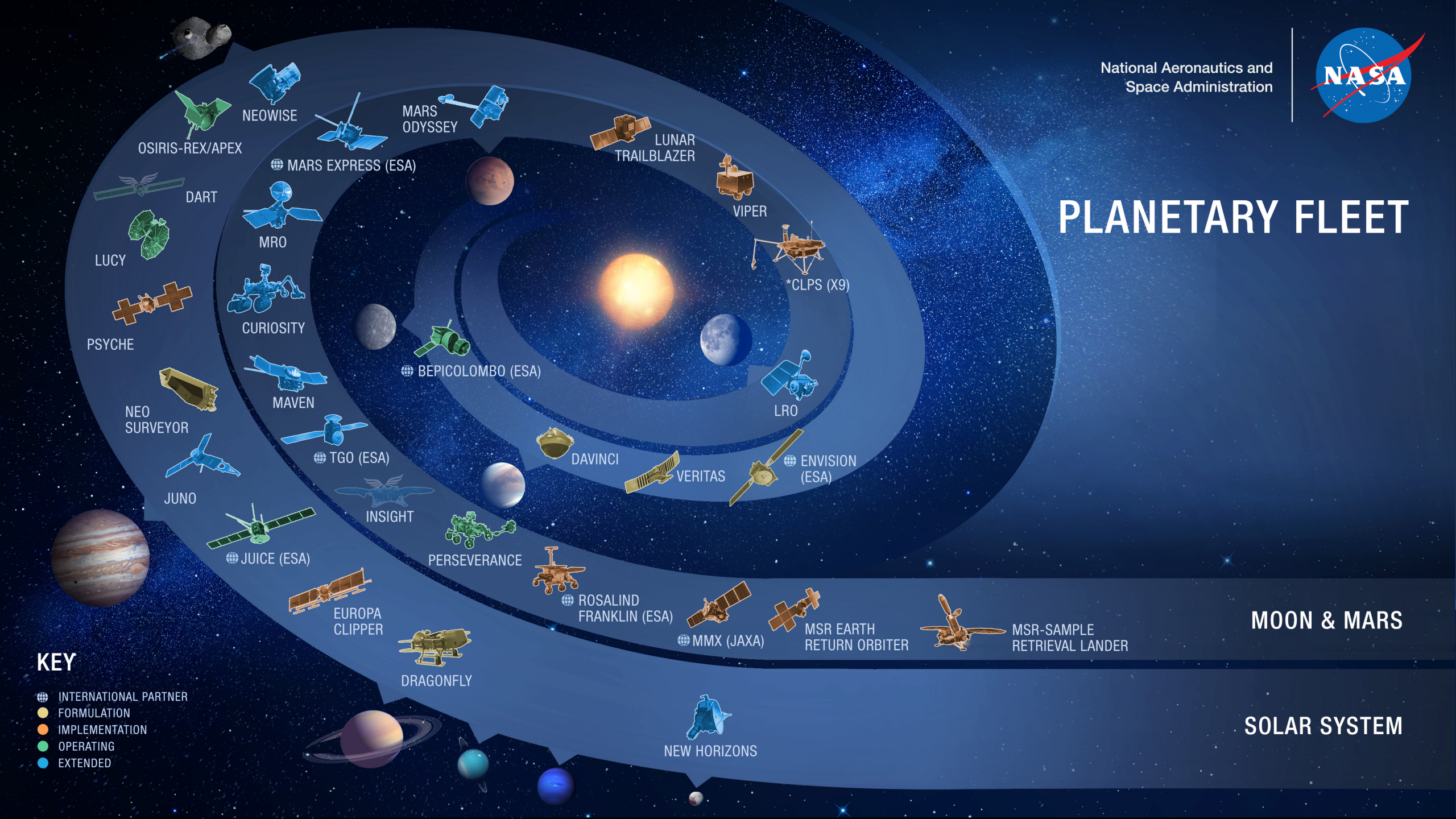
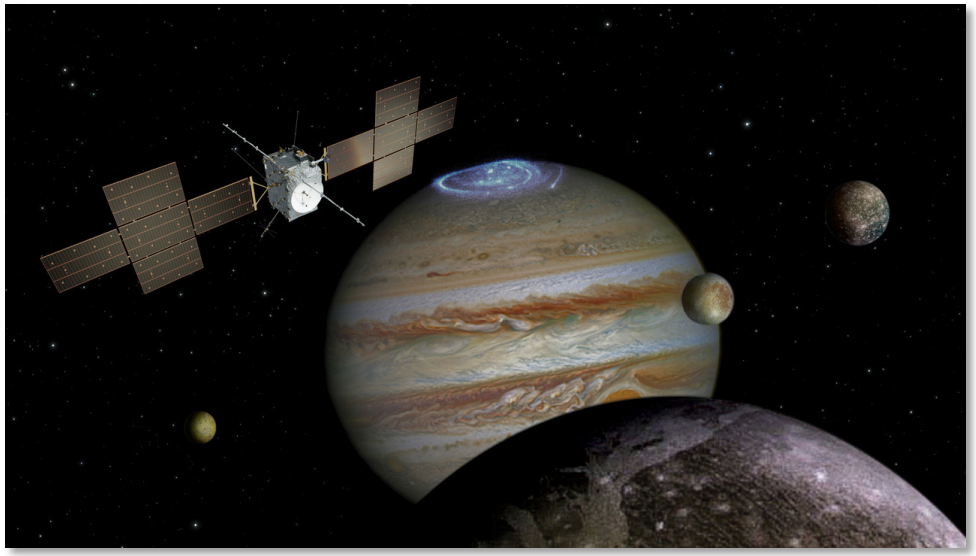

National Aeronautics and
Space Administration
NASA
EXPLORE
SCIENCE
Lori S. Glaze, Ph.D.,
NASA Planetary Science Division Director
PAC
June 21, 2023


National Aeronautics and Space Administration
NASA
PLANETARY FLEET
NEOWISE
OSIRIS-REX/APEX
MARS ODYSSEY
MARS EXPRESS (ESA)
LUNAR TRAILBLAZER
VIPER
DART
MRO
LUCY
*CLPS (X9)
CURIOSITY
PSYCHE
BEPICOLOMBO (ESA)
LRO
MAVEN
NEO SURVEYOR
TGO (ESA)
DAVINCI
VERITAS
ENVISION (ESA)
JUNO
INSIGHT
JUICE (ESA)
PERSEVERANCE
ROSALIND FRANKLIN (ESA)
EUROPA CLIPPER
MMX (JAXA)
MSR EARTH RETURN ORBITER
MSR-SAMPLE RETRIEVAL LANDER
MOON & MARS
DRAGONFLY
NEW HORIZONS
SOLAR SYSTEM
KEY
INTERNATIONAL PARTNER
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED

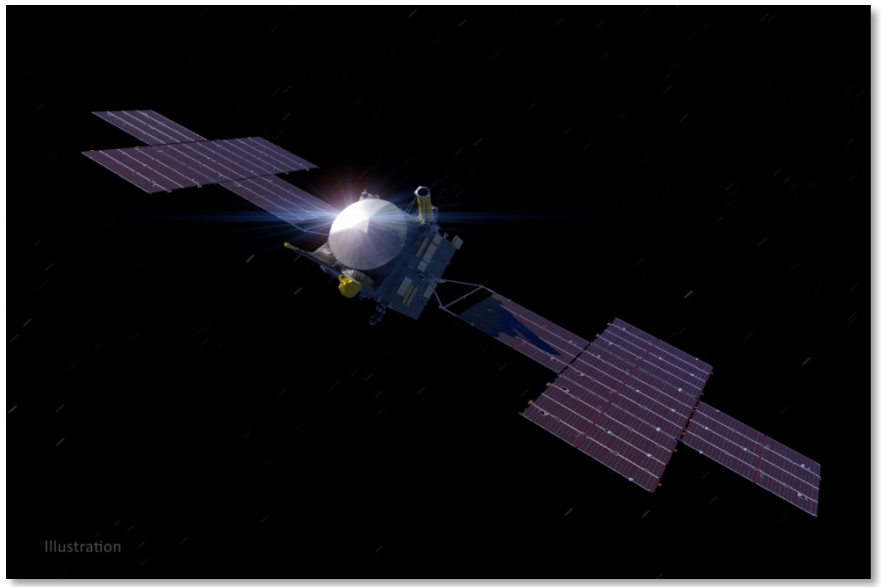
Mission updates

JUICE Launched!



