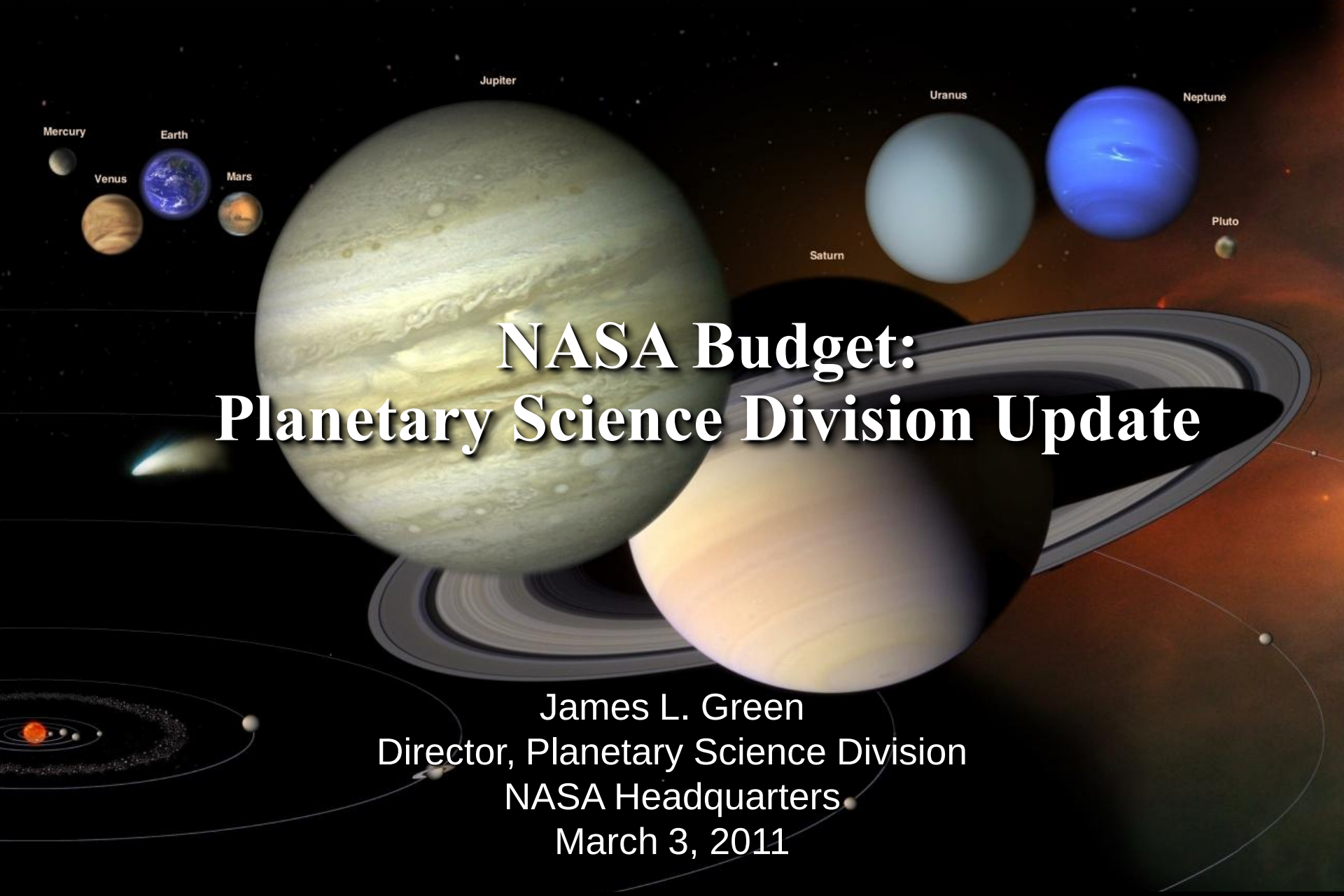


NASA Budget: Planetary Science Division Update

James L. Green
Director, Planetary Science Division
NASA Headquarters
March 3, 2011

Planetary Science Missions

Mission	Current LRD	Vehicle	FY11 CJ LRD	Change (months)	Phase
Cassini	Oct-97				Extended Operations
Stardust/NExT	Feb-99				Extended Operations
Mars Odyssey	Apr-01				Extended Operations
Mars Expl. Rovers	Jun-Jul 03				Extended Operations
MESSENGER	Aug-04				Prime Operations (Cruise)
Deep Impact/EPOXI	Jan-05				Extended Operations
Mars Recon Orbiter	Aug-05				Extended Operations
New Horizons	Jan-06				Prime Operations (Cruise)
Dawn	Sep-07				Prime Operations (Cruise)
Lunar Recon Orbiter	Jun-09				Prime Operations
Juno	Aug-11	Atlas V	same		Development
GRAIL	Sep-11	Delta II-H	same		Development
Mars Science Lab	Nov-11	Atlas V	same		Development
LADEE	Nov-13	Minotaur	Jan-13	+10 mos	Development
MAVEN	Oct-13	Atlas V	same		Development
Mars 2016/TGO	Jan-16	Intermediate	same		Formulation
Discovery 12	TBD	Intermediate	same		In Review
New Frontiers 3	TBD	Intermediate	same		In Review
Jup. Ganymede Orbiter	TBD	TBD		new	Pre-Formulation/ESA Partnership

Planetary Science
Major FY10 Accomplishments

- MSL, Juno and GRAIL all started Assembly, Test, and Launch Operations (ATLO)
- Successfully completed PDR for both LADEE and MAVEN
  - Both confirmed to proceed into implementation phase with LRDs of Nov 2013
- Selected five instruments (4-US, 1-European) in Aug ’10, to fly on the ESA/NASA ExoMars Trace Gas Orbiter 2016 mission
  - ESA completed ExoMars PDR in December ’10, and proceeded to implementation phase
- Completed Cassini Equinox Mission and began the Solstice Mission
- Spirit/Opportunity 7th anniversary in January ‘11, and the 50th anniversary of Astrobiology
- Released AO for the Discovery 12 mission – Proposals received Sept ‘10
- Supported JAXA Hayabusa asteroid sample return in June ‘10 including participating scientists (will receive 10% of the samples by mass)
- Comet encounters Hartley 2 November ’10, and Tempel 1 in February ’11
- Discovered a microbe that can grow utilizing As instead of P
- Concept studies completed and under review for New Frontiers 3
- Supported ESA Rosetta flyby of asteroid Lutetia Aug ‘10

