National Aeronautics and Space Administration

EXPLORE MARS

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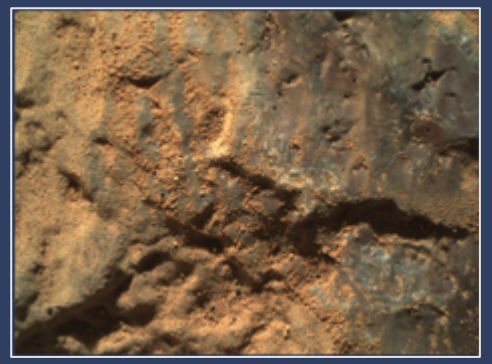
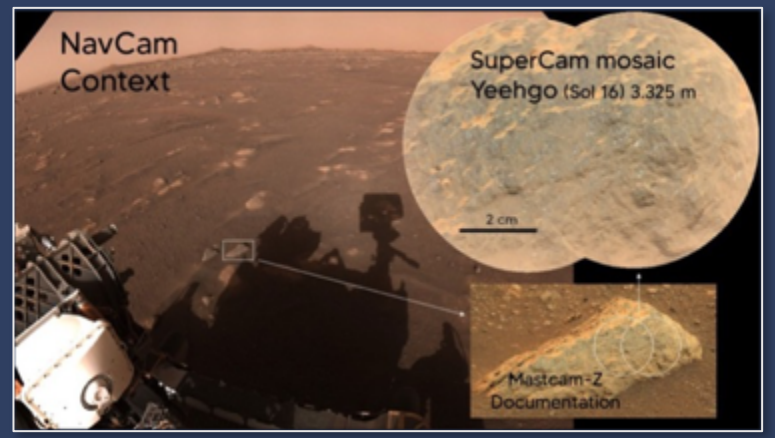
Mars Exploration Program Presentation to MEPAG
June 21, 2021

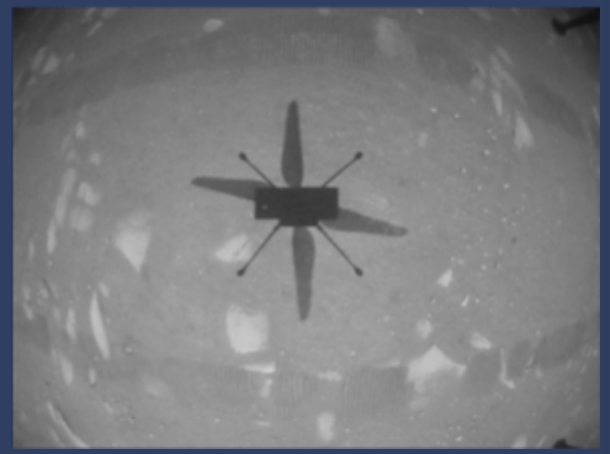
Mars Exploration Status Highlights

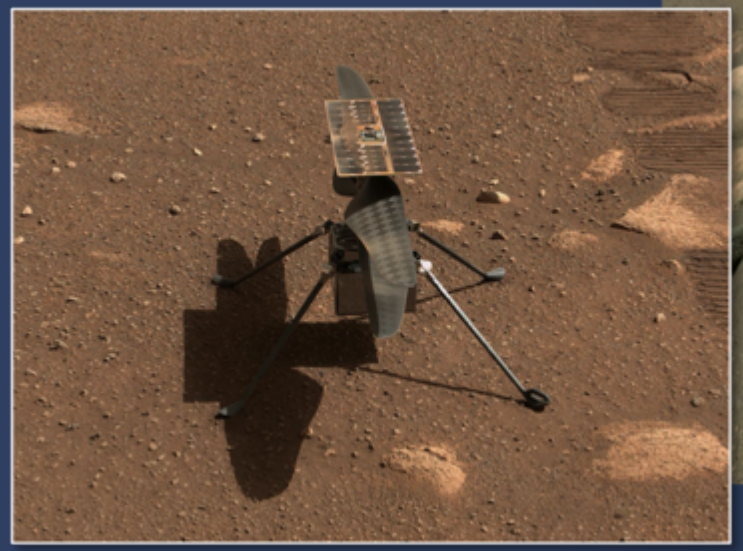
- Perseverance rover and Ingenuity helicopter are healthy and stable on the surface of Mars.
- Commissioning is complete; Perseverance is headed South on our first science campaign
- 100 days (sols) milestone at Jezero Crater as of June 1
  - Tested all cameras and instruments
  - Returned over 75,000 images
  - Deployed Ingenuity and completed technology demonstration phase
  - Recorded first sounds of Mars
  - Extracted oxygen from the atmosphere



WATSON focus test







Ingenuity successfully completed flight test program, validating atmospheric flight on Mars. Beginning operations demonstration phase, identifying scientific utility of surveying inaccessible terrains.