Psyche

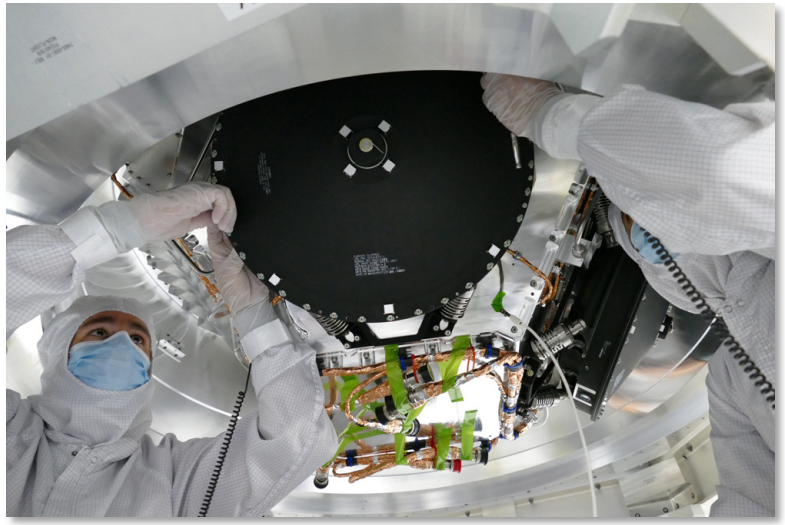
- Launch period: **October 5–25, 2023**
  - Arrives at Psyche August 2029
- ATLO 2.0 began June 6, 2023!
- JPL working closely with project to maintain level of experienced staff to complete remaining work prior to launch
- Status DPMC held February 2023: Phase-E cost profile approved
- IRB out brief DPMC held May 30, 2023
  - Final report media briefing held June 5, 2023
- KDP-E scheduled for September 14, 2023



Europa Clipper

- ATLO is continuing: live feed from High Bay
- Message in a Bottle campaign launched
  - New poem from U.S. Poet Laureate will be inscribed on chip on spacecraft
  - Send your name: go.nasa.gov/MessageInABottle
- Nine of ten instruments have been delivered:
  - MISE on track for delivery in July
  - REASON antennae and ECM boom not yet delivered, but electronics are
  - Most instruments are installed in the spacecraft
- Spacecraft stacked into final flight configuration week of June 12
- Target launch: October 2024
- Jupiter Orbit Insertion: April 2030

Message in a bottle campaign



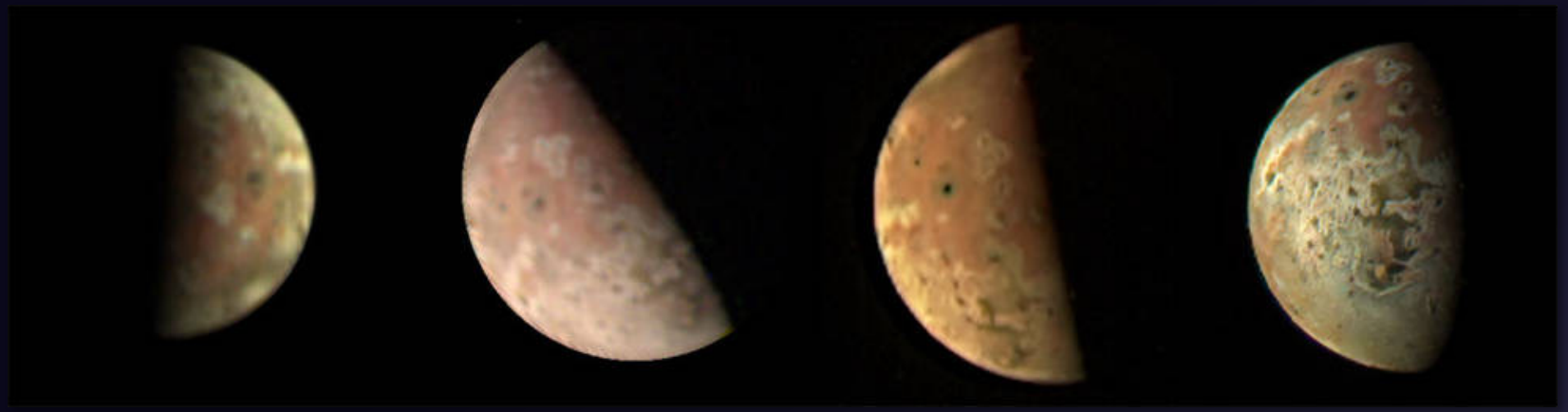
Installation of 2-ft-wide reaction wheels on main body of spacecraft

NEO Surveyor

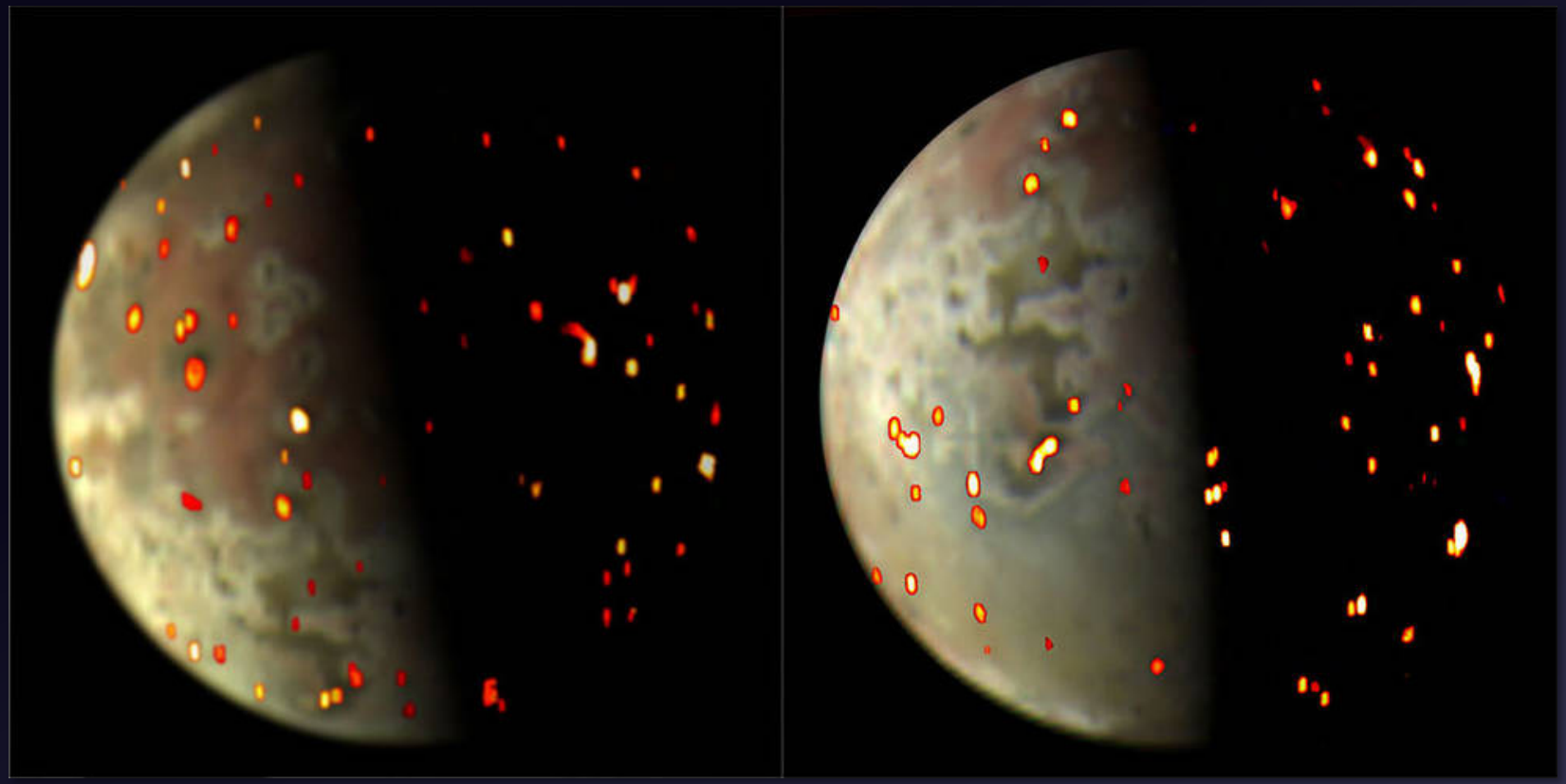
- Successfully passed KDP-C, November 2022
- Instrument subsystem-level Critical Design Reviews started in 2023
- On track to launch no later than June 2028

Juno

50th Jupiter orbit completed April 2023!



Composite image of Io, generated using data from JunoCam during four flybys of the moon.



Composite views of volcanic activity on Io, generated from visible light and infrared data obtained during December 2022 and March 2023 flybys.

Io Flybys

- May 2023: altitude of ~22,000 miles
- Upcoming Io flybys will bring spacecraft to within 1,500 km of surface
  - July and October 2023
  - December and February 2024

So Much Moon!