Planetary Science Program/Budget Strategy

- Ensure successful launch of Juno, Grail, and MSL
- Ensure successful development to meet near-term launches:
  - LADEE launch in 2013
  - MAVEN launch in 2013
- Preserve near-term opportunities
  - NASA-ESA partnership commitment, and Mars 2016 TGO launch
  - New Frontiers-3 selection FY 2011 (LRD ~2016)
  - Discovery-12 selection FY 2011 (LRD ~2015)
- Restructure Planetary portfolio with Decadal Survey Report guidance
  - Current 5-program structure not sustainable due to out-year budget reductions
- Budgeted for higher launch vehicle costs due to NLS-II and 70% JCL
- Ensure specific technology programs can support expected future missions (ASRG, Instruments, and ISP)
- Actively manage projects' and grants' uncosted carryover and adjust budget as needed
- Cover 50% of Pu-238 Restart Budget

Planetary Science Program Content

	FY 2010	Pres Bud	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Planetary Science	**$1,364.4**	**$1,485.7**	**$1,488.9**	**$1,365.7**	**$1,326.4**	**$1,271.0**	**$1,188.9**
Planetary Science Research	*$161.6*	*$180.4*	*$183.9*	*$196.0*	*$208.6*	*$208.4*	*$210.5*
Planetary Science Research and Analysis	$131.5	$131.0	$134.6	$135.3	$140.0	$142.8	$149.8
Other Missions and Data Analysis	$21.3	$23.9	$23.7	$25.5	$31.7	$28.2	$23.0
Education and Directorate Management	$3.0	$5.1	$5.1	$14.7	$16.3	$16.7	$16.5
Near Earth Object Observations	$5.8	$20.3	$20.4	$20.5	$20.6	$20.7	$21.1
Lunar Quest Program	*$94.5*	*$121.6*	*$114.5*	*$81.2*	*$48.9*	*$28.1*	*$19.5*
Lunar Science	$31.4	$59.7	$50.9	$48.1	$48.9	$28.1	$19.5
Lunar Atmosphere and Dust Environment Explorer	$48.2	$57.9	$63.2	$33.1			
International Lunar Network	$14.9	$4.0	$0.3				
Discovery	*$184.5*	*$202.0*	*$175.6*	*$205.1*	*$245.7*	*$265.5*	*$242.8*
Gravity Recovery and Interior Laboratory (GRAIL)	$124.1	$104.8	$40.5	$4.4			
Other Missions and Data Analysis	$60.4	$97.2	$135.1	$200.6	$245.7	$265.5	$242.8
New Frontiers	*$279.6*	*$223.8*	*$176.9*	*$265.8*	*$245.5*	*$291.1*	*$296.3*
Juno	$257.1	$184.2	$31.2	$17.6	$17.9	$16.7	$29.6
Other Missions and Data Analysis	$22.4	$39.6	$145.7	$248.2	$227.6	$274.4	$266.7
Mars Exploration	*$438.2*	*$532.8*	*$594.4*	*$433.1*	*$408.7*	*$309.0*	*$245.9*
2009 Mars Science Lab	$258.4	$231.6	$136.4	$40.5	$37.0		
MAVEN	$48.1	$161.2	$240.3	$140.6	$34.9	$15.4	$4.7
Other Missions and Data Analysis	$131.7	$140.0	$217.7	$252.0	$336.8	$293.5	$241.1
Outer Planets	*$100.6*	*$103.5*	*$120.8*	*$80.5*	*$82.2*	*$84.1*	*$88.5*
Technology	*$105.5*	*$121.5*	*$122.9*	*$104.1*	*$86.6*	*$84.9*	*$85.4*

**** FY 2010-2011 includes Civil Service Labor and Expenses***

Planetary Science
What's Changed and What's the Same

What Changed:

- Reduction in out-year funding can no longer support all 5 planetary programs
  - JEO, Mars 2018 and MSR indefinitely delayed
  - Decadal Survey will provide priorities to guide decision-making on which programs will be cancelled, delayed, descoped, or implemented as planned
- Established a Joint Mars Exploration Program with ESA, starting with the ExoMars Trace Gas Orbiter in 2016
- Reduction in Discovery flight rate due to significantly higher launch vehicle costs but no impact to current AO

What's the Same:

- Continuing current operating science missions
  - MRO, Odyssey, Opportunity, MEX, MESSENGER, Dawn, Cassini, New Horizons, LRO, EPOXI, NEXT, Aspera-3
  - Likely loss of Spirit due to failure over the last Mars winter
- Launch Juno, GRAIL and MSL in CY 2011 within MPAR commitments
- Continue the Mars Exploration Program through 2016
  - MSL and MAVEN launches in 2011 and 2013 respectively
  - The first joint mission in the ESA/NASA partnership launch in 2016
- Technology and Data Programs: Radioisotope Power Systems (RPS) completes ASRG for a possible 2016 launch; continue to support Planetary missions with data, navigation, and sample curation
- Continue with R&A selections and awards

Status on PU-238 Restart and Acquisition

Restart of Domestic PU-238 production:

- June 2010 – DoE issued the joint NASA/DoE restart report to Congress (cost share)
- President's Budget for FY11 and FY12 includes this shared funding
- Congress has not completed its work on the FY11 budget so this effort is not funded
- FY11 Authorization Act Congress requested a Pu-238 production report from NASA
  - The report is complete and in the pre-release approval cycle
  - The facts have not changed substantively since the 2010 DOE report

Purchase of PU-238 from Russia:

