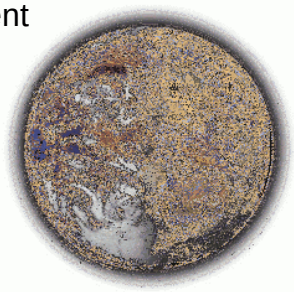


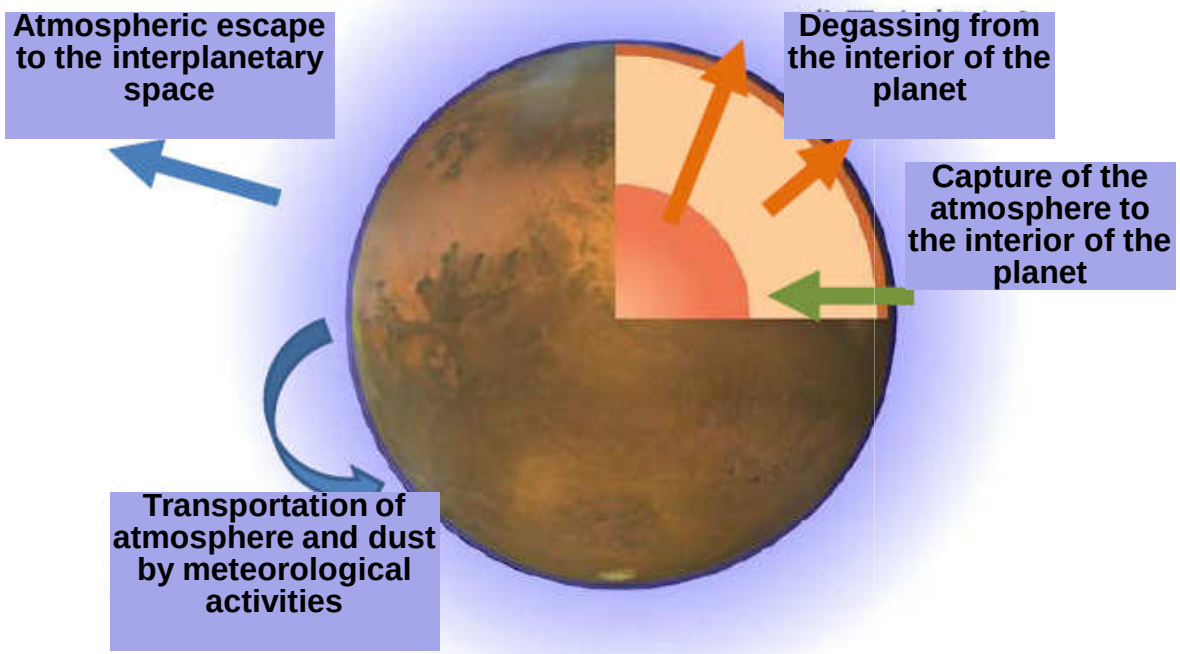
MELOS: Japan's Mar Exploration Plan for 2020's

Mars Exploration with Lander-Orbiter Synergy

T. Satoh (JAXA)
and
MELOS Working Group

Science Target of MELOS

- Understanding the Martian System
  - Interior + surface + atmosphere + surrounding space
    - To understand the evolution and to answer the fundamental question “Why (and how) is Mars different from the Earth?”, missions designed to study inter-relations between these are needed.
    - Both “orbiting” science and “landing” science are important.



Keyword:
Why is Mars “red”?

Orbiter (A): Meteorology
Orbiter (B): Aeronomy
for **MELOS-1**

Lander (A): Surface
Lander (B): Biology
Lander (C): Interior
Lander (D): Sample Return
for **MELOS-1 EDL** and
for MELOS-2

