumi Niihara¹, and Mars
subsurface exploration team

¹University Museum, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

² Earthquake Research Institute, University of Tokyo, Tokyo 113-0032, Japan

³ Research and Development Directorate, JAXA, Japan

⁴ Dept of Geophysics, Grad school of Science, Tohoku University, Miyagi, 980-8578, Japan

⁵ ISAS, JAXA, 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan

⁶ IRSPS, Univ. G.d'Annunzio, Pescara, Italy

⁷ Earth Life Science Institute, Tokyo Institute of Technology, Tokyo 152-8550, Japan

ABSTRACT

We consider that shallow subsurface structure of Mars will be among the most important exploration target of the near future Mars missions because (1) while the surface of Mars has been mapped out in various ways at high resolutions, information regarding subsurface is still limited; (2) because the surface of Mars is covered by relatively homogeneous regolith materials, understanding the condition immediately below the regolith is important to properly understand the information obtained at the surface; (3) numerous geological features are found to indicate recent and persistent activities in both volcanic and aqueous senses at shallow depths; and (4) shallow structures are relatively easier to explore than deeper structures at high spatial resolutions. We reviewed previous findings of MARSIS, SHARAD, and MOLA, as well as geological and geophysical

investigations, and conclude that the reasonable targets in the near future are (1) structures of 1-100m depths at cm-m resolution by radar instrument, such as UHF band SAR and ground penetrating radar; (2) structures of 500m-several km depths at ~100m resolution by muography instrument, and (3) layering of >5km by seismic instrument.