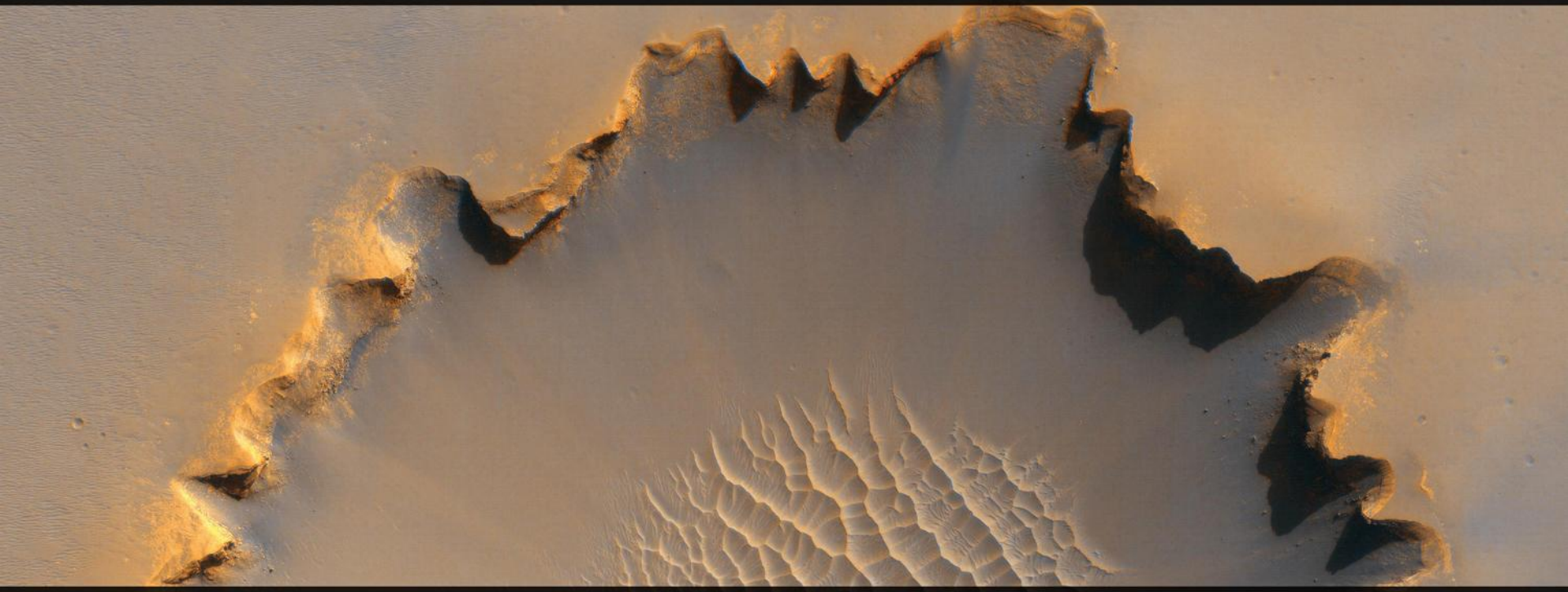
- Dec 2008 - Last purchase of PU-238 from Russia
- In 2009 Russia declared they needed to renegotiate a new PU-238 contract
- Oct 2010 – DoE met with Rosatom - agreed on basic terms for a new contract
- DoE is in the process of closing out its existing contract
- Next: Negotiate new contract then PU-238 must be processed and packaged
- Preliminary estimate of next delivery will be no earlier than CY2013
- Quantities and pricing are procurement sensitive

Status on PU-238 Restart and Acquisition (2)

Pu-238 Future:

- The FY12 President's budget request supports Pu-238 production restart
- As a mission enabling capability, it is critical to infuse this Radioisotope capability into smaller lower cost missions if we are to continue to explore low light regions

National Aeronautics and Space Administration



Planetary Science: Highlights

Planetary Mission Events

2010

November 4 - EPOXI encountered comet Hartley 2

2011

February 14 - Stardust NExT encounters comet Tempel 1

Early March – Planetary Decadal Survey

March 18 - MESSENGER orbit insertion at Mercury

July - Dawn orbit insertion at asteroid Vesta

August 5 - Juno launch to Jupiter

September 8 - GRAIL launch to the Moon

November 25 - MSL launch to Mars

2012

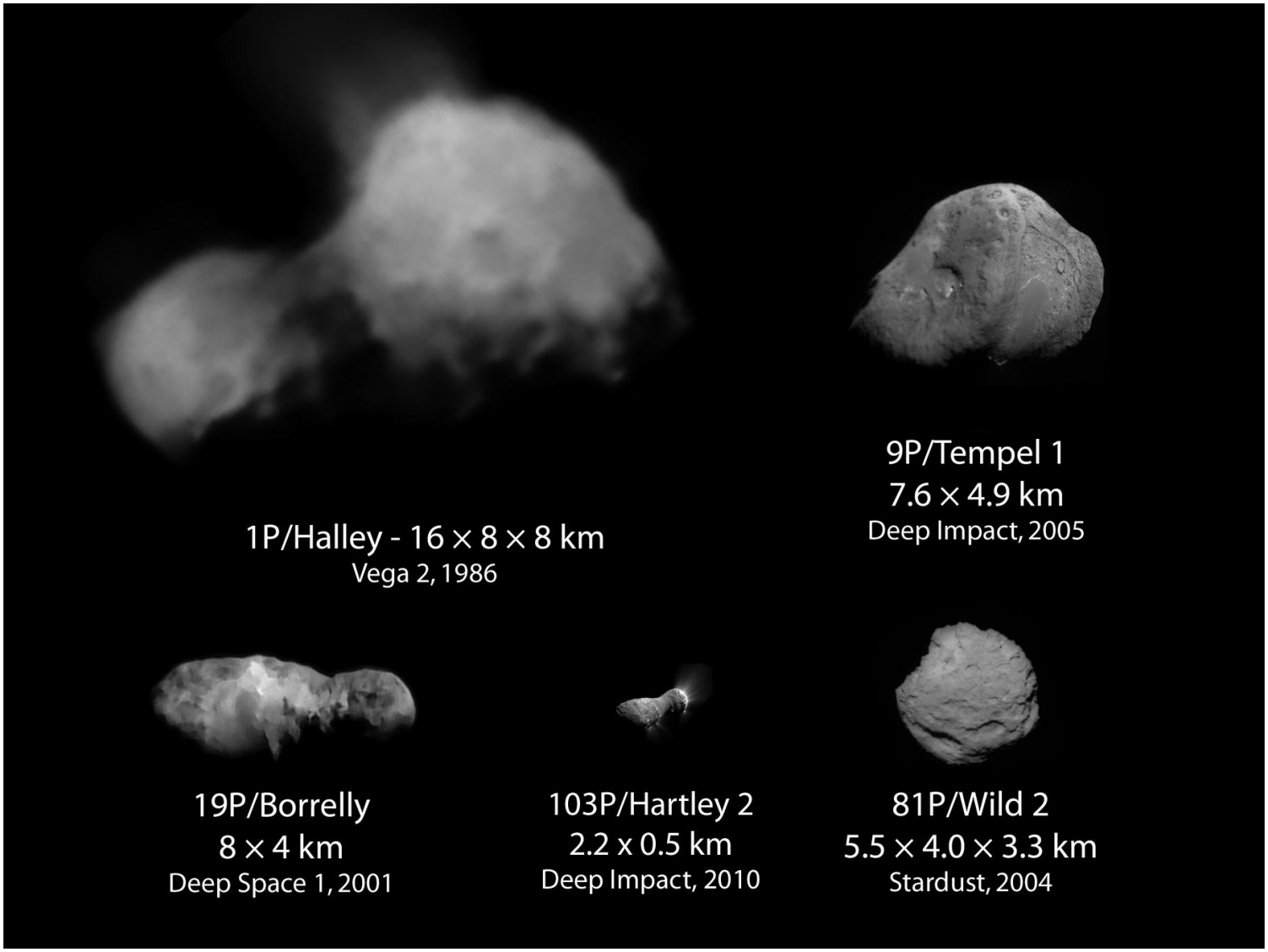
Mid 2012 -- Mars Opportunity Rover gets to Endeavour Crater

