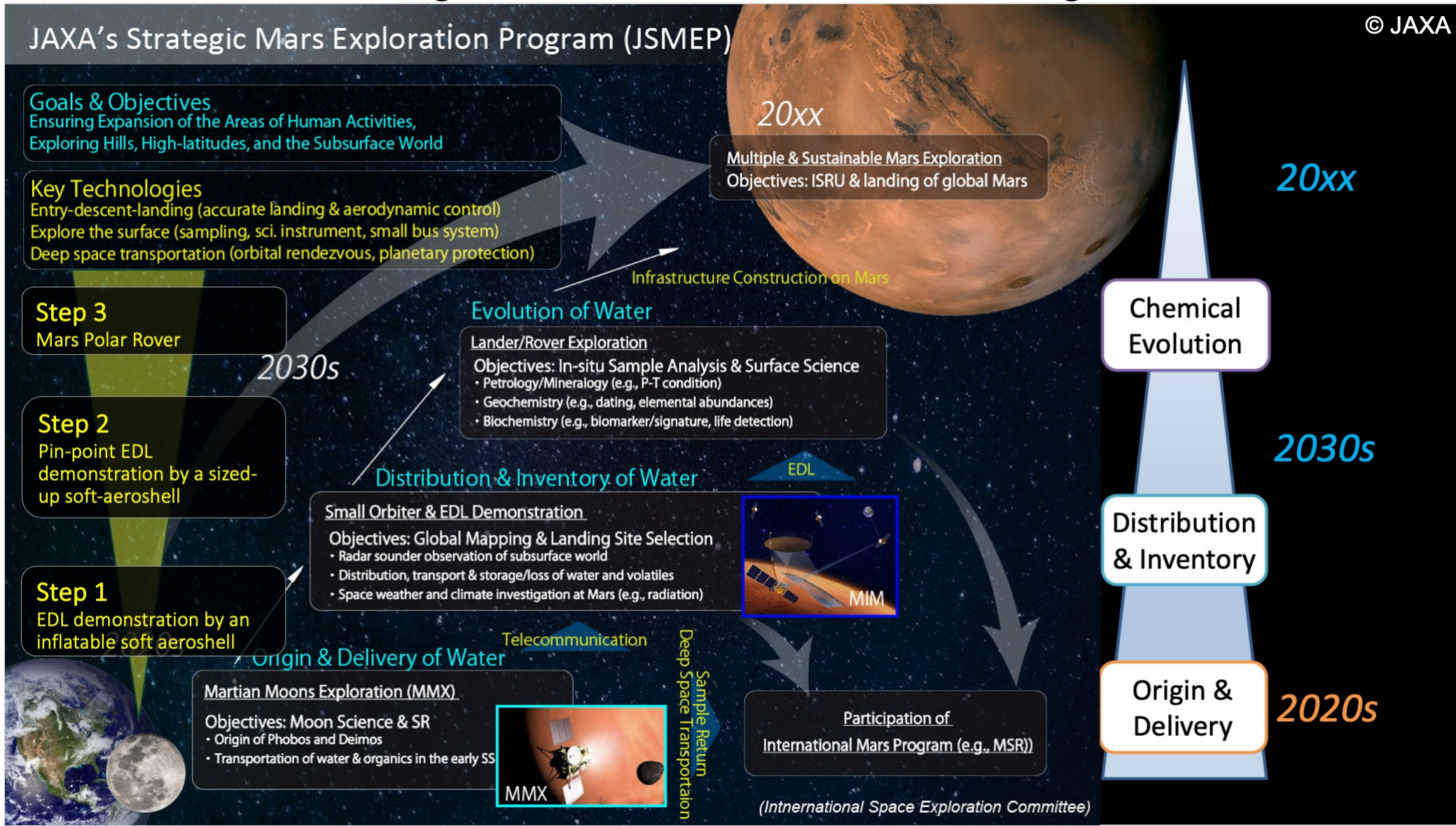


ISAS PEWS 2023: ~ Summary of Mars splinter~

Splinter leads: Shotaro Sakai, Rina Noguchi, Shunta Kimura, Mizuho Koike, Kei Masunaga, Takao Maeda, Hiromu Nakagawa, Tomo Usui



Splinter discussion

An ongoing discussion about science for Martian exploration with an emphasis on Steps 1, 2, and 3.

- But we should not be too aware of these “Steps”.