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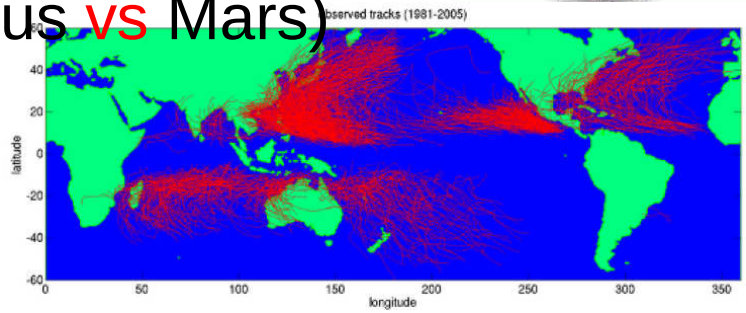
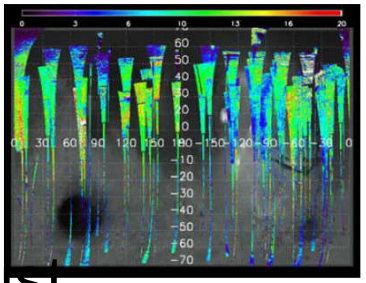
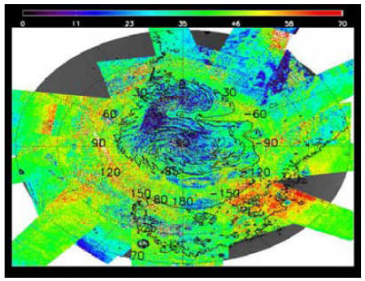
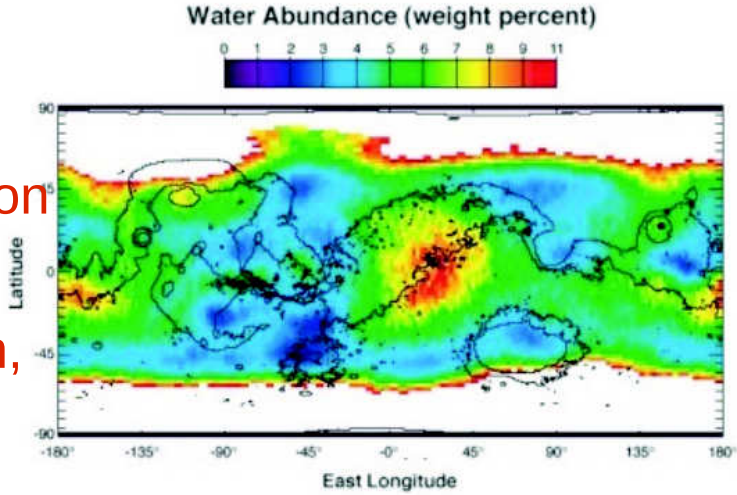
Orbiter (A): Martian Meteorology

- Comparative Meteorology (Earth vs Venus vs Mars)
  - Similarity: rotation period, tilt of the pole
    - Tenuous CO_2 atmosphere vs suspended dust (heat source)
    - Large seasonal variation (eccentricity) vs relatively small thermal inertia
    - Episodic “global” dust storm
    - Underground water (ice) reservoir
- Transportation/Relocation of Water & Dust
  - Never been studied in detail
    - Limitation of “local-time fixed” orbit
    - Need to characterize “global” transportation
    - Especially in the lower-most atmosphere
    - 3-D structure of temperature, composition, isotopic ratio, etc.









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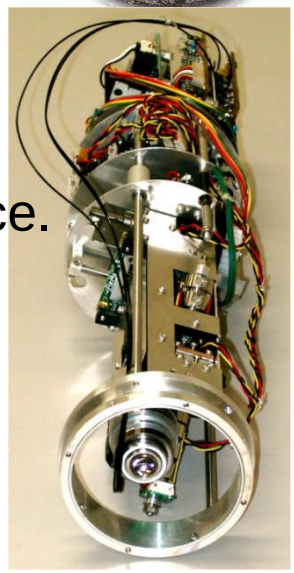
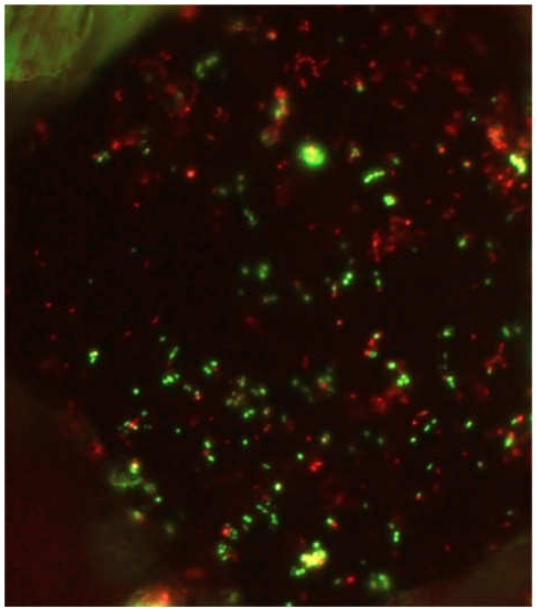
Lander (B): Astrobiology