Other Updates

- Dr. Fuk Li retired from JPL as the Mars Exploration Program Manager in April 2021; Mr. Joe Parrish was named by JPL as the new MEP Program Manager
- InSight power generation continues to decay due to buildup of Martian dust on the solar arrays; soil-drop saltation test yielded positive increasing power generation by 30 wh/sol
- MOMA: Instrument fully integrated with Rosalind Franklin rover. NASA providing assistance with ExoMars Rover parachute testing.
- Ongoing NASA missions are healthy, productive, and funded through FY21
  - Odyssey: > 20 years since launch, and still going strong
  - MRO: Decision made to keep MRO in the 15:10 crossing time orbit, began June 9
  - MSL: Left Mount Mercou, approaching/in the “sulfate unit” identified from orbit
  - MAVEN: Exciting science ahead during solar cycle 25; Supported Mars 2020 EDL
  - ExoMars/TGO (ESA): Provides ~50% of relay data from landed assets
- NASA/ESA MSR Science Planning Group-2 been meeting regularly meeting since June 2020
  - Reported out to NASA and ESA HQ on May 27
  - Final documents to be completed by end of June
- Mars Data Analysis Program
  - ROSES 2020: selected 31 of 96 Step 2 proposals submitted this year
  - FINESST proposal selections to be announced soon

Joe Parrish background info

2000-2002 NASA HQ: Program Executive (PE) - Mars Exploration Program

- First engagement with Mars Exploration Program and “Follow the Water” science strategy
- PE for Mars Sample Return, Mars Smart Lander/Mobile Science Laboratory, Mars Scouts

2002-2012 Various positions in industry, government

- Industry: President - Payload Systems Inc., then VP-R&D - Aurora Flight Sciences
- Government: Division Director in what is now NASA STMD, then NASA Deputy Chief Technologist
- While in industry, executed several SBIR/STTR projects relating to Mars Sample Return
  - OS rendezvous and capture
  - Sample handling technologies (cell biology, biocontainment)
- Served on several committees and peer review panels for Mars missions that are flying now

2012-2018 JPL: Deputy Manager - Mars Program Formulation Office, MEP

- Worked on many efforts germaine to today’s program
  - Architecture for sample caching rover (was MAX-C, now M2020)
  - Led study that resulted in today’s adaptive caching strategy
  - Organized 2014 workshop for Mars smallsat missions
  - Led concept development for what is now called the Capture, Containment, and Return System (CCRS)