Topics on which we focused in this splinter

- Interesting landing sites from the perspective of science

Examples of landing site ideas

Landing sites	Targets
Southern Elysium Planitia	Rootless cones, Young lava, Medusae Fossae formation
Valles Marineris	Ancient Mars geological and environmental history, Amazonian volcanic activity, Crustal thickness, Marsquake, Present meteorological condition
Hellas Planitia	Tectonic evolution, Crustal thickness, Strength of magnetic field, Glacial and periglacial landforms, Present meteorological condition
Elysium Mons	Detection of gasses possibly associated with Martian life
RSL, Mud Volcano, Underground cavity	Life extruded from the underground onto the surface
Strong and weak crustal magnetic field region	Ancient magnetic field strengths

Small bodies session: invited and contributed talks

Mohit Melwani Daswani

“The Metamorphic Brine – Ocean – Surface Deposit Connection at Ceres”

- Thermophysical evolution of Ceres
- Inspect to the Ceres sample return mission

Jin Beniyama

“Recent Telescopic Observations of Near-Earth Asteroids: Asteroids of Interests for Future Missions”

- E-type asteroid pair, and very-red tiny asteroids
- Proposal of multi-flyby of tiny asteroids

Hideyo Kawakita

“Review on Comet Science from Ground-based/Space Observatories”

- Comets have a wide variety.
- Is comets primitive? What is comet? Different from asteroids?

S. Kikuchi, N. Sakatani; Next generation small body sample return mission

- Science WG was established. Great achievement of this WS.

R. Fukai; Subsurface exploration

Small bodies splinter summary

- **Concept exercise of a new mission: Multi-flyby of near-Earth tiny asteroids**
 - ◆ Science objectives: Confirm if the tiny asteroids (< 100m) are monolithic or rubble-pile.
 - ◆ Micro-sat constellation flyby is being considered by N. Ozaki & R. Hyodo. 10 flyby in one-year will be possible. Statistically sufficient.
 - ◆ How can we confirm the internal structure with flyby mission?
 - Density is the most relevant properties. But difficult. U.S. has gravity-probe concept, flyby by multiple spacecraft to determine GM property. Need follow-up.
 - Non-gravitational force, such as Yarkovsky effect, will be also important for mass estimation. (e.g., detection of Yarkovsky drift by ground observation, and in-situ flyby determination of thermal property?)
 - ◆ Ground-based observations are essential to support flyby navigation and to extract information on bulk properties combined with flyby observations
 - ◆ Reconfigurable or variable shape spacecraft can be a solution for changing geometry of instruments & rapid attitude slewing. Potential collaboration.
 - ◆ Optical navigation with high solar phase angle, like “new moon”, is difficult. Alternative solution is “thermal navigation” using thermal infrared imager?

Updates on the Moon splinter

ISAS Planetary Exploration Workshop (PESW)
28–30 September 2023
(2023/08/30版)

SOC: 西野真木、長岡 央、大竹真紀子、仲内悠祐、
小野寺圭祐、関根北斗

Presentations

	Author	Title	
1	Ishihara	Current Understating of Lunar Polar Water, and LUPEX Project – ISRO/JAXA Joint Exploration for Searching, Detection, and Quantification of Water at South Polar Region of the Moon –	LUPEX, water
2	Nagaoka	Sample return missions for important lunar science theme	SR
3	Miyoshi	Development of compact and highly functional space radiation environment measurement technology for Lunar surface	Radiation and charge environments
4	Kobayashi	Lunar Dielectric Analyzer (LDA): In-situ measurement for electromagnetic properties of lunar regolith	Dielectric constant
5	Sekine (*)	Propellant selection for Cubesat propulsion system and the possibility of water	CubeSat, propellant, water, planetary resource utilization

Splinter

1. Brief review of SPS 2023
2. Review of presentations in the Moon splinter
 1. Ishihara : LUPEX, Polar water
 2. Nagaoka : Sample return
 3. Miyoshi : Radiation and charging environments (不在)
 4. Kobayashi : Lunar Dielectric Analyzer (不在)
 5. Sekine : Water as cubesat propellant
3. Others
 - U (于) : Thermal history
 - (LEAD → to be discussed in Moon-to-Mars session)

Follow up

1. Ishihara-san : LUPEX

LUPEX、CY-2 orbiterのデータ、もし興味があればPOCへ

2. Nagaoka-san : SR

観測機器のキー技術の共通化、オープン化、工学側へのフィードバック

5. Sekine-san : Propellant, Cubesat

推進剤の水は凍らない環境に制御。凍結を許容する設計も可能。

水を押し出すのはArガス。水だけ再充填、Arガスは使い回せる。

燃費の良さなら液化ガス

Others : U-san (月の熱膨張・収縮史の話)