Mid-year -- Dawn leaves Vesta starts on its journey to Ceres

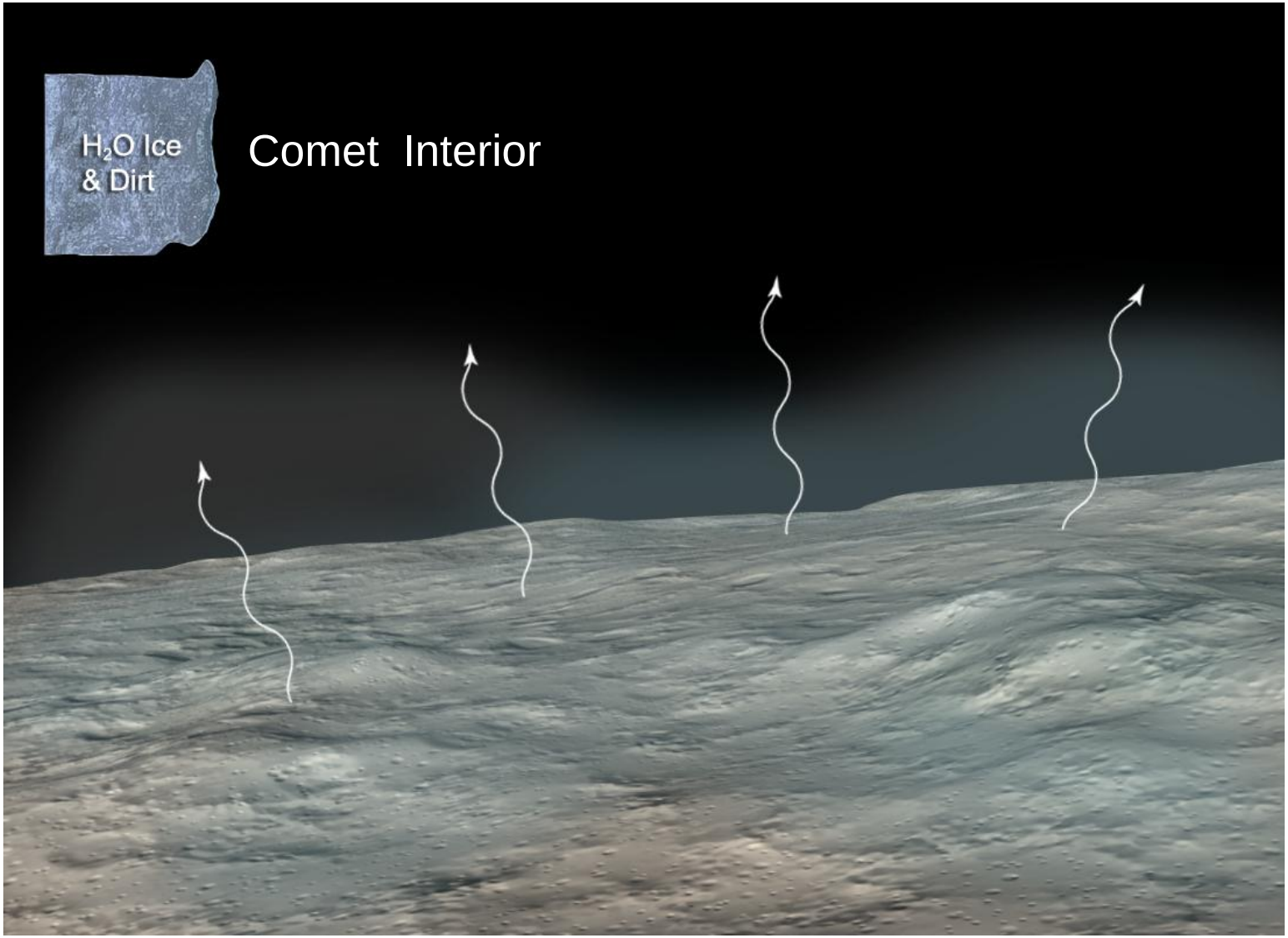
August - MSL lands on Mars

These mission events will lead to vast amounts of new data and new knowledge – feeding the revolution in our science and rewriting the text books