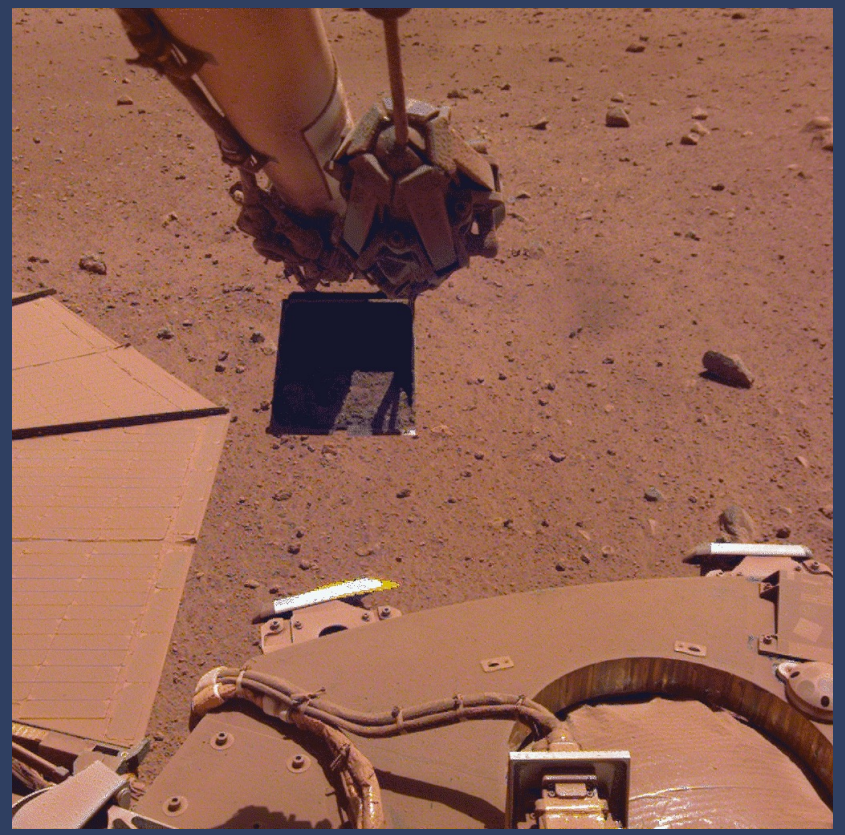
2019-2021 DARPA: Program Manager – Tactical Technology Office

- IPA assignment from JPL to DARPA
- Program Manager for an on-orbit servicing robot (Robotic Servicing of Geosynchronous Satellites - RSGS), launching in 2024

Joe on NASA C-9 “vomit comet” in 2006, testing MSR OS capture technologies

InSight Power Boost

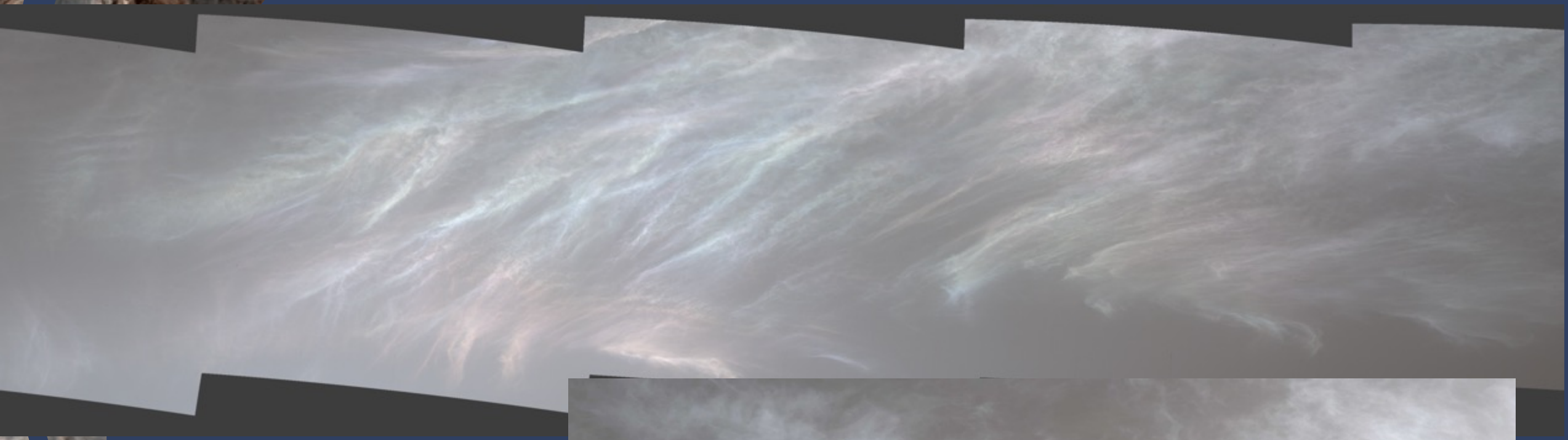
Saltation from sand sprinkled on solar panel removed dust, increasing output by 30 Watt-hours/sol