- LRO
- ShadowCam/KPLO
- VIPER
- CLPS/PRISM
- Artemis
  - Artemis II Astronaut training conducted
  - Geology team proposals received
  - Artemis III Payloads solicitation released (coming soon for Artemis IV)
  - LTV instruments draft solicitation coming soon
  - Landing site science community workshop conducted
  - JETT-5 Artemis III analog science team selected through Analog Activities solicitation
  - Artemis III and IV Project Scientists named
- ANGSA 2.0 and SSERVI CAN4 selections made
- Joint PSD/ESSIO team develop new lunar science strategy

Mars2020

Perseverance and Ingenuity on Sol 815

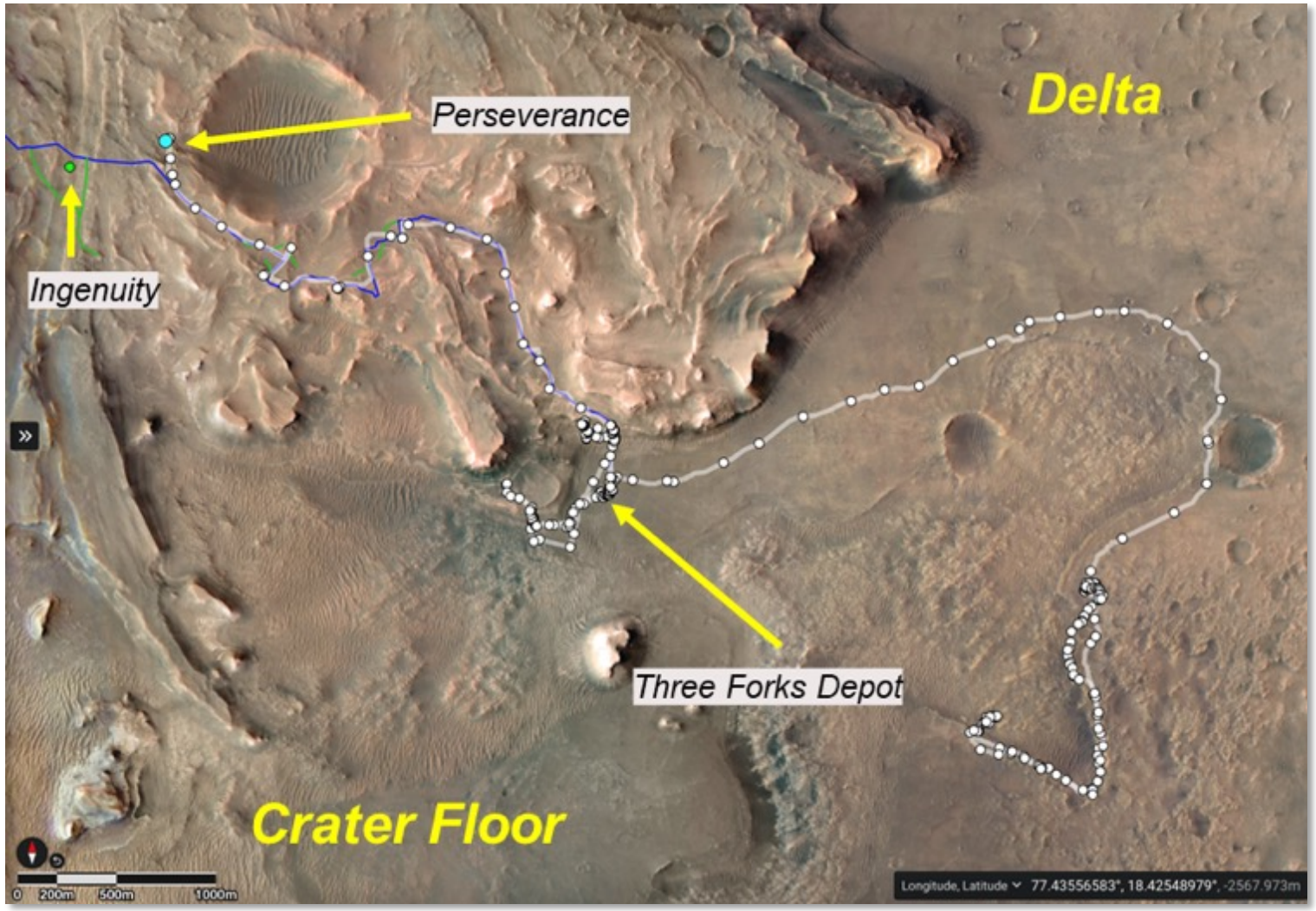
- Rover has traveled >19 km
- Ingenuity: completed 51 flights *(initial look at flight 52: successful)*

Samples collected to date (22 of 43 tubes)

- 14 paired rock core samples
  - 8 during Crater Floor Campaign
  - 6 during Delta Front Campaign
- 2 single samples
  - 1 during Crater Floor Campaign
  - 1 during Upper Fan Campaign *(second Upper Fan sample on the way)*
- 2 regolith samples
- 1 atmospheric sample
- 3 witness blank samples

Samples cached at Three Forks

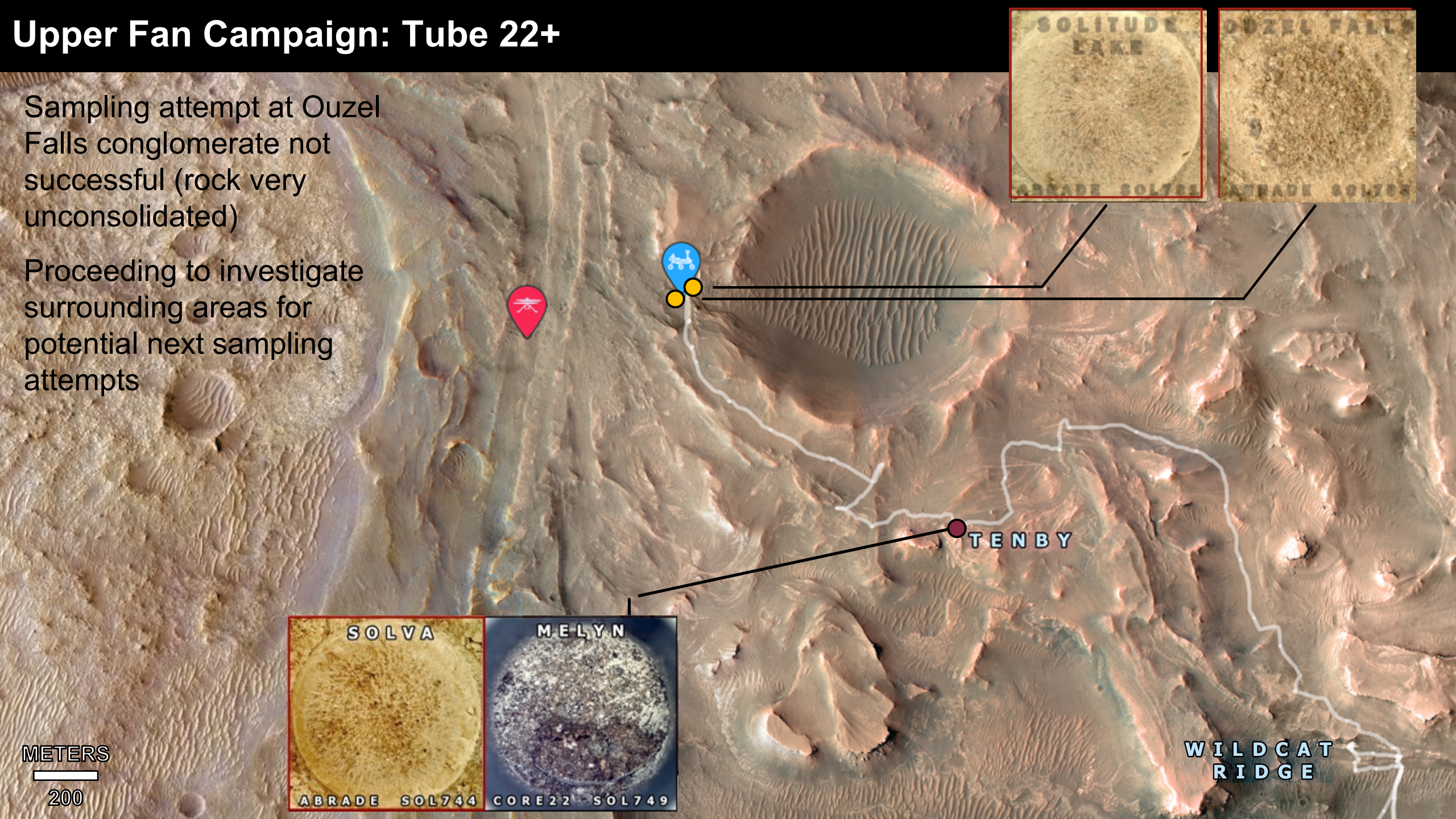
- 10 tubes
  - 7 rock cores (4 igneous, 3 sedimentary)
  - 1 regolith sample
  - 1 atmospheric sample
  - 1 witness blank sample