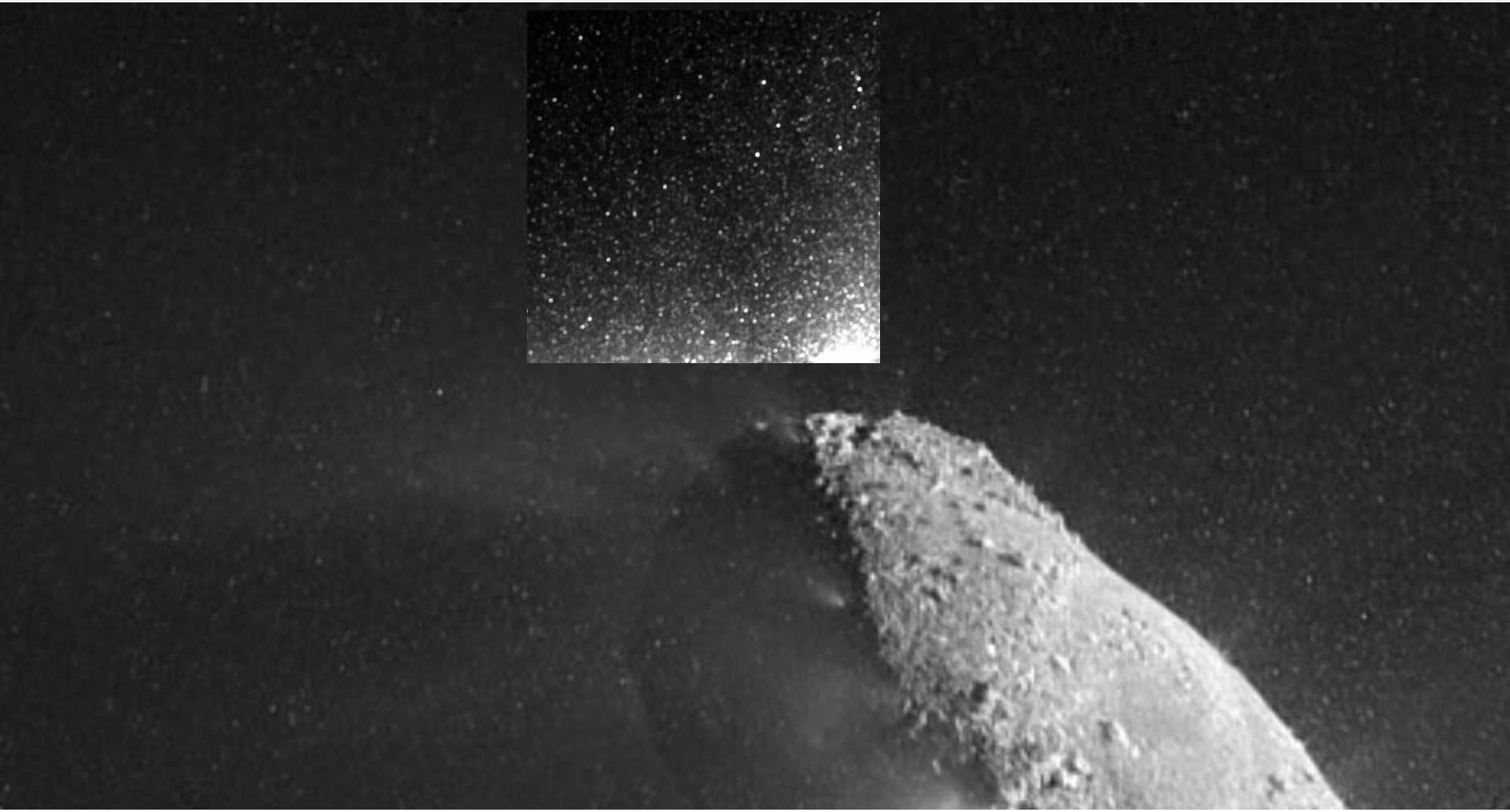
Comets


1P/Halley - 16 × 8 × 8 km
Vega 2, 1986
9P/Tempel 1
7.6 × 4.9 km
Deep Impact, 2005
19P/Borrelly
8 × 4 km
Deep Space 1, 2001
103P/Hartley 2
2.2 x 0.5 km
Deep Impact, 2010
81P/Wild 2
5.5 × 4.0 × 3.3 km
Stardust, 2004

