National Aeronautics and Space Administration

Mars Science Laboratory: Science and Technology Support for Human Missions to Mars

ASTROMATERIALS RESEARCH EXPLORATION SCIENCE (ARES) MSL SCIENTISTS

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OVERVIEW

Mars Science Laboratory (MSL) Curiosity Rover has traversed 14.5 km analyzing the physical and chemical environment of the martian surface in Gale Crater (Fig. 1). Knowledge gained from the MSL mission can be used to inform future human missions to Mars.

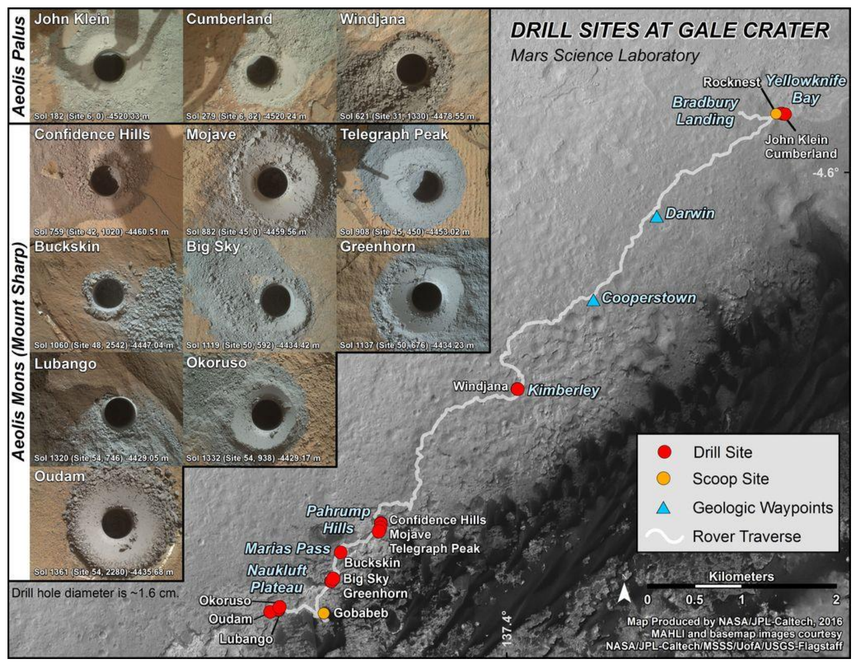

Fig. 1 MSL sampling sites in Gale Crater

SCIENCE/TECHNOLOGY SUPPORT

Surface Sediment and Rock resources

- Surface geochemistry/mineralogy is suitable for plant growth in Advanced Life Support (ALS) system. Phosphate minerals essential for plant growth were detected but some nitrogen amendments may be required (Fig. 2a)
- Water (1 - 2wt.%) and O_2 (up to 0.15 wt.%) for ALS could be extracted from surface material by moderate heating (~400°C) (Fig. 2b)