Upper Fan Campaign: Tube 22+

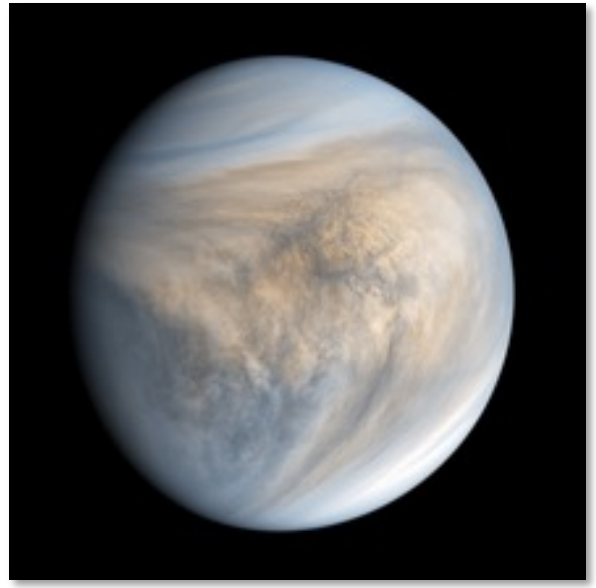
Sampling attempt at Ouzel Falls conglomerate not successful (rock very unconsolidated)

Proceeding to investigate surrounding areas for potential next sampling attempts



Venus Science Coordination Group (VeSCoor)

Membership selections have been made for the newly established joint NASA/ESA committee for identification of synergistic scientific approaches and outcomes for the Venus mission



NASA Selections	ESA Selections
David Grinspoon, PSI (Co-Chair)	**Lucia Marinangeli, Universita G. d'Annunzio (Co-Chair)**
Tatiana Bocanegra-Bahamon, JPL	Giulia Alemanno, DLR
Larry Esposito, U. Colorado, Boulder	Yoshifumi Futaana, Swedish Institute of Space Physics
Patrick McGovern, LPI	James Holmes, Open University
Joseph O'Rourke, ASU	Arianna Piccialli, BIRA-IASB
Jason Rabinovitch, Stevens Institute of Technology	Iván López Ruiz-Labranderas, Universidad Rey Juan Carlos

Planetary Data Ecosystem

Continuing work addressing PDE IRB recommendations

- Dr. Robin Fergason has recently joined the NASA team as the Planetary Data Officer
- Additional PDE updates will be provided at the Fall PAC meeting

Robin Fergason, new NASA Planetary Data Officer

PSD Early Career Award 2022 Winners!

Michael Sori (Purdue)
Enabling the future of planetary geodesy

Jamie Molaro (Planetary Science Institute)
Efficacy of thermally driven regolith creep on lunar, martian, and asteroid surfaces

David Welch (Columbia University)
Development of an inexpensive UV spectrometer for science education

Xinting Yu (University of Texas, San Antonio)
The next-generation laboratory experiments on planetary materials

Lynnae Quick (GSFC)
An HBCU pilot program to diversify the planetary science pipeline

Here to Observe (H2O)

- Second year of program with two MSI/Mission pairings: **University of Puerto Rico/Europa Clipper** and **Virginia State University/Dragonfly**
- **C.24 Here to Observe Program** solicitation released in ROSES-23

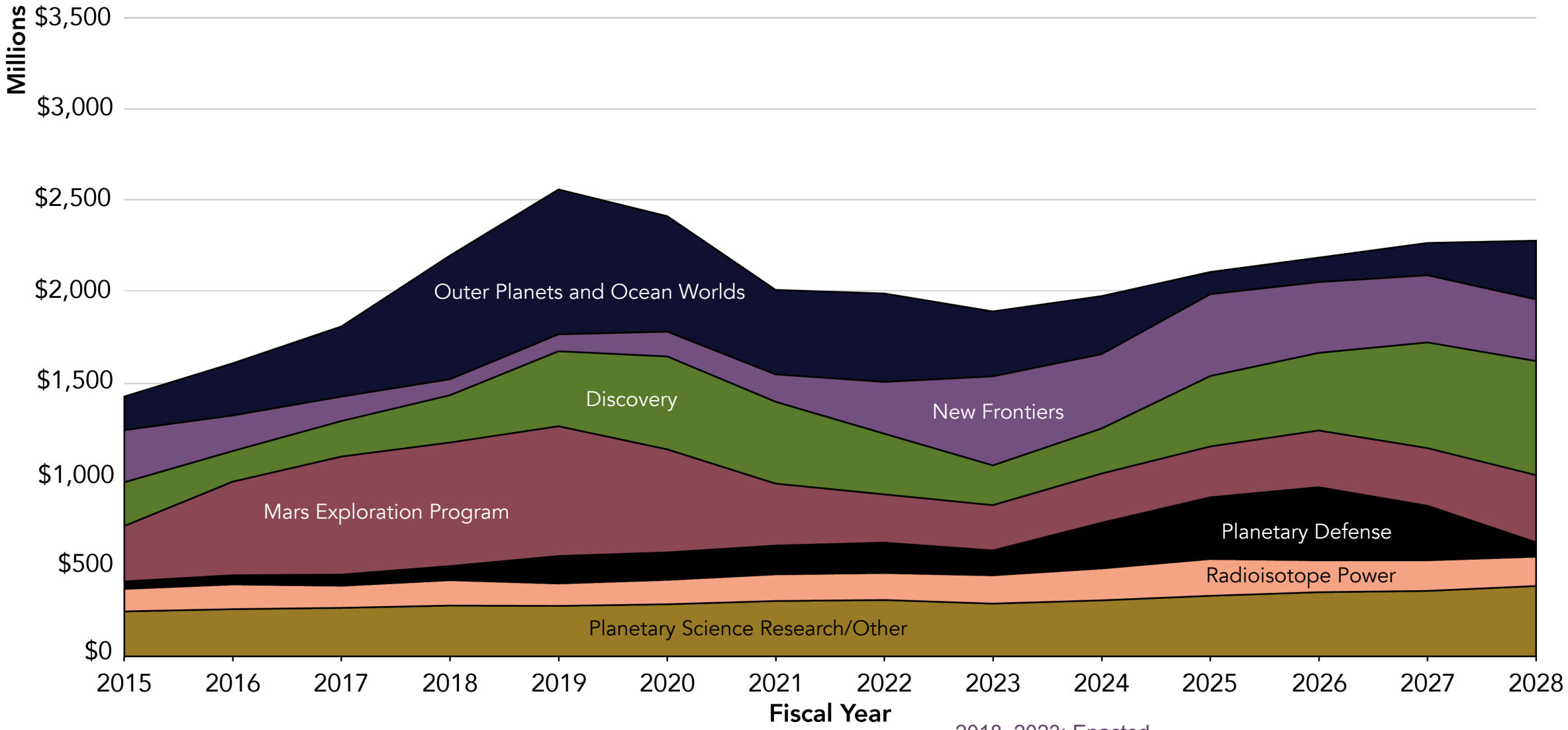
UPR students with NASA PSD at Space Grant Meeting, San Juan, October 2022