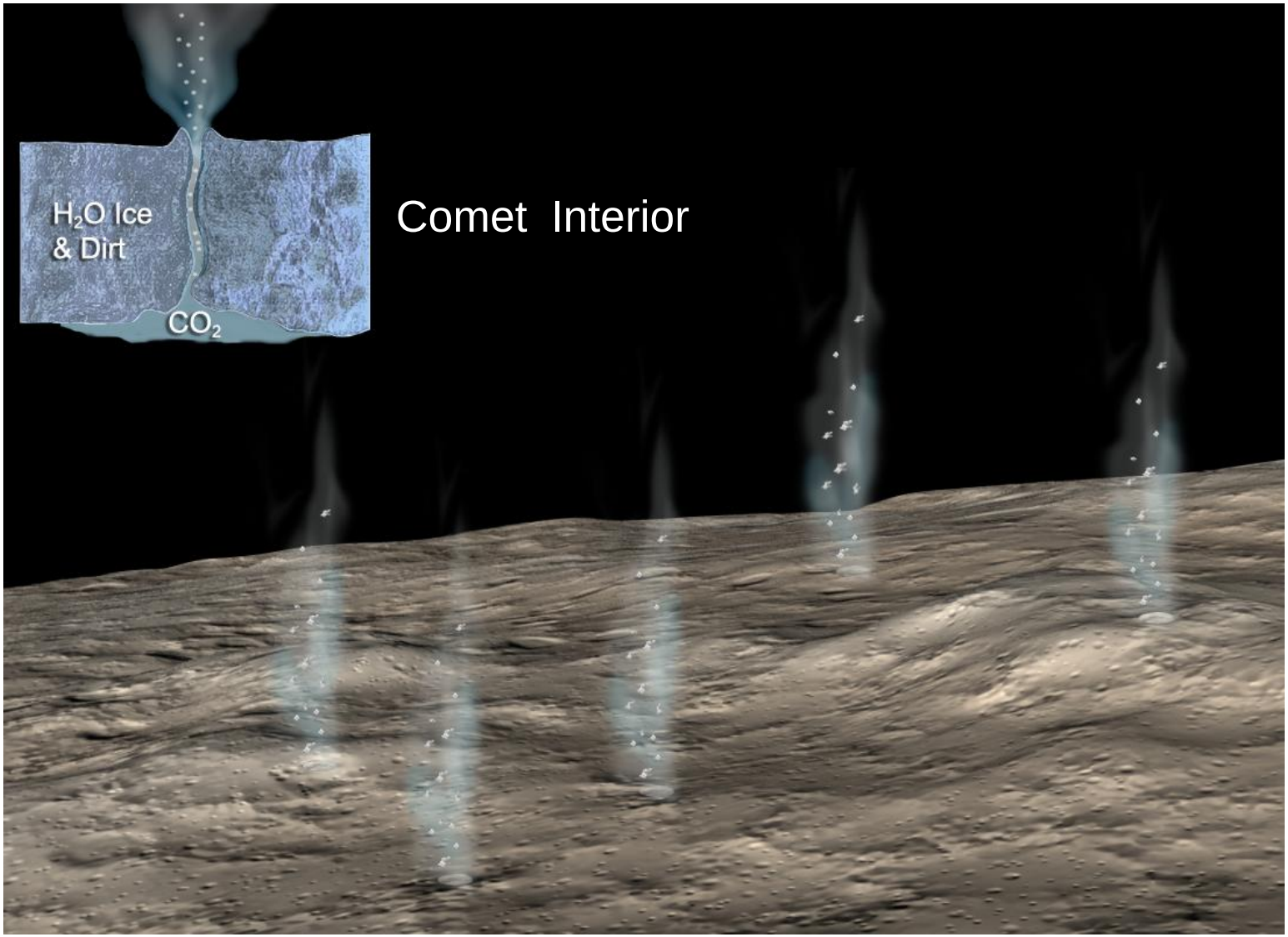
Comet Sublimation Process



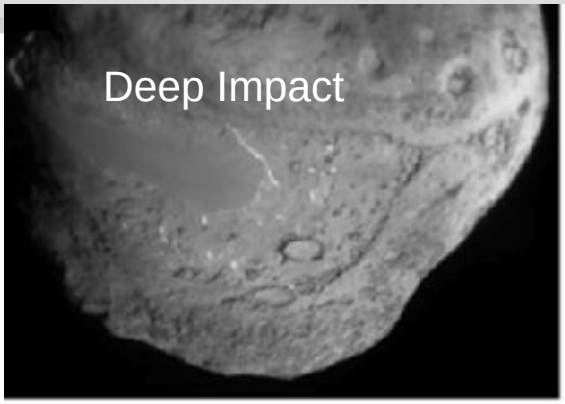
EPOXI's Encounter With Hartley 2

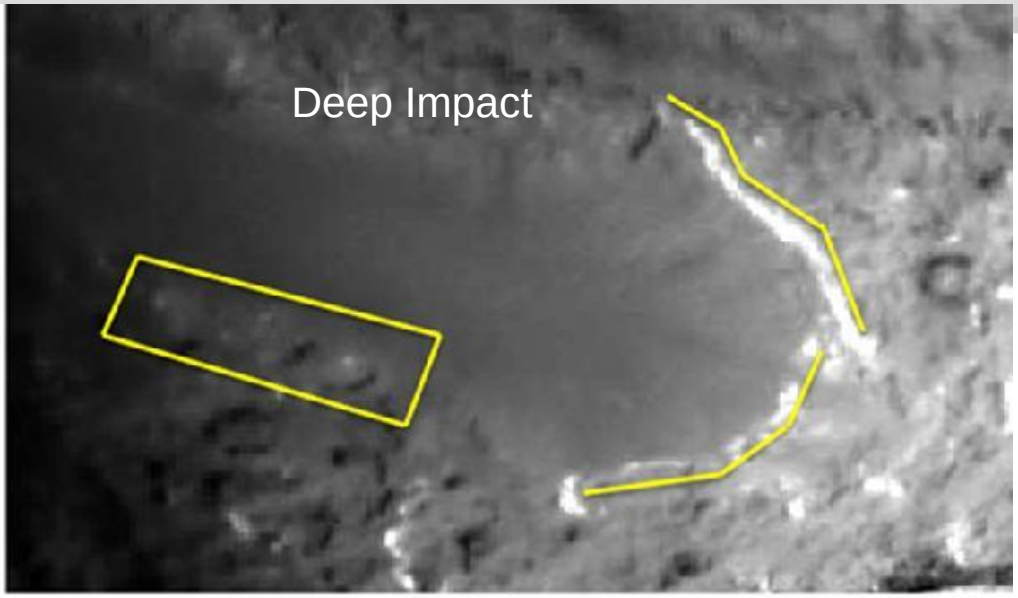


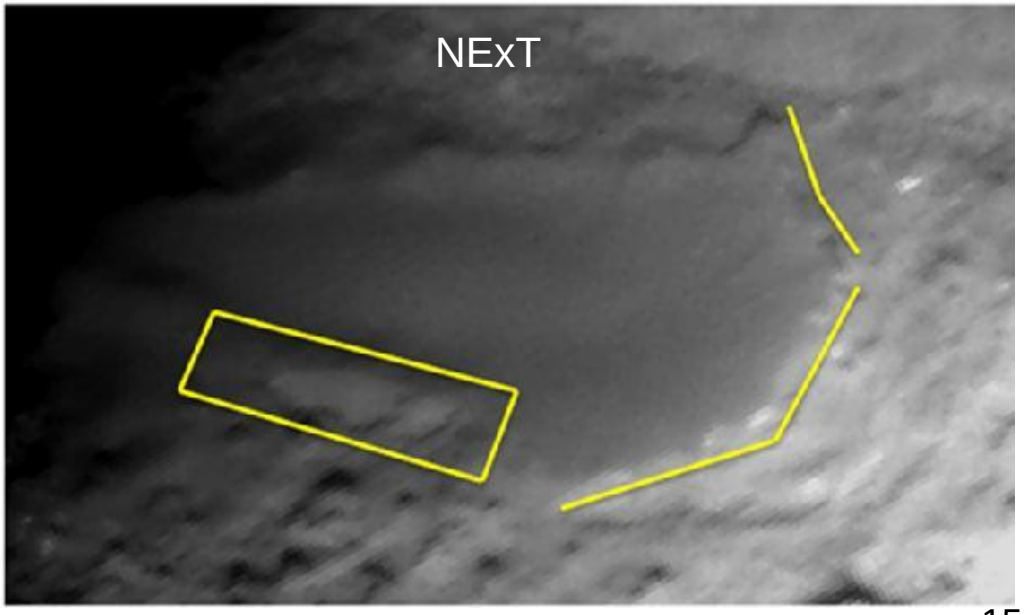
Internal Processes Within Hartley 2 May Case the Ejection of the Snowballs



Comet Tempel 1 – Before & After Perihelion





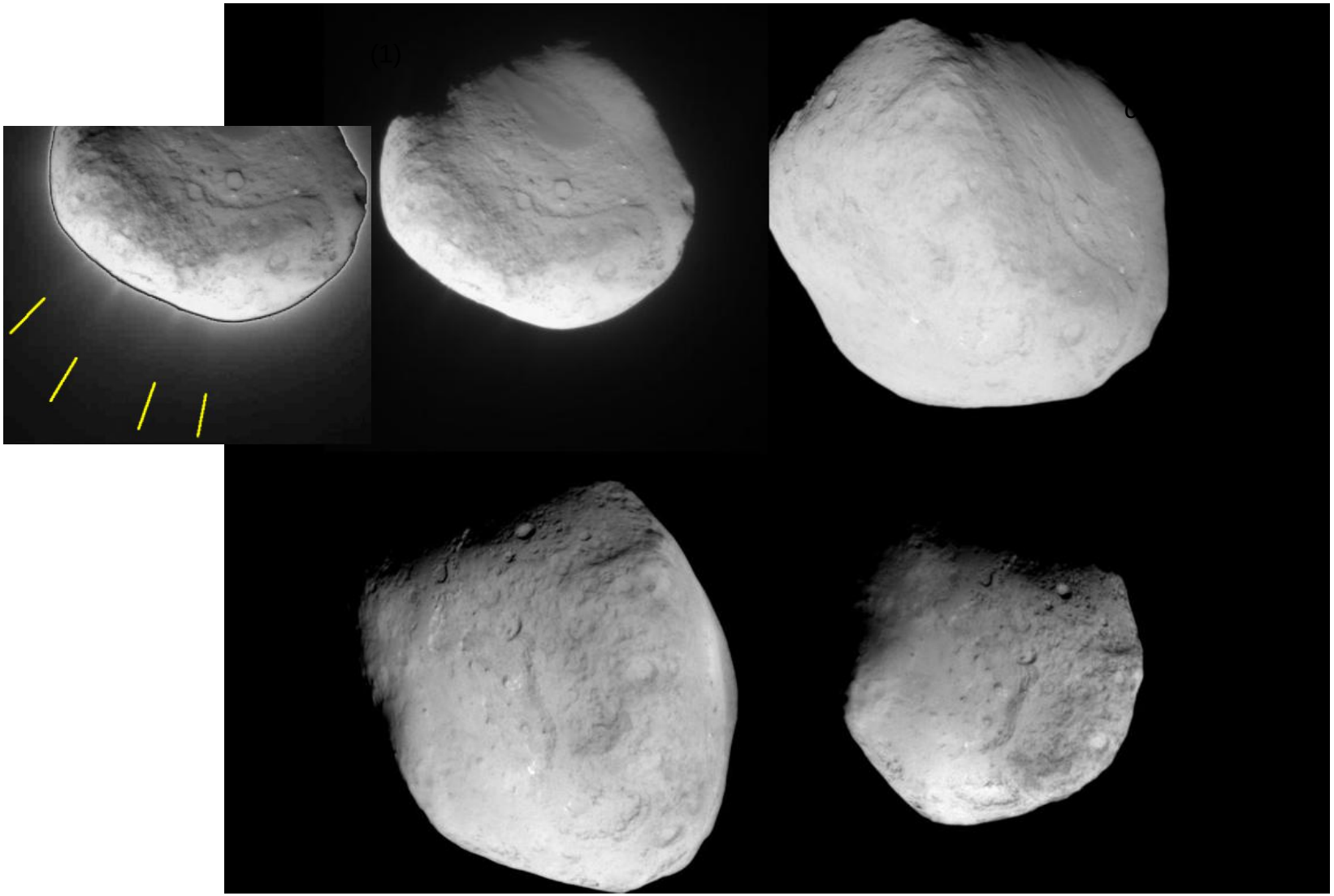


Between the two visits, the comet made one trip around the sun.