Budget Status

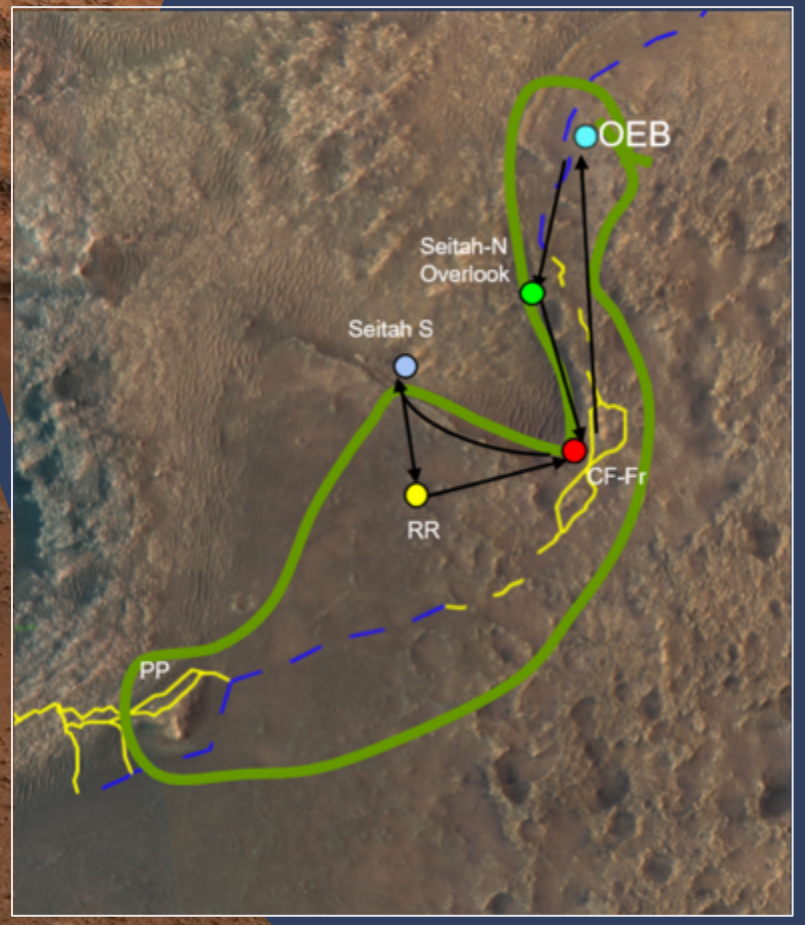
- FY22 President's Budget Request supports a robust Mars Exploration Program, including:
  - Perseverance's science & sample caching campaign on the surface of Mars
  - Continued operation of existing missions, including planning for extended missions
  - International Mars Ice Mapper identified as a separate "project" in the budget
  - Funding to support the delay to the ExoMars/Rosalind Franklin mission
  - Mars fundamental research & analysis
  - Support for existing and future international partnerships
  - Planning for the receiving and curation of returned samples
- Mars Sample Return identified as a separate "project" in the budget

Noctilucent Clouds

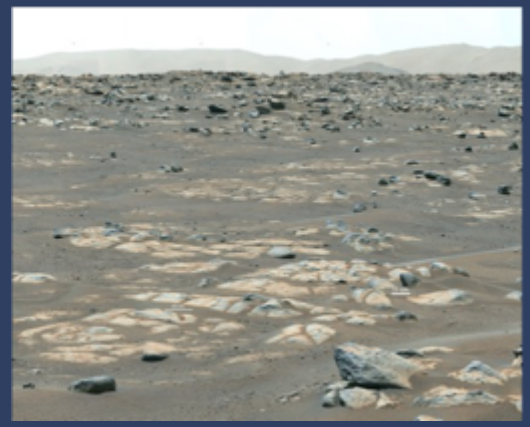


Perseverance "Green Zone" Science Campaign

- First segment of 3 Earth-year Jezero phase of Mars 2020 mission: crater floor exploration
  - Other two segments are *delta* and *marginal/crater rim*
- Collect ~ 4 samples (plus duplicates) and a witness blank
- After campaign, fast traverse to Jezero delta (arrive approximately Spring 2022)