VSU students visit NASA Wallops, April 2023

VSU students visit JHUAPL, April 2022

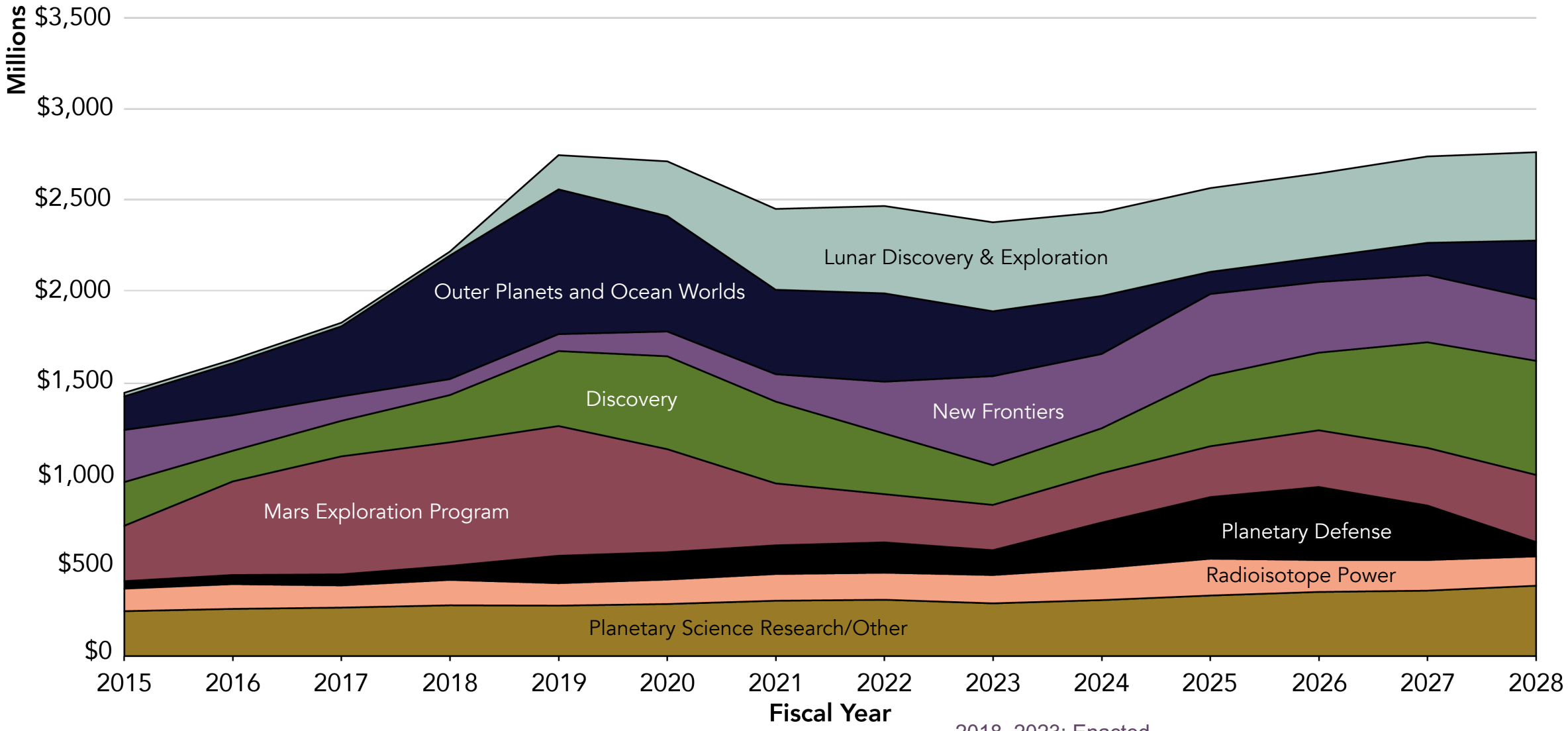
Challenges

PSD Budget 2015–2028 (data in backup)



2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

PSD Budget 2015–2028 (data in backup)



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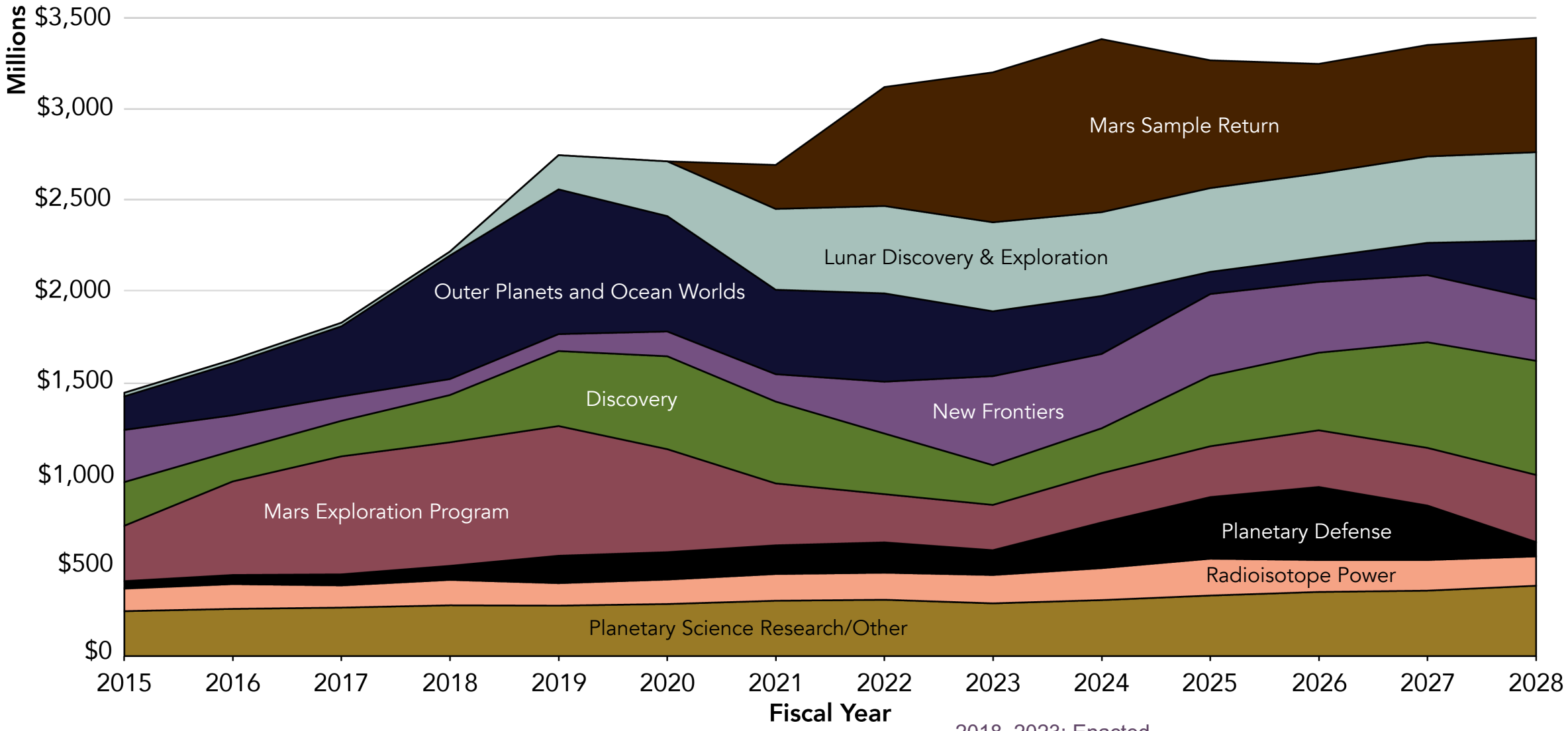
PSD Budget 2015–2028 (data in backup)



2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Specific Challenges

Mars Sample Return

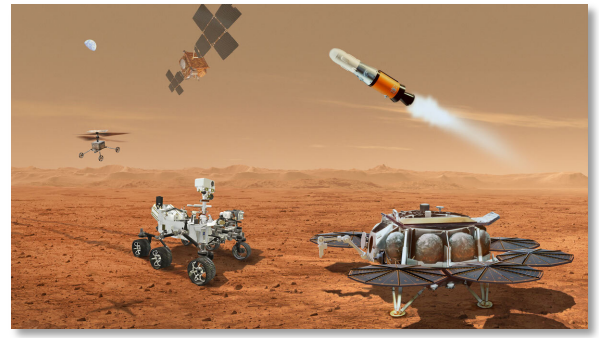
- Additional funds (‘upper’) proposed for FY24, but not yet for FY25 and beyond
- Path to confirmation
- Backwards planetary protection
- Sample Receiving Project

Dragonfly

- Preliminary design and technology maturation are complete
  - Successfully passed all technical requirements for mission PDR in March 2023
- Ongoing detailed design activities and preparation for NASA confirmation review later this year

VERITAS

- Working through the budget process to incorporate the mission delay (of no less than three years)



Future Mission AOs

New Frontiers

- AO release will be delayed beyond November 2023
  - In part owing to uncertainty around the impacts of the Debt Ceiling deal
  - A Community Announcement released this summer will provide more details

Discovery/SIMPLEx

- A delay to the next Discovery and SIMPLEx AOs is likely

New Horizons

PSD, HPD, and APD are coordinating on the future of New Horizons

- HPD received sufficient input from RFI responses to inform the budget planning process for FY25 and beyond
- HPD will determine the timeline and future steps for the possibility of spacecraft operations through HPD
- If HPD is unable to support New Horizons in FY25, spacecraft may be placed in hibernation mode
- PSD continues to support observations of the Kuiper Belt that could influence future activities, through the Solar System Observations R&A program

Looking forward

Commercial Lunar Payload Services (CLPS)

Astrobotic Peregrine Mission 1

Launch date awaiting ULA/Vulcan-Centaur

7 NASA Payloads from 5 Centers

Astrobotic will deliver VIPER in 2024

Intuitive Machines Nova-C

Launching Q3 2023

5 NASA Payloads from 3 Centers

6 Non-NASA payloads

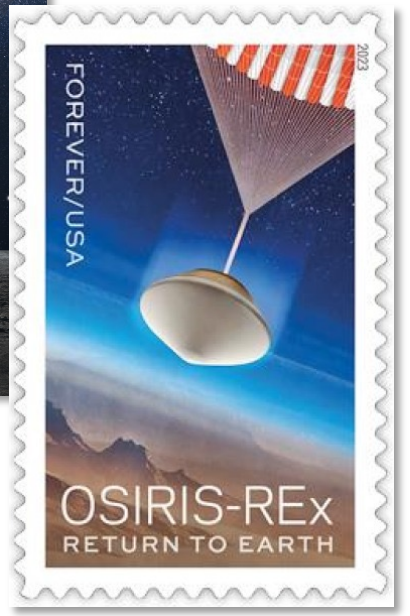
Intuitive Machines PRIME-1

Launching November 2023

Lunar Trailblazer (SIMPLEx) rideshare

OSIRIS-REx

- Sample capsule lands **10:55 am EDT, September 24, 2023**, at the Utah Test and Training Range (UTTR)
- Estimate **~250 grams** (±100 g) of material was collected
- Capsule will be retrieved by helicopter and taken to a UTTR pop-up clean room for a preliminary checkout
  - Capsule and contents will be flown to JSC on September 25, 2023
- Once samples are delivered, **OSIRIS-APEX** mission will begin, while OSIRIS-REx sample analysis campaign begins
- New USPS stamp will be released to honor OSIRIS-REx



Findings

Finding 1: Follow-up on VERITAS delay (1/2)

Finding: The PAC re-affirms their support for the VERITAS mission (see December 2022 PAC Finding 2) and efforts that aim to enable a VERITAS engineering development restart in 2025 and launch in 2031 (or sooner, should the situation allow). The PAC acknowledges that PSD leadership described, at the Feb 2023 and the Dec 2022 PAC meetings, specific requirements for the approval of new mission starts managed by JPL. The PAC acknowledges and shares community concern/confusion about how these metrics will be evaluated and applied to the approval/selection of new mission starts managed by JPL, and to the restart of VERITAS.