The smooth terrain is at a higher elevation than the more textured surface around it. The cliffs appear to have eroded as much as 20 to 30 meters (66 to 100 feet) in some places.

The box (right) shows depressions that have merged together over time, from erosion. This erosion is caused by volatile substances evaporating away from the comet.

Comet Tempel 1 - New Views from Stardust-NExT

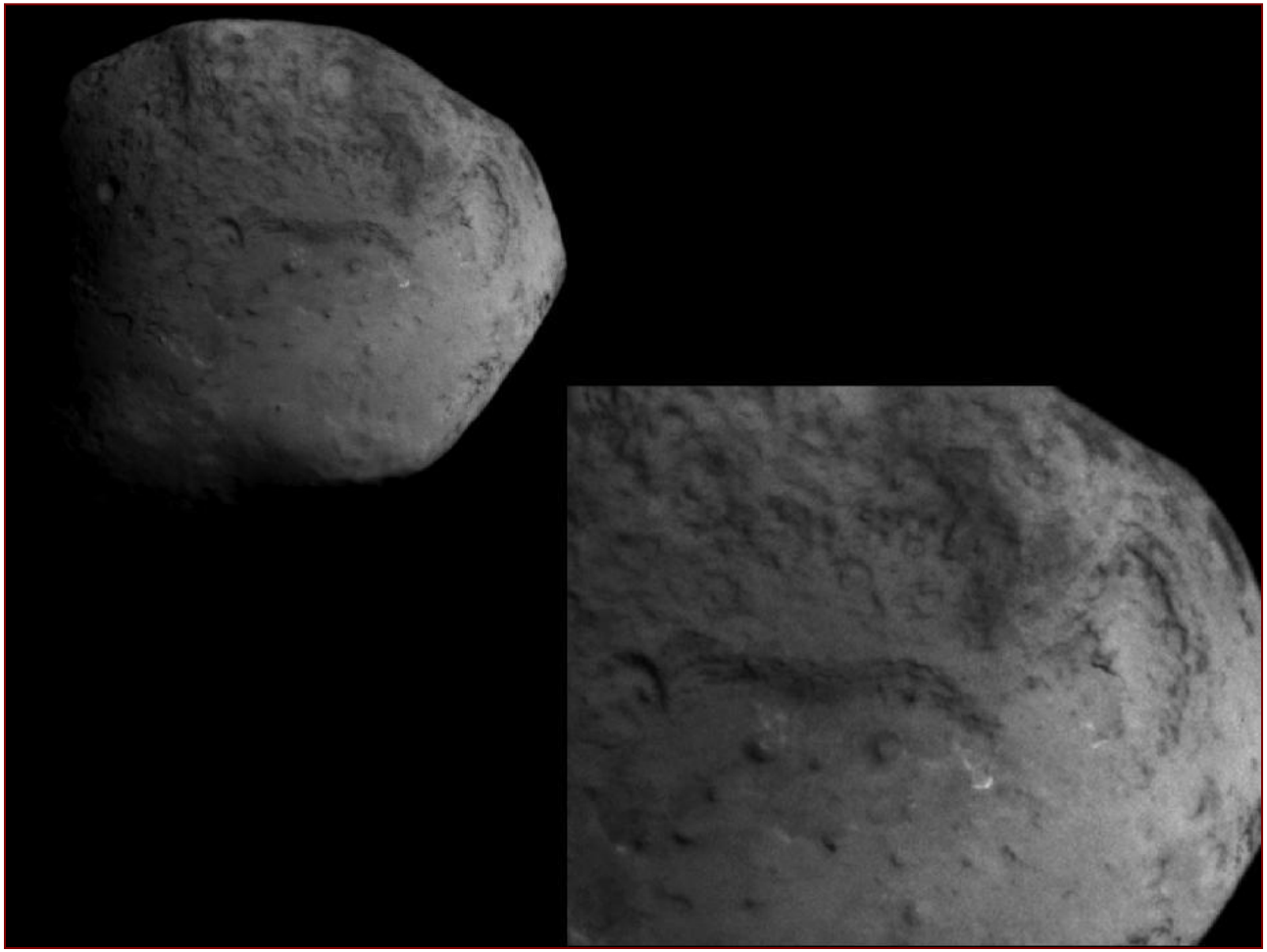


Comet Tempel 1 - New Views from Stardust-NExT (2)