放射性元素の地殻とマントルの量比(内部構造・バルク組成)を将来探査で決めてほしい

ISAS Planetary Exploration Workshop 2023

Splinter MTG: Engineering

28-30 August, 2023

Yuki Kubo, Kuniyoshi Tabata, Naoya Ozaki, Takahiro Sasaki,
Takao Maeda, Yuki Takao, Shota Kikuchi, Yuto Takei

Motivation of this session

- Target in FY2023: **Matching of engineering seeds & science needs**
 - Encourage novel technologies that are not currently categorized into specific exploration
 - Promote interactive discussion, not only simple Q&As
 - Small splinter meetings after each talk
 - Expect that the succeeding splinter meetings refer to the discussion in this session
- Sub-target: **Making transversal community in engineering field**
 - Share common engineering problems in space exploration
 - Contribute to establishing new space exploration mission

Quick summary of talks

Authors	Keywords	Potential application
Yuki Takao	constellation of micro solar sails, small bodies	global mapping, seismic observ., subsurface radar
Tetsuhiro Nakashima	micro solar power sail, navigation technology demonstration	moon, outer planets exploration
Kei Watanabe	variable-shape spacecraft, agile attitude maneuver	fast & multiple flyby, jumping/walking switchable rover
Wataru Torii	software defined radio, OMOTENASHI/EQUULEUS	outer planets, inter-spacecraft communication
Jusuke Shimura	anomaly detection of Li-ion battery, mahalanobis-taguchi method	outer planets, formation flight
Yoshitsugu Sone	intelligent battery, low temperature degradation of Li battery	outer planets, moon exploration
Ayuto Manabe	millimeter-wave maser propulsion, shock-wave detonation thrust	interplanetary exploration
Takamitsu Iwaya	portable gas chromatograph instrument, domestic product in Japan	in-situ observation, small bodies
Hiroto Tanaka	in-operation thermal analysis, thermal surrogate model	BepiColombo
Hiroki Nagai	domestic mars airplane, light weight & small-size system	mars
Shunta Kimura	bioburden control, astrobiology, dry heating	mars, system design

Venus session – Invited/Contributed talks

- **Yeon Joo Lee** (Inst. for Basic Science) : **Chasing the long-term variability of Venus**
 - Venus Express + Akatsuki data: Venus cloud's UV albedo has been changed by a factor of 2 in 10 years.
 - Super-rotation speed also changed. ← possibly due to the change in the incident Solar heating.
 - Venus as a “dynamical” terrestrial planet. **Importance of long-term monitoring.**
 - Concept of **CLOVE** mission : UV + NIR camera system onboard Earth orbiting **CubeSats**.
 - Long-term monitoring mission needs to overcome the degradation of sensors.
- **Toru Kouyama** (AIST) : **Long-term variations in temperature & thermal-tide, derived from Akatsuki/LIR**
 - Interesting **periodical variations** in the mean atmospheric temperature and thermal-tide amplitude derived from LIR (10 um) camera onboard Akatsuki.
 - Data mining/machine learning technique. Also, it's important to “re-explore” Akatsuki data (remember that the recent detection of volcanic activity from 30 yrs old Magellan data).
 - Akatsuki is going to complete **a full coverage of one solar cycle**. This is a very unique data set.
- **Yosuke Kawabata** (UTokyo) : **CROVA & Interplanetary transfer using kick-motor and Lunar gravity assist**
 - Cross-Link Radio Occultations **for intensive temperature measurements**. Also planned in M-Matisse.
 - Optimization of the inclination angles of two orbiters.
 - Kickmotor + LGA is a good tool to **increase the opportunity** of sending spacecraft to Venus.

Venus session – Splinter discussion

(A) New mission in 2030's (targeting JAXA's Small-class mission)

Potential ideas: **How much resources is acceptable for the science payloads?**

• If launched with H3 (so, it's not 公募型小型 though), 2,500 kg for total spacecraft.

(1) **CROVA** : Cross-Link Radio Occultations to fully map the temperature field.

(2) **CROVA** + α (other instruments on mother-ship).

(3) **Orbiter mission** : MAVEN for Venus. / **Long-term (climate) monitoring?**

(4) **CubeSats from Earth orbit?**

• Point-source like image is still informative.

• What kind of physical parameters to be monitored?

• Period, Cadence? - one Solar cycle?

(B) Further-future mission with developing new technologies

We should not stop at considering "*doable*" missions, but also discuss "*missions that are technically impossible now, but should be achieved someday*"! Entry system with inflatable soft aeroshell ?

Surface exploration, Deep lower atmosphere, In-situ measurements of clouds, Sample-Return mission, etc. *Seeds for the Next generation planetary explorations*

Interplanetary transfer using kick-motor + lunar gravity assist

Cross-link radio occultation between two satellites • Application to other planetary atmospheres.