- Most likey place for Martian life?
  - Surface soil near the methane vent
    - Terrestial life may survive at a few cm below Martian surface.
    - Martian environment ~4 Gy ago similar to Earth.
    - The birth of life can be in very short time.
    - Martian methane detected recently.
    - Bacteria that utilize methane & iron oxide discovered.
- Method?
  - With fluorochrome and a microscope
    - Dye protein, membrane, catalyst, etc.
    - Target sensitivity: 10 cells / 1 g of soil. (compared to 10^4 cells / 1 g in Earth desert)
    - Conclude “no life on Mars” if no detection.
    - Possibly detect organic materials related to chemical evolution before life.

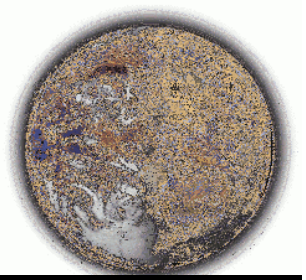




Antarctic soil after dying

Mars Exploration with Lander-Orbiter Synergy

Lander (C): Interior Structure



(Depth)

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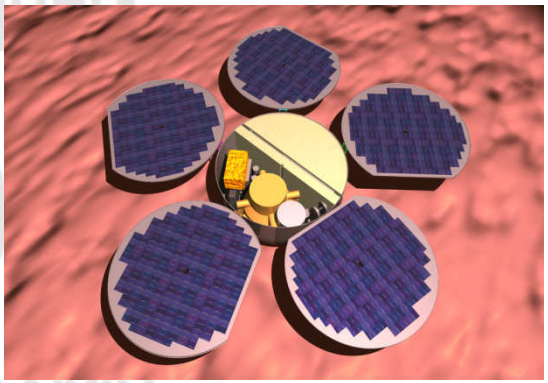
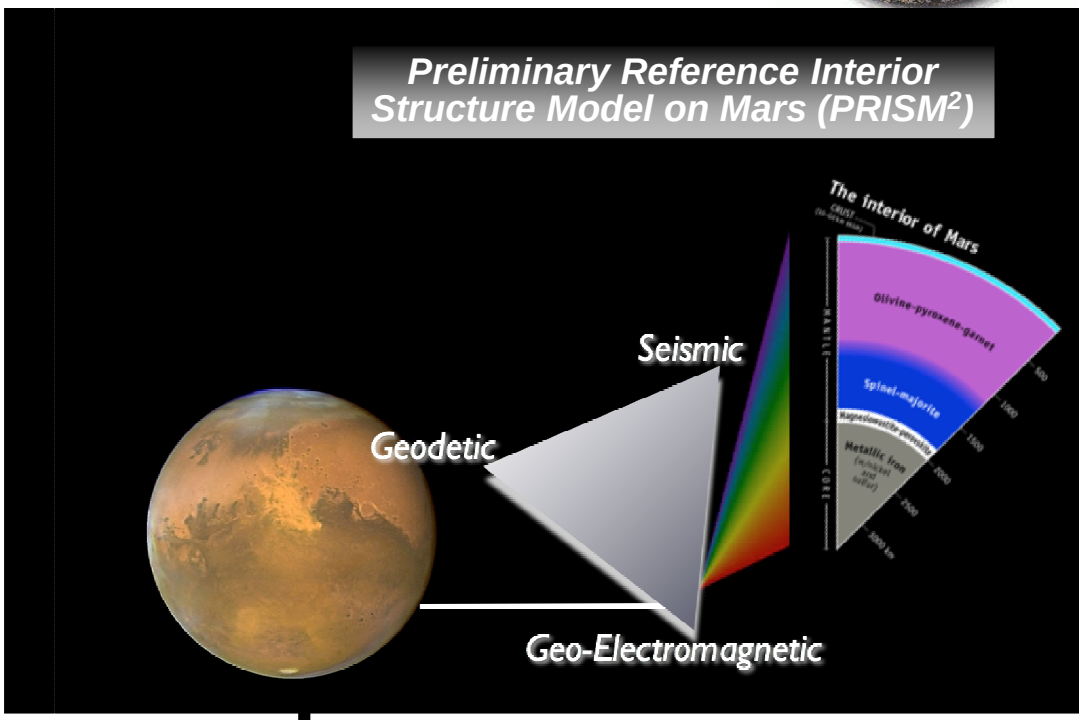
Heat flow