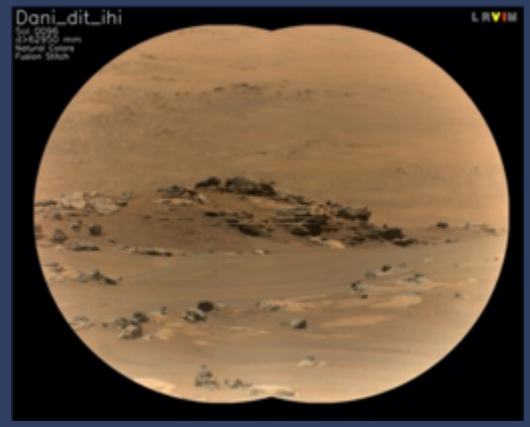


Strategy: an out and back traverse. Head south following black arrow doing imaging and identifying locations for detailed work on return journey. Then fast counter-clockwise traverse from Octavia E. Butler Landing to delta entrance. *Be highly disciplined and focused on sample collection.*

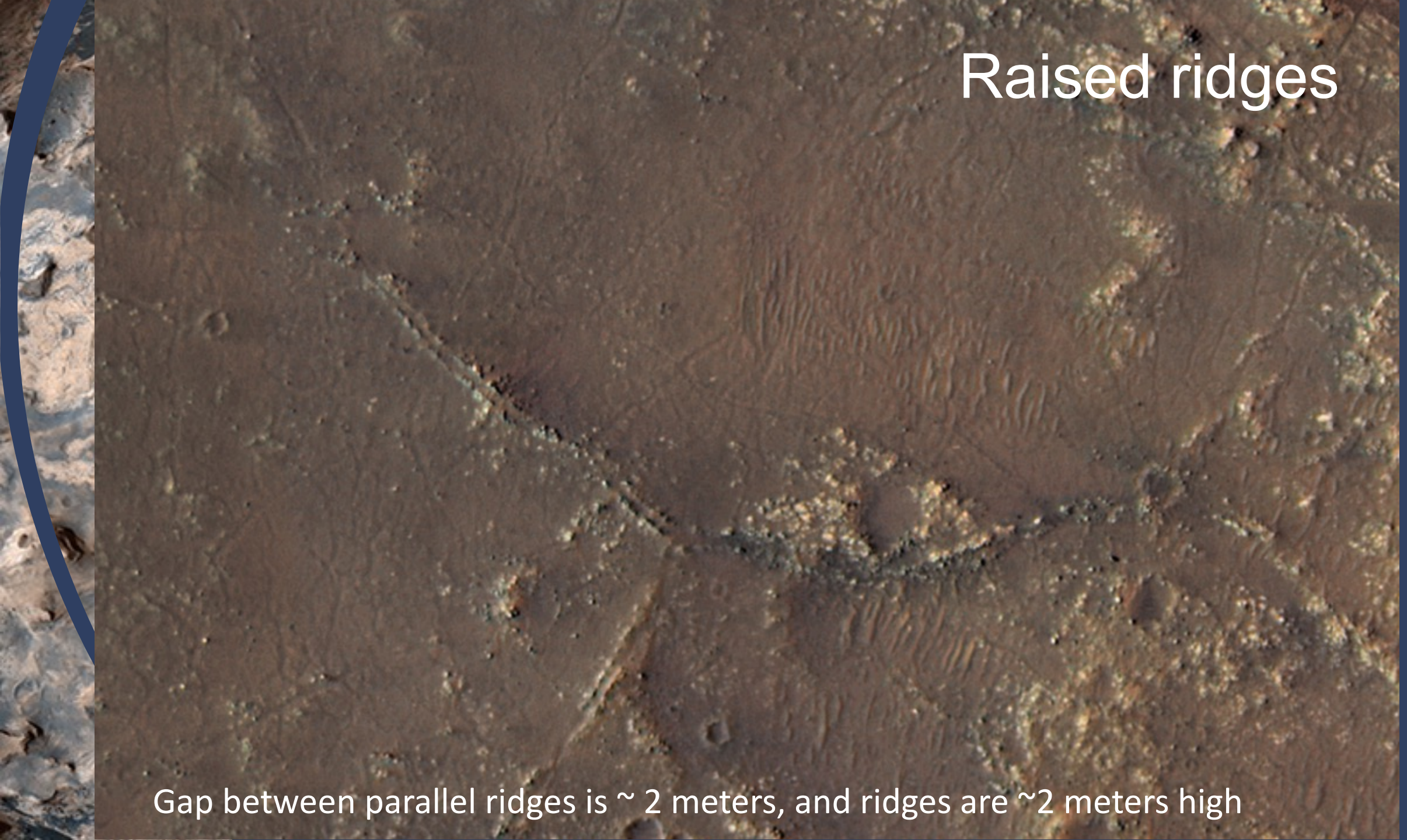


<u>Possible or likely sample sites:</u>

1. Crater Floor – Fractured Rough at red dot
   - heavily cratered unit the rover landed beside and has been studying ever since
2. "Seitah" unit at blue or green dot
   - lacustrine/deltaic sediments (?)
3. Sample of Opportunity
   - mineralized raised ridge (RR)? Pilot Pinnacle (PP) delta remnant?