Recommendation: To maintain community confidence and transparency, the PAC recommends that PSD leadership continue to publicly share the specific metrics required for the approval of new mission efforts managed by JPL, and for the restart of VERITAS. Additionally, the PAC recommends that any requirements/circumstances that may lead to changes to these metrics also be shared clearly and promptly in a public forum. As a means of clarifying circumstances that may impact JPL readiness evaluations, the PAC also recommends that PSD publicly document if there is any relationship between requests for budget updates and the metrics that must be met by JPL in order for them to be approved to manage a new mission effort. In particular, the PAC requests updates on the PSD plan at (1) the Summer 2023 PAC meeting, following the interim Psyche IRB assessment, and (2) at the Spring 2024 PAC meeting, following the full Psyche IRB assessment and NASA budget updates.

Finding 1: Follow-up on VERITAS delay (2/2)

Response: As shared during the previous PAC meeting (February 28/March 1, 2023), there are three criteria that must be met before the VERITAS mission will be restarted: (1) JPL must successfully address matters arising from the Psyche IRB report; (2) PSD must secure funding in the appropriate years; and (3) NISAR and Europa Clipper missions must stay on schedule for their respective launches. An update on the mission status was provided earlier in this presentation and NASA will continue to update the PAC on the progress towards restarting the VERITAS mission. The current budget planning cycle (for FY25 and beyond) provides the opportunity to lay in a re-start plan for VERITAS. SMD is requesting a budget profile for VERITAS that targets a launch no earlier than 2031.

In addition, SMD's response to the Psyche IRB's final Implementation Assessment was published on June 5, 2023 (available online with NASA's Response). That assessment indicates, and NASA concurs, that the response to all JPL institution findings and recommendations are appropriate and exceed the board's expectations. JPL Director, Dr Laurie Leshin, will provide a summary of JPL's response to the IRB findings on day 3 of this PAC meeting. Further, NASA acknowledges that one finding received an "inadequate" rating in the final IRB assessment, relating to Standing Review Board (SRB) changes. The NASA response to this finding is ongoing and we note that it relates to the agency as a whole rather than SMD or PSD.

Finding 2: NASA Center Workforce Health

Finding: The PAC recognizes that the success and future health of the planetary science community hinges upon the health of the workforce. The Psyche IRB report pointed out insufficiencies in staffing, necessary expertise, and communication and psychological safety related to one Federally Funded R&D Center (FFRDC) and likely relevant to other major institutions involved in planetary missions. Such issues have been demonstrated to have far-reaching, negative ramifications for NASA goals and missions. The PAC has heard about ongoing assessments of planetary missions and involved major institutions, and that there are plans for future assessments of additional major institutions involved in PSD missions.

Recommendation: The PAC requests to hear the results of the ongoing and future assessments of workforce health at major institutions involved in PSD missions at a future PAC meeting. The PAC recommends the involvement of the SMD-operated Inclusivity, Diversity, Equity, and Accessibility (IDEA) group (https://science.nasa.gov/about-us/idea) in these assessments to ensure that IDEA concerns are part of that conversation and the assessors have access to the expertise provided by that group, including their outside contractors.

Response: NASA concurs that the success of PSD depends on the health of the planetary science community and would value additional conversation with the PAC on the intent of this finding/recommendation. For now, we note an external-facing SMD website (https://science.nasa.gov/about-us/science-workforce-initiatives) that provides information on a study commissioned by SMD in 2020 to develop workforce strategies targeted towards the broad science community. The final report, from February 2021 is available, along with details on several workforce initiatives that resulted from the study. This study focused on the science workforce at NASA Centers and major partners (APL and JPL) and is therefore likely the broadest workforce study in all of NASA to date. NASA acknowledges, however, that it was focused only on the science workforce and thus did not include other integral members of the planetary exploration community (e.g., engineers, program/project managers, administrative support personnel, etc). Laurie Leshin, JPL Director, will provide a summary of the JPL IRB response on day 3 of this PAC meeting, which will include topics related to the JPL workforce.

Finding 3: Large Mission Progress and Risks

Finding: As PSD and JPL work to support ongoing missions before new mission starts, the PAC is concerned about the potential of programs at the scale of Mars Sample Return (MSR) to affect the delay of VERITAS and other new mission selections. While the PAC is encouraged with the recent reports on MSR development and upcoming reviews, a general concern remains about potential MSR development delays and their impact on PSD planning.

Recommendation: The PAC requests to hear about potential risks identified at key reviews for ongoing NASA directed and flagship missions if those risks appear likely to lead to cost/schedule overruns that would impact PSD/SMD decisions about other ongoing missions or future opportunities. In particular, the PAC requests continued reports on the MSR development, including any major risks identified at the upcoming KDP-C if those risks may impact other missions' development.

Response: The MSR Program is developing the cost and schedule estimates based on flight element preliminary design activities during Phase B prior to an agency confirmation decision (KDP-C), which is expected to occur later this fall. In addition to NASA's internal formulation process that provides for multiple independent lifecycle reviews of project designs and performance, SMD has commissioned a second Independent Review Board (IRB) to review program risks, cost, and schedule prior to the system-level Preliminary Design Review (PDR) and Confirmation, at which point program cost and schedule commitments are established. Additional information related to program status and risk posture will continue to be included in the MSR Program updates to the PAC.

Finding 4: Astrobiology Research Coordination Networks (RCNs)

Finding: The PAC commends and appreciates the positive work done by the Astrobiology Research Coordination Networks (RCNs) towards community engagement, early career involvement, and diversity, equity, and inclusion (DEI). The inclusive group formats highlighted by the RCNs (e.g., as reported by NFOLD and PCE3: the think tank, social hour, and early career seminar series) are capturing the attention of the community and target audiences very successfully. Clear topical connections were recognized by the PAC between the work by these RCNs, community Assessment/Analysis Groups (AGs), and NASA groups working on planetary samples.

Recommendation: As many clear similarities and overlap in research interests exist between RCNs and AGs and NASA groups working on samples, particularly with relevance to ongoing and upcoming astrobiology-focused missions, it would be beneficial for PSD to more fully explore formal, intentional and strategic avenues to share information in order to leverage advantages and avoid duplicating efforts. The PAC recommends that relevant programs in PSD explore options to leverage the clear organizational and community-driven advantages that the RCNs provide, and that PSD clearly delineate the roles, responsibilities, and activities of the RCNs. It's possible that some of these connections and definitions are already in place, and the PAC would be interested in hearing about specific examples in future presentations.

Response: This is a timely recommendation, as we have recently completed the review of the NExSS RCN (slide in the R&A presentation). PSD concurs that the RCNs have been an effective tool for the development of the astrobiology community, and that there are potential benefits from exploring a similar model for other segments of the planetary science community. As we digest the NExSS report, we will also explore how we might implement RCNs more broadly. The roles, responsibilities, and activities of the RCNs have been described on several occasions and will be discussed as part of the astrobiology presentation at this PAC meeting.

Finding 5: IDEA Cross-AG Working Group Communication

Finding: The PAC recognizes the importance of the work done by the Inclusivity, Diversity, Equity, and Accessibility (IDEA) Cross-AG Working Group, facilitated by the science community existing across the AGs and the greater planetary community. Thus, as stated in prior Findings (see March 2021 PAC Finding 7 and August 2020 PAC Finding 1), the PAC would like to receive regular updates from the IDEA Cross-AG Working Group about community concerns and their work to address such concerns.