Electromagnetic (>2 stations)



Possible collaboration with International network mission



Rotation

(better to have multiple stations)

(precession, nutation)

Z Term of Mars

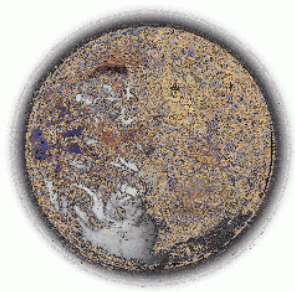
Mars-quake

(better achievement with multiple stations)

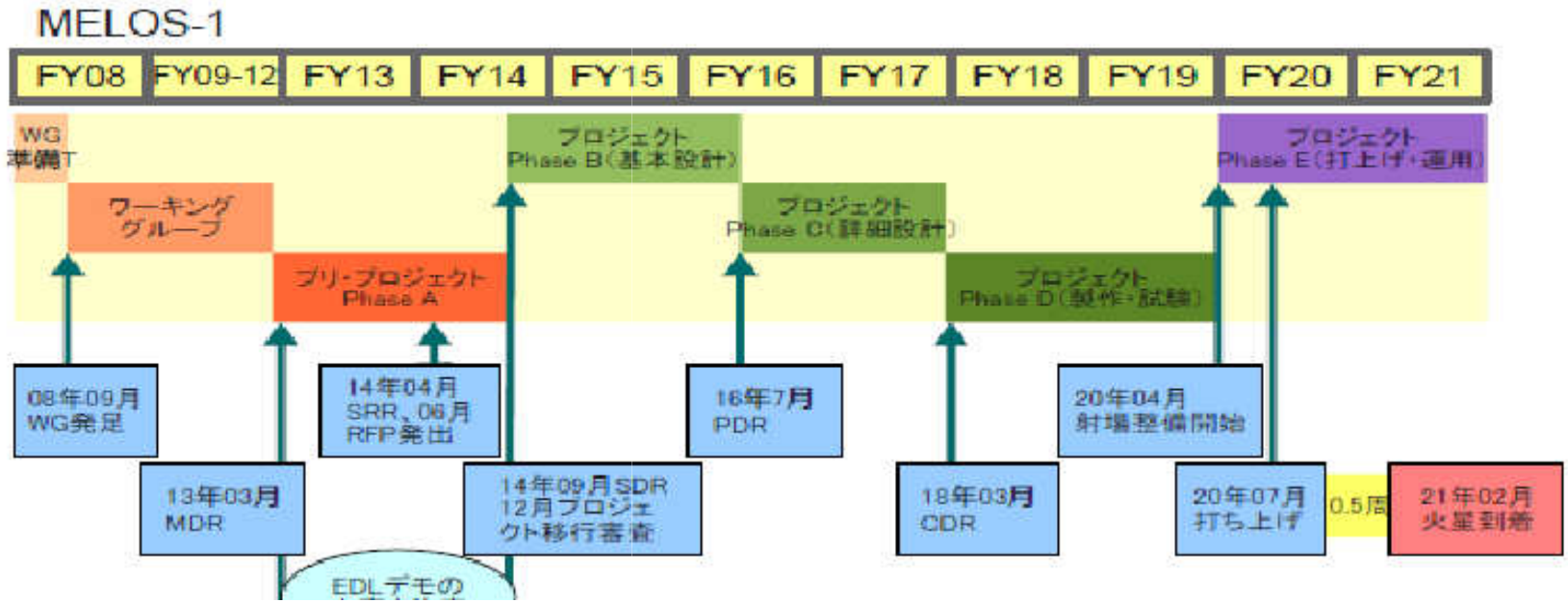
(quakes, free oscillations)

(Information)

Selecting from Proposals to MELOS1



– The selection process:
  - Review & evaluation through *hearings* (the 1st one will be in August)
  - Will evaluate scientific significance, feasibility (TRL, resources), lander-orbiter synergy, etc.
  - One of orbiter proposals will be selected first
  - Will keep 2 possible candidates for EDL science until later phase