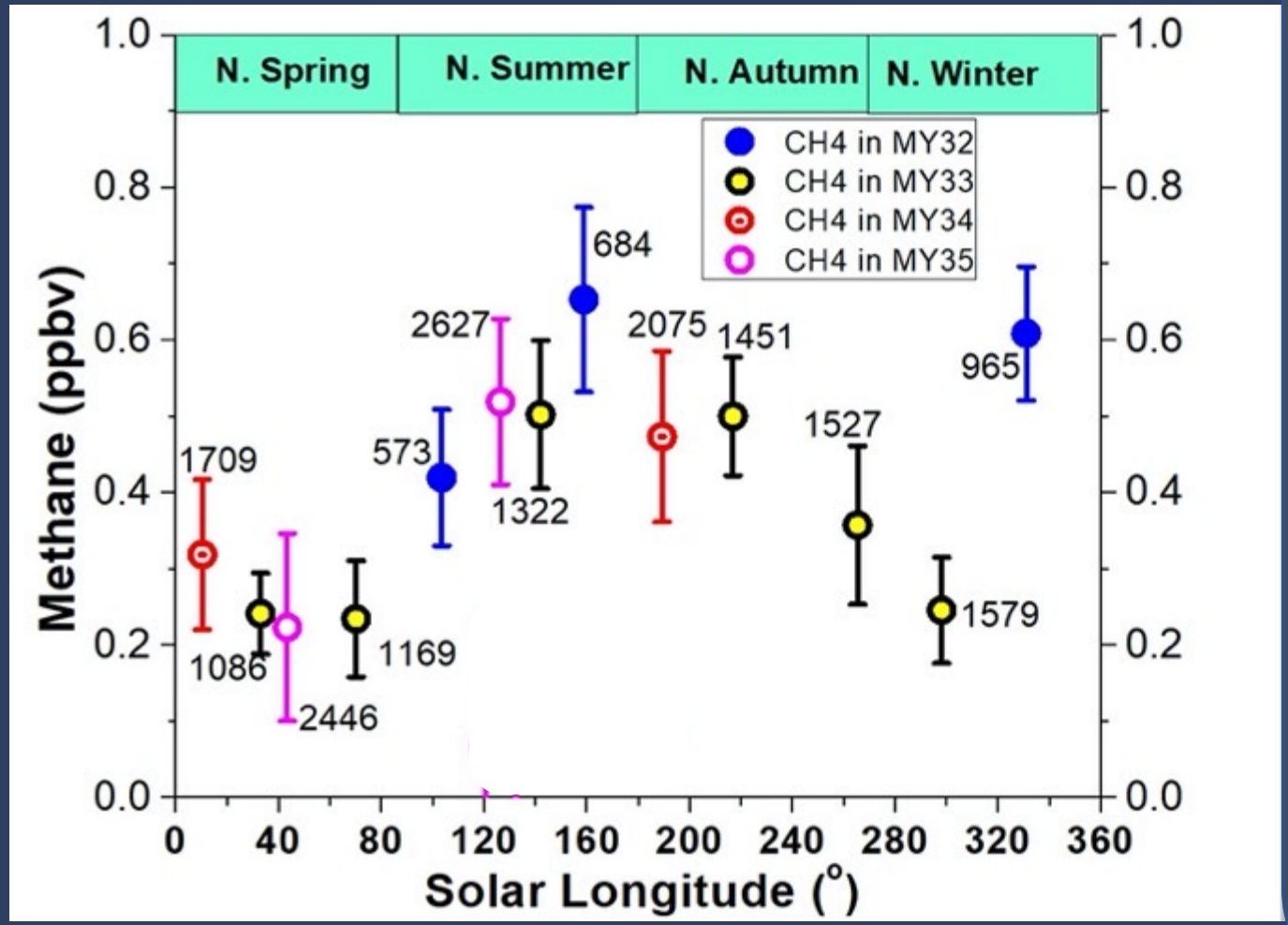


Raised ridges



Gap between parallel ridges is ~ 2 meters, and ridges are ~2 meters high

Methane on Mars

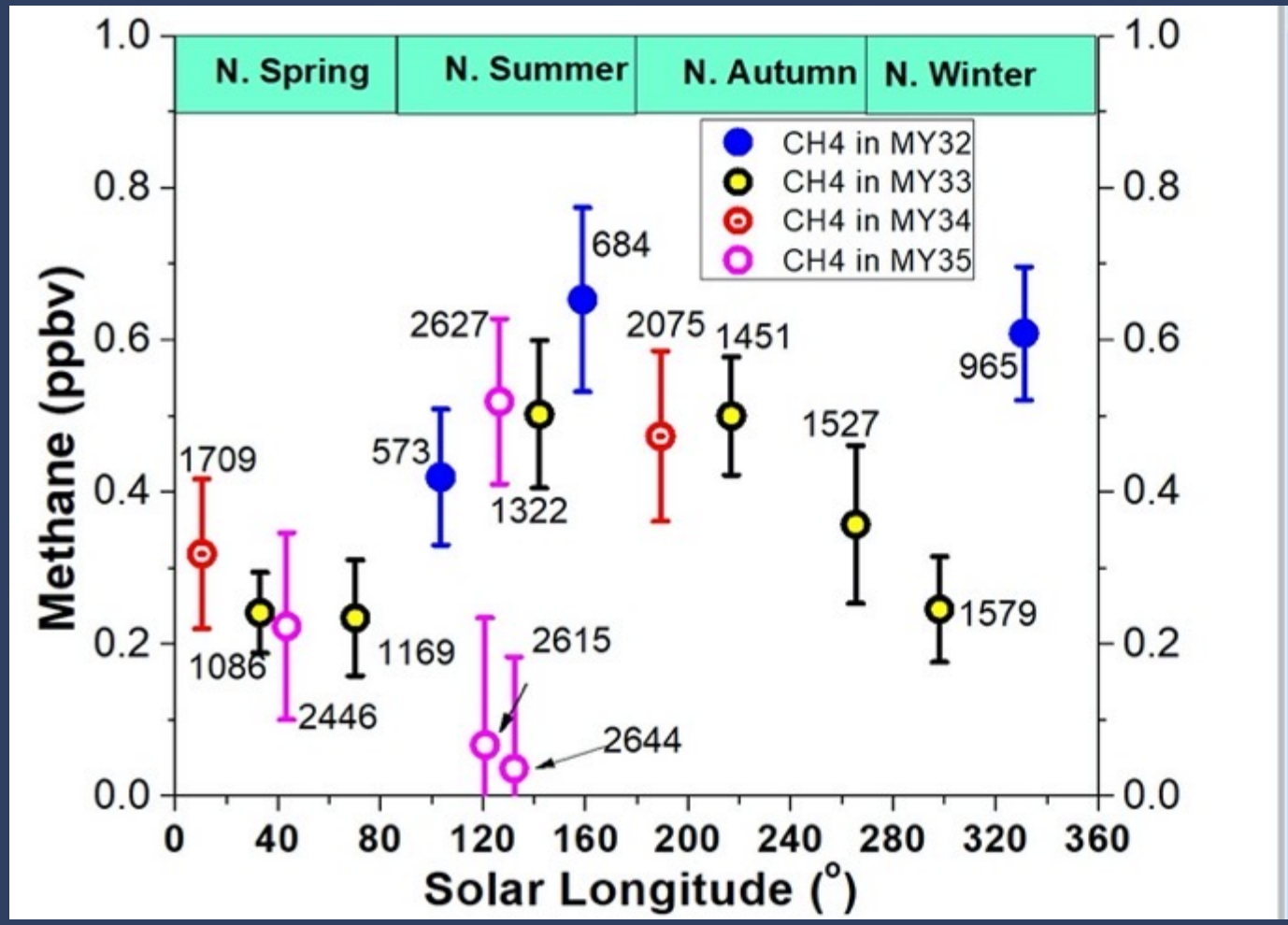


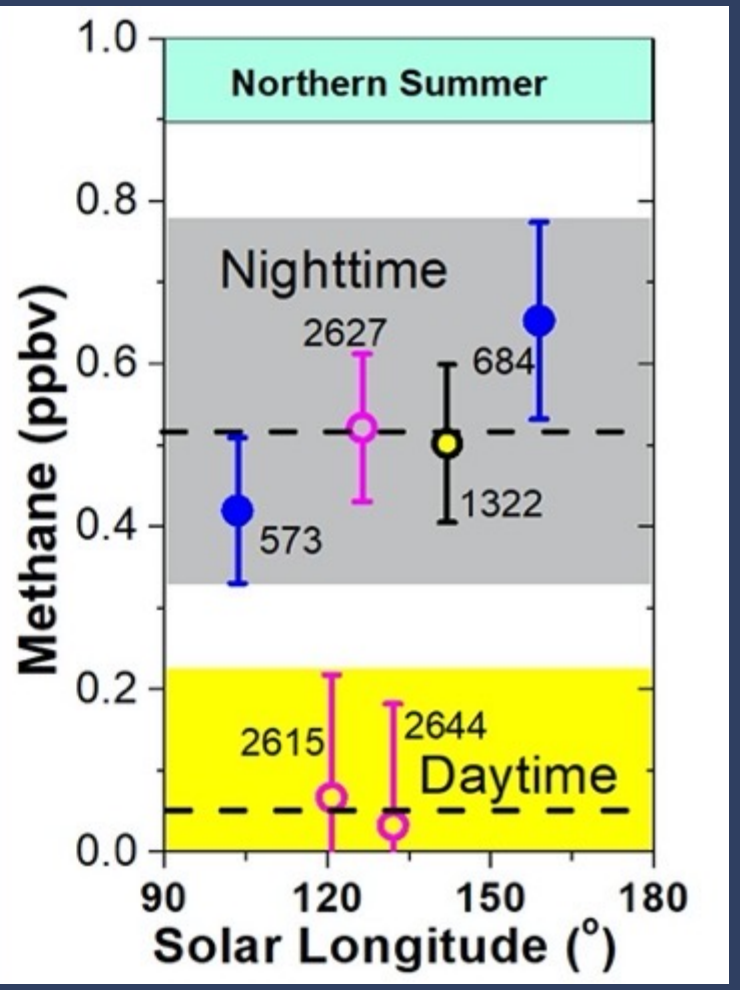
- Nighttime measurements on Mars consistently showed low amount of methane with a seasonal variation,
- But TGO did not see methane from orbit.

What is the cause of this apparent discrepancy?

- Theory - Micro-seepage of methane could be contained within the collapsed boundary layer at night

Methane on Mars





MSR Science Planning Group –2 (MSPG2)

Initiation

Terms of Reference signed by ESA and NASA in April 2020

Statement of Task

1. Provide inputs for an MSR Science Management Plan
2. Identify technical issues related to potential scientific usefulness of the samples
3. Develop high level requirements for the Sample Receiving Facility to be used for cost estimation and budgeting
4. List key decision points related to the returned samples and represent them on a master timeline

Formation

- Members competitively selected through joint NASA-ESA process
- International team comprised of appointed Coordination team plus 25 members: 12 from Europe, 11 from the United States, one from Canada, one from Japan

MSPG2 Results

1. Science Management Plan

Demonstrated the need for an overarching MSR Campaign Science Program and proposed an implementation approach

2. Technical Issues

Established which sample related activities must be conducted in the containment, either because they are time-sensitive, sterilization-sensitive, or are needed for initial sample characterization

3. Sample Receiving Requirements

Provided technical requirements that would enable the containment laboratory to meet its objectives and accommodate activities that cannot be done in external laboratories

4. Integrated Timeline

The MSR Science Program comprises multiple types of activities - some are tied to the sample return date, while others are tied to the planning and activity of the flight missions, and some must start immediately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