Recommendation: The PAC recommends that PSD leadership converse with the AGs and the IDEA Cross-AG Working Group to (1) determine the types of inputs PSD thinks would be useful additions to PAC meetings and (2) for PSD to hear from the AGs and the IDEA Cross-AG Working Group on the IDEA Cross-AG Working Group's scope and goals. From this conversation, PSD should create a clear pathway for the IDEA Cross-AG Working Group to share relevant information with the PAC, clarifying if such updates/communications would generally come through the AG reports and/or via direct reports (e.g., when covering a broad-reaching topic). In either case, adequate presentation and discussion time for the community's IDEA topics/concerns should be included in each PAC meeting agenda.

Response: PSD thanks the PAC for this recommendation and recognizes the importance of the work done by the IDEA Cross-AG Working Group (CAWG). PSD is committed to IDEA and, with one exception (November 2020), has included an IDEA-related topic on the agenda of each PAC meeting since August 2020. To ensure the IDEA CAWG has a direct line of communication to PSD leadership, PSD has provided the IDEA CAWG with two NASA Headquarters liaisons. PSD welcomes a presentation from the IDEA CAWG at one PAC meeting per year (i.e., the second PAC meeting of each year) to share relevant information with the PAC. In addition, given the limited time availability on the PAC agendas, and the underlying principle that the IDEA CAWG is representative of the greater planetary science community, the IDEA CAWG has also been encouraged to share their findings and recommendations with the AGs they represent throughout the year—for the AGs to bring forward to the PAC. Furthermore, given the importance of the work done by the IDEA CAWG, PSD encourages the AGs to develop open communication mechanisms between their AG and the IDEA CAWG, have at least one member of their steering committee represent their AG as a member of the IDEA CAWG steering committee, and dedicate time in their AG meetings for IDEA-related discussions.

Finding 6: Planetary Radar Data

Finding: The Arecibo Observatory is currently scheduled to end science operations in April 2023 with discontinued access for the scientific staff after mid-August 2023. To ensure continued usability of the Arecibo radar data, processing software and systems need to be preserved along with the data. It is presently unclear to the community if the end-of-operations plan includes retaining Arecibo planetary radar data processing software and systems in addition to the radar data archive, and which agency (NSF or NASA) is responsible for such work.

Recommendation: The PAC requests to hear, at the Summer 2023 PAC meeting, the end-of-operations plan for retaining Arecibo planetary radar data processing software and systems, including identification of the appropriate organization for hosting them and the agency responsible for supporting the endeavor.

Response: NASA's Planetary Data System Small Bodies Node (SBN) is in the process of capturing the Arecibo radar data and software copy hosted by Arecibo radar team members at the University of Arizona. The SBN will deliver those data and software as a pre-archive backup to the NASA Space Science Data Coordinated Archive for preservation. The Arecibo radar team continues formal PDS archiving of the radar data products with the SBN and the software on a publicly accessible software archive. NSF has communicated to NASA that the Arecibo radar data and software copy at the Texas Advancing Computing Center will be kept for the foreseeable future, while NASA completes its preservation and formal archiving process.


EXPLORE
With Us

PSD Budget 2015–2028

2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Program (in Millions)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Planetary Science	*$1,444*	*$1,626*	*$1,828*	*$2,218*	*$2,747*	*$2,713*	*$2,693*	*$3,120*	*$3,200*	*$3,383*	*$3,266*	*$3,246*	*$3.351*	*$3,390*
Mars Sample Return	-	-	-	-	-	-	**$241.6**	**$653.2**	**$822.3**	**$949.3**	**$700.0**	**$600.0**	**$612.1**	**$627.6**
Mars Sample Return	-	-	-	-	-	-	$241.6	$653.2	$822.3	$949.3	$700.0	$600.0	$612.1	$627.6
Lunar Discovery & Exploration	**$19.9**	**$19.0**	**$19.0**	**$22.0**	**$188.0**	**$300.0**	**$443.5**	**$478.8**	**$486.2**	**$458.5**	**$459.0**	**$460.5**	**$472.0**	**$483.3**
VIPER	-	-	-	-	$39.7	$54.9	$99.1	$112.2	$97.2	$61.3	$33.0	-	-	-
Lunar Instruments	-	-	-	$2.0	$55.2	$34.1	$17.1	$23.6	$21.3	$24.3	$57.3	$80.3	$83.8	$85.0
CLPS	-	-	-	-	$69.1	$184.6	$233.4	$244.3	$242.3	$223.5	$224.1	$254.4	$254.5	$259.5
Lunar Int'l Mission Collaborations	-	-	-	-	$0.2	<$0.0	$0.7	$0.0	$0.1	$2.4	$0.5	$0.5	$0.5	$0.5
Lunar Trailblazer	-	-	-	-	-	-	$23.2	$22.8	$11.2	$4.3	$2.4	-	-	-
PRISM-1	-	-	-	-	-	-	$21.0	$26.5	$23.0	$9.1	-	-	-	-
DALI	-	-	-	-	-	-	$20.5	$13.2	$14.5	$10.0	$20.0	$15.0	$15.0	$15.3
PRISM-2	-	-	-	-	-	-	-	<$0.0	$25.3	$20.4	$6.2	$5.8	-	-
PRISM-3	-	-	-	-	-	-	-	-	-	$25.0	$30.0	$5.0	-	-
Artemis Instruments	-	-	-	-	-	-	-	-	$12.0	$30.5	$31.3	$29.5	$31.0	$33.0
Lunar Future	-	-	-	-	$1.8	$4.3	$2.8	$0.9	$5.0	$3.9	$4.8	$19.7	$36.6	$37.9
LRO	$19.9	$19.0	$19.0	$20.0	$22.0	$22.0	$22.2	$22.1	$22.1	$22.1	$22.1	$22.1	$22.1	$22.2
Lunar Management	-	-	-	-	-	-	$3.5	$10.9	$5.5	$5.2	$5.4	$5.5	$5.7	$5.6
Lunar Science	-	-	-	-	-	-	-	$2.2	$6.7	$16.3	$21.7	$22.5	$22.8	$24.3

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2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Program (in Millions)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Outer Planets & Ocean Worlds	**$183.9**	**$285.8**	**$384.5**	**$676.2**	**$793.6**	**$632.0**	**$461.5**	**$484.3**	**$356.8**	**$318.4**	**$121.3**	**$134.8**	**$178.3**	**$321.9**
Cassini	$68.1	$58.8	$54.1	$19.2	$3.9	-	-	-	-	-	-	-	-	-
JUICE	$7.3	$18.7	$22.9	$18.5	$15.6	$18.2	$4.4	$0.6	$1.7	$2.4	$2.2	$2.8	$2.8	$2.9
Europa Clipper	$100.0	$149.4	$237.4	$525.0	$545.0	$592.6	$434.8	$472.1	$345.0	$303.3	$100.7	$80.6	$77.7	$84.0
Europa Lander	-	$25.6	$37.6	$70.0	$187.4	-	-	-	-	-	-	-	-	-
Icy Satellites Surface Technology	-	$24.9	$25.0	$35.0	$35.0	$14.2	$14.2	$3.2	-	-	-	-	-	-
Planetary Decadal Future	-	-	-	-	-	-	-	-	-	-	$3.0	$36.0	$82.4	$219.4
Outer Planets Research	$8.4	$8.5	$7.5	$8.5	$6.7	$7.0	$8.1	$8.5	$10.1	$12.7	$15.4	$15.4	$15.4	$15.5
New Frontiers	**$285.8**	**$194.0**	**$134.0**	**$88.1**	**$93.0**	**$136.8**	**$150.9**	**$283.7**	**$488.2**	**$407.5**	**$447.8**	**$386.1**	**$367.2**	**$337.5**
New Horizons	$28.8	$21.5	$29.4	$12.0	12.7	$17.3	$12.5	$9.5	$10.4	$9.7	-	-	-	-
Juno	$35.4	$45.8	$61.9	$17.8	$11.8	$33.8	$35.0	$31.8	$30.5	$28.4	$26.2	$8.1	-	-
OSIRIS-REx	$209.8	$124.7	$39.5	$42.8	$50.3	$37.1	$10.4	$12.5	$30.7	$16.8	$5.4	-	-	-
Dragonfly	-	-	-	-	$8.0	$41.0	$86.0	$219.1	$400.1	$327.7	$355.5	$274.8	$207.7	$24.8
Apophis Explorer	-	-	-	-	-	-	-	-	$5.0	$14.5	$15.8	$19.9	$22.1	$31.0
New Frontiers Future Missions	$11.9	$2.0	$1.6	$13.4	$2.3	$1.7	$2.2	$0.5	$0.9	$0.0	$35.6	$74.0	$128.0	$272.0
New Frontiers Research	-	-	$1.6	$2.1	$7.9	$5.9	$4.9	$10.4	$10.5	$10.5	$9.3	$9.4	$9.5	$9.7