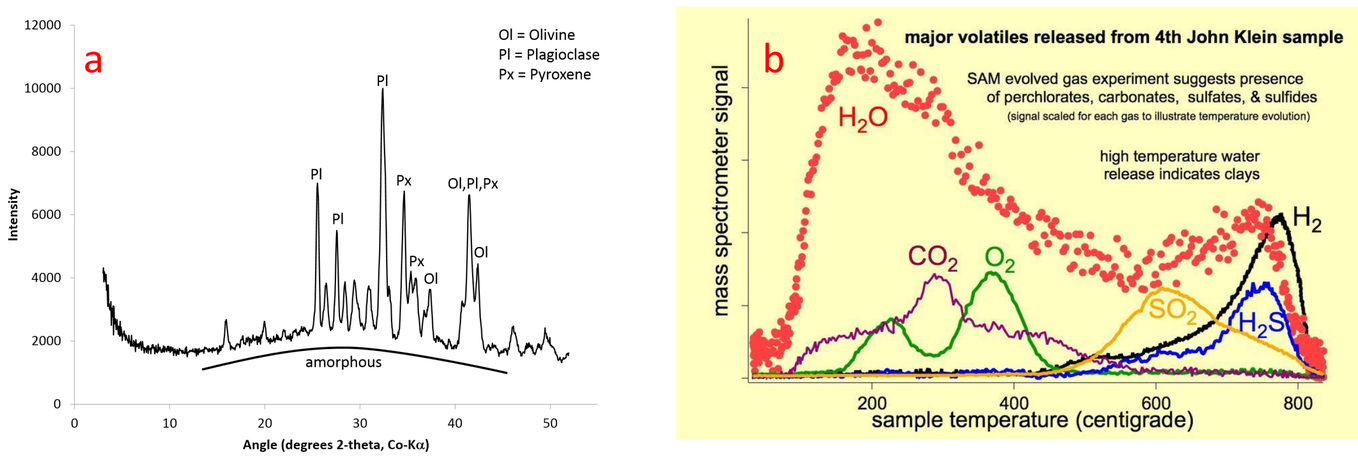

Fig. 2 (a)Chemin X-ray diffraction analysis of basaltic Gale sediment. (b) SAM-evolved gas analysis of Gale sedimentary rock .

Surface Hazards to Exploration

- MSL rover wheels were damaged by surface roughness. (Fig. 4).
- Lessons learned on MSL can be used to enhance robustness of future human operated rovers on Mars.

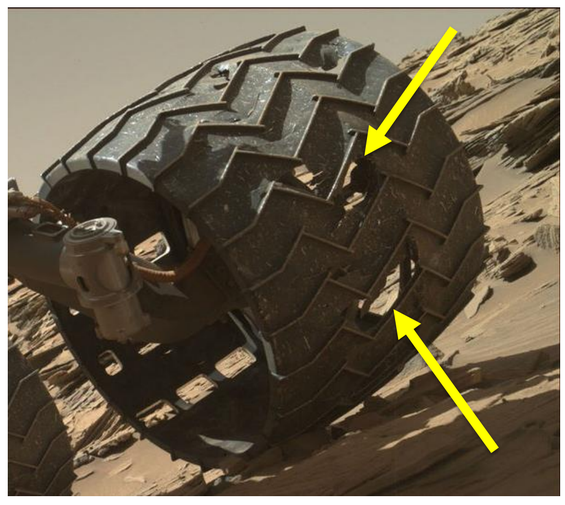

Fig. 3. Punctures in rover wheels indicated by yellow arrows

Radiation hazards

- MSL Radiation Assessment Detector (RAD) determined that astronauts could exceed radiation lifetime limits by a factor of 4 on a 860 d Mars mission (Fig. 4).
- NRC lifetime does limits (250mSv) indicate mitigating astronaut exposure to radiation will be a major factor in human missions to Mars.

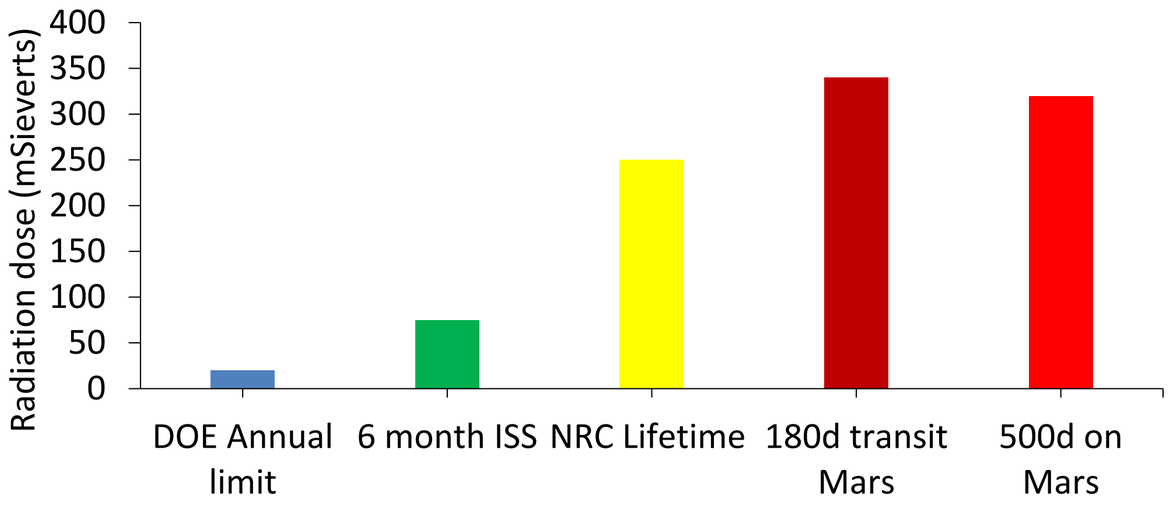

Fig. 4. Radiation exposure comparisons