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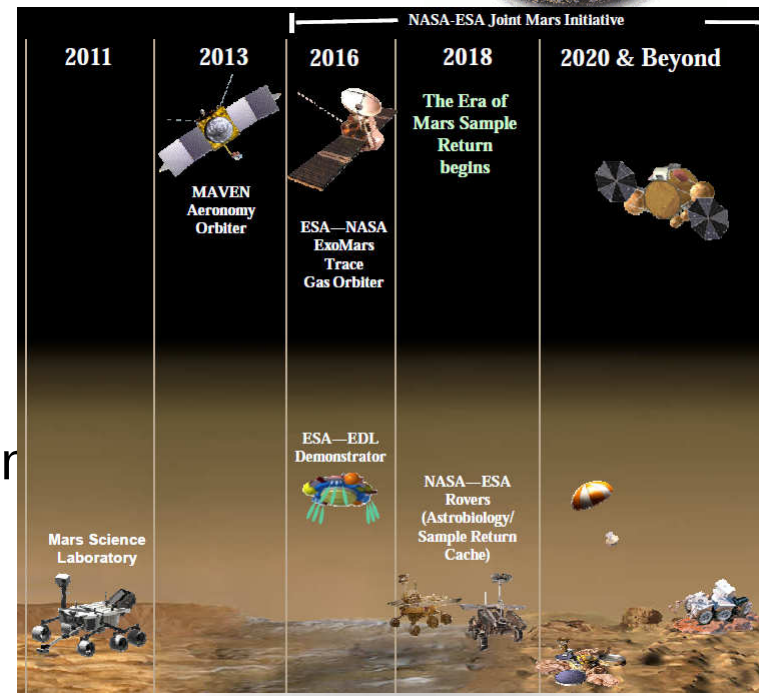
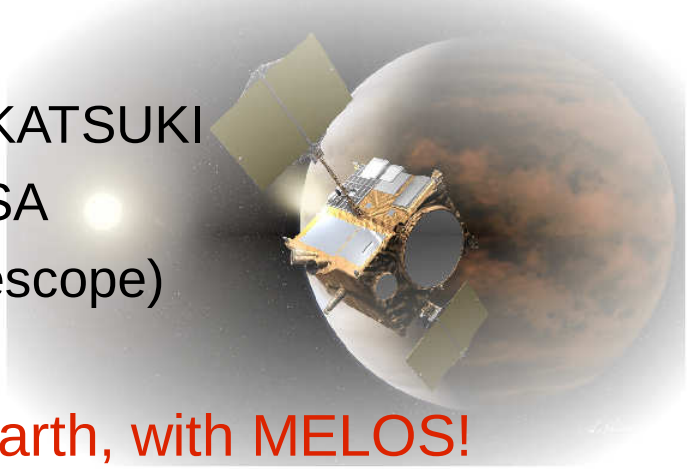
International Challenges to Mars

- Launches in all possible windows
  - Sample return in late 2020's
    - NASA+ESA2016, 18
    - 2011: Curiosity (MSL) (USA)
    - 2013: MAVEN (USA)
    - 2011: Phobos-Grunt (Russia) + YH-1 (Chir
    - Indian Mars mission (2018?)
- Japan: NOZOMI (launch in 1998)
  - Failure before arrival at Mars
    - Then, we had HAYABUSA, KAGUYA, and AKATSUKI
    - 2014: BepiColombo Mercury mission with ESA
    - SPRINT-A/EXCEED (Earth-orbiting EUV telescope)
    - Plans of lunar, asteroidal, planetary missions
    - We challenge Mars, the planet like the Earth, with MELOS!





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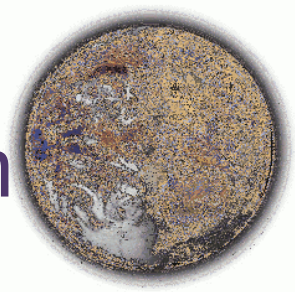
What's happend to “Akatsuki” Venus Mission



- VOI attempted on 7 Dec 2010 but failed...
  - Likely cause is “clogged” check valve in the fuel line (CV-F)
    - It prevented smooth flow of fuel, resulting in “*less fuel than oxidizer*” condition (O/F > 1).
    - The excess fuel acts as “*coolant*” for the thruster throat & nozzle. This does *not* work if the fuel is less than the oxidizer.
    - Without enough cooling, a damage has occured to the thruster, and the spacecraft went to “Safe Hold”.
  - The spacecraft (including mission instruments) seems to be in good condition, and we will re-challenge VOI 6 years later.