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2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Program (in Millions)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Discovery	**$239.0**	**$169.1**	**$194.6**	**$258.3**	**$409.5**	**$508.7**	**$447.7**	**$331.8**	**$217.5**	**$247.5**	**$386.4**	**$426.0**	**$579.2**	**$625.9**
Dawn	$17.2	$22.2	$1.0	$11.1	$0.2	-	-	-	-	-	-	-	-	-
DAVINCI	-	-	-	-	-	-	$4.1	$12.4	$20.2	$55.8	$173.0	$201.2	$268.7	$213.0
VERITAS	-	-	-	-	-	-	$6.5	$14.4	$9.5	$1.5	$1.5	$1.5	$1.5	$1.5
Psyche	-	-	$47.3	$42.0	$174.2	$214.0	$175.6	$163.8	$109.3	$57.7	$34.5	$34.5	$37.1	$15.4
MEGANE	-	-	-	$0.7	$3.9	$8.1	$12.2	$2.9	$4.3	$4.1	$3.8	$4.2	$1.6	$1.7
Planetary SmallSats	-	-	-	-	$4.4	$15.6	$4.8	$1.6	$1.3	$0.1	$7.5	$31.4	$40.0	$6.1
Venus Technology	-	-	-	-	-	-	$4.9	$6.6	$6.0	$7.0	$3.2	$1.7	$1.0	$1.0
Janus	-	-	-	-	-	-	$23.7	$16.3	$1.2	-	-	-	-	-
EnVision	-	-	-	-	-	-	$3.9	$17.8	$2.1	$33.1	$47.1	$43.9	$46.6	$28.7
Int'l Mission Contributions	$1.9	$2.9	$2.0	$2.2	$3.0	$9.4	$5.2	$8.5	$6.8	$6.8	$8.5	$10.3	$10.2	$8.6
Discovery Future	$24.9	$11.6	$33.9	$28.0	$13.9	$20.2	$22.3	$4.5	$5.0	$5.3	$28.3	$21.8	$82.4	$257.2
Strofio	$0.3	$1.6	$0.1	$0.6	$0.9	$1.3	$1.3	$1.0	$0.9	$1.0	$1.8	$1.2	$2.3	$2.4
InSight	$170.0	$91.9	$32.3	$74.3	$23.1	$13.6	$15.0	$11.4	<$0.0	-	-	-	-	-
Lucy	-	-	$54.5	$81.4	$165.5	$208.6	$139.9	$44.6	$18.9	$24.8	$25.9	$23.8	$34.8	$34.0
Planetary Management	-	$16.6	$12.1	$11.4	$12.9	$11.1	$21.6	$18.3	-	-	-	-	-	-
Discovery Research	$9.5	$15.8	$11.4	$6.7	$7.7	$6.9	$6.7	$7.8	$8.8	$9.2	$10.1	$12.1	$13.1	$13.4
Discovery Management	$7.6	-	-	-	-	-	-	-	$23.2	$41.2	$41.2	$38.5	$40.0	$43.0

PSD Budget 2015–2028

2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Program (in Millions)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Mars Exploration	**$304.6**	**$512.9**	**$647.0**	**$678.0**	**$712.7**	**$565.7**	**$339.5**	**$265.0**	**$248.1**	**$268.6**	**$279.2**	**$311.6**	**$315.3**	**$367.2**
MOMA	$24.5	$12.5	$12.1	$12.9	$6.9	$7.3	$5.3	$3.4	$1.7	$0.2	-	-	-	-
Mars Future Missions	-	$3.5	$20.0	$1.7	$31.5	$65.5	$23.3	$6.9	$9.6	$49.9	$68.5	$108.4	$118.8	$177.4
Mars Technology	$7.0	$23.0	$22.9	$3.7	$20.6	$3.7	$10.1	$9.1	$6.6	$3.0	$3.0	$3.0	$3.0	$3.0
Mars 2020	$103.6	$321.8	$408.0	$505.8	$502.6	$353.0	$155.0	$111.1	$$91.1	$85.0	$80.5	$82.0	$82.5	$83.0
TGO - ExoMars	$1.5	$1.3	$2.2	$1.9	$2.1	$1.9	$2.1	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0	$2.0
MSL	$63.4	$50.3	$56.2	$51.4	$51.1	$47.4	$48.9	$45.2	$45.0	$40.5	$35.0	$30.0	$25.0	$20.0
MRO	$27.9	$27.7	$28.0	$26.3	$26.0	$26.9	$28.3	$24.4	$25.7	$25.6	$25.4	$25.4	$25.4	$25.0
Mars Odyssey	$12.0	$9.7	$10.8	$11.3	$11.5	$11.7	$11.4	$10.6	$11.1	$11.0	$6.2	-	-	-
Mars Express	$2.5	$2.9	$3.0	$2.7	$3.1	$1.1	$0.3	<$0.0	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Mars Mission Operations	$1.5	$1.5	$1.9	$1.7	$1.9	$5.9	$6.8	$6.7	$5.5	$5.5	$5.5	$5.6	$5.4	$5.4
MAVEN	$13.8	$21.3	$20.5	$22.2	$17.9	$20.5	$21.0	$22.0	$23.0	$23.0	$24.0	$24.0	$24.0	$22.0
Mars Program Management	$23.4	$13.3	$24.2	$8.5	$11.8	$10.8	$12.7	$10.8	$11.8	$6.9	$13.2	$15.3	$13.3	$13.5
Mars Research & Analysis	$9.9	$9.9	$10.0	$10.0	$9.9	$9.9	$14.4	$12.7	$14.7	$15.7	$15.7	$15.7	$15.7	$15.7
Mars Rover 2023	$13.7	$14.2	$12.5	$12.5	$3.5	-	-	-	-	-	-	-	-	-
Aeroscience Ground Test	-	-	$14.6	$5.5	$12.5	-	-	-	-	-	-	-	-	-

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2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

Program (in Millions)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Planetary Defense	**$39.9**	**$49.9**	**$60.0**	**$76.0**	**$150.0**	**$150.0**	**$158.1**	**$166.0**	**$135.5**	**$250.7**	**$337.7**	**$400.5**	**$299.6**	**$79.0**
NEO Surveyor	-	-	-	-	-	-	$31.3	$110.0	$90.0	$209.7	$297.7	$358.5	$257.6	$39.0
DART	-	-	-	$41.0	$98.0	$72.4	$75.5	$13.8	$3.5	-	-	-	-	-
Near Earth Object Observations	$39.9	$49.9	$60.0	$35.0	$52.0	$77.6	$51.3	$42.2	$42.0	$41.0	$41.0	$42.0	$42.0	$40.0
Radioisotope Power	**$123.8**	**$134.8**	**$121.1**	**$139.8**	**$123.3**	**$133.5**	**$146.3**	**$148.6**	**$154.9**	**$175.5**	**$201.1**	**$174.6**	**$166.8**	**$160.9**
Radioisotope Power System	$25.2	$29.0	$32.4	$33.3	$38.8	$48.0	$58.2	$48.3	$63.7	$67.1	$78.4	$56.2	$39.6	$32.3
Advanced Technology	$6.2	$32.3	$13.2	$31.4	$1.5	-	-	-	-	-	-	-	-	-
Plutonium	$17.0	$17.7	$20.0	$16.0	-	-	-	-	-	-	-	-	-	-
DOE Operation & Analysis	$57.4	$55.8	$55.5	$59.1	$83.0	$85.5	$88.1	$90.3	$91.2	$108.4	$122.7	$118.5	$127.2	$128.6
Planetary Science Research / Other	**$247.4**	**$260.2**	**$267.3**	**$279.5**	**$276.6**	**$286.0**	**$304.1**	**$309.0**	**$290.6**	**$307.4**	**$333.3**	**$352.0**	**$360.2**	**$386.4**
Astromaterial Curation	$6.4	$8.5	$9.1	$9.5	$12.5	$11.2	$12.9	$16.0	$12.1	$12.4	$12.4	$14.0	$14.4	$14.2
Rosetta	$14.3	$12.4	$7.8	$5.4	$1.0	-	-	-	-	-	-	-	-	-
Robotics Alliance	$4.0	$4.3	$4.1	$4.1	$4.1	$4.0	$4.0	$4.0	$5.0	$4.0	$5.0	$5.0	$5.0	$5.1
Planetary Science R&A	$161.7	$162.4	$178.1	$197.9	$195.7	$209.8	$223.2	$221.3	$205.1	$224.6	$249.3	$261.5	$267.4	$290.3
Advanced Multi-Mission Operation System	$35.4	$37.0	$37.2	$39.9	$40.2	$39.2	$39.9	$40.5	$40.5	$38.0	$38.0	$38.0	$37.7	$38.2
Planetary Data System	$13.7	$15.0	$14.5	$16.8	$17.0	$19.2	$24.1	$27.3	$27.8	$28.4	$28.6	$33.5	$35.7	$38.6
Science Data &. Computing	$2.0	$2.3	$2.4	$2.5	$2.7	$2.6	-	-	-	-	-	-	-	-
PS Directed R&T	-	-	-	$3.4	$3.4	-	-	-	-	-	-	-	-	-