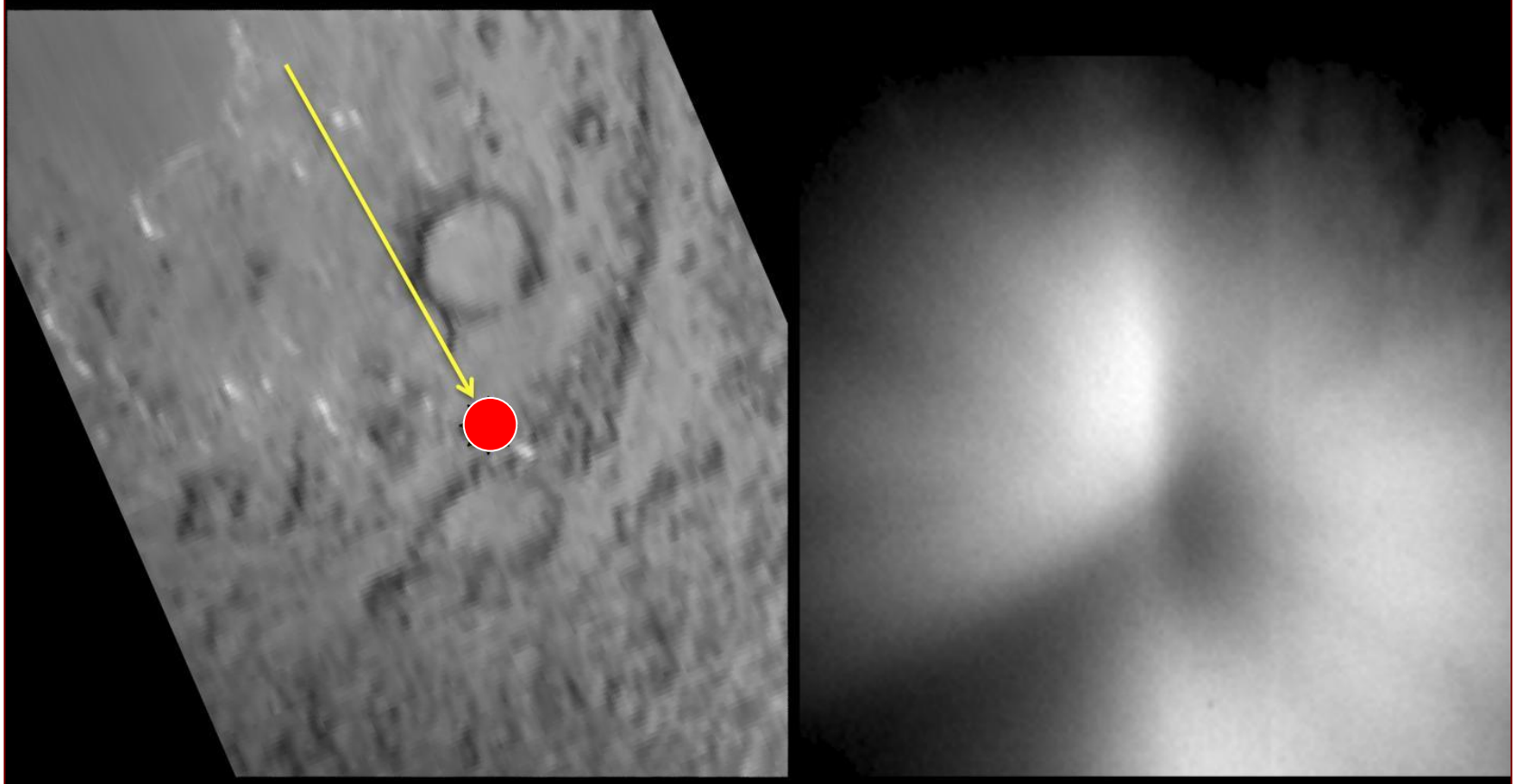
New images shows a side of the nucleus of comet Tempel 1 that has never been seen before.

Three terraces of different elevations are visible, with dark, banded scarps, or slopes, separating them. The widest of the banded slopes is about 2 kilometers (1 mile). The lowest terrace has two circular features that are about 150 meters (500 feet) in diameter.

2/3 of the surface has now been imaged!

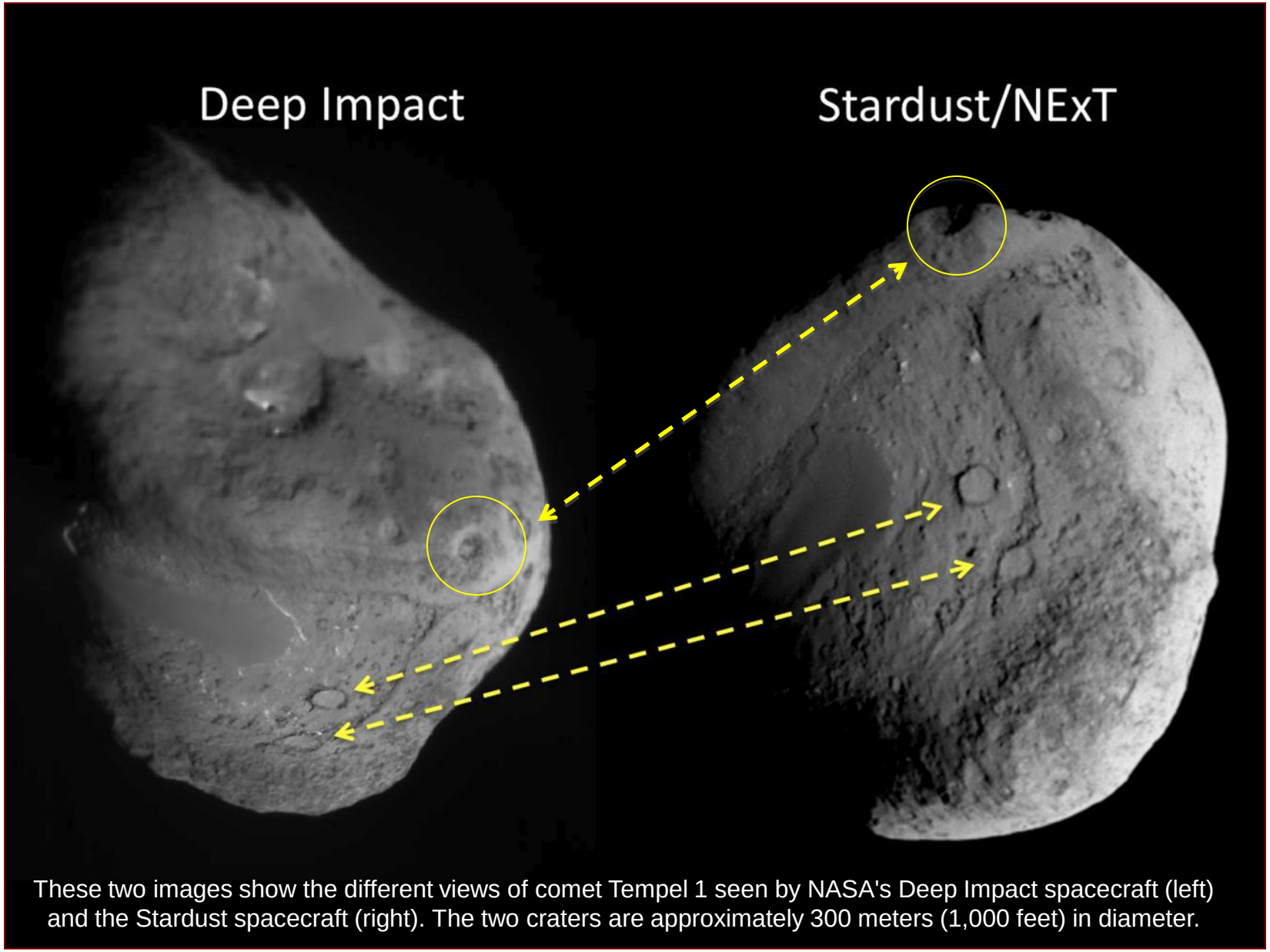


Comet Tempel 1 – Impact Region – GOAL!



This pair of images shows a before-and-after comparison of the area on comet Tempel 1 targeted by an impactor from NASA's Deep Impact spacecraft in July 2005. **Left:** This image is one of the last obtained of the Tempel 1 surface by the impactor's high resolution imager before the impactor hit the surface. An arrow shows the direction the impactor traveled toward the surface, with a yellow spot that shows the impact target. **Right:** This image shows the plume of material kicked up by the impact that obscures the surface. It was obtained about 700 seconds after the impact.

Comet Tempel 1 – Impact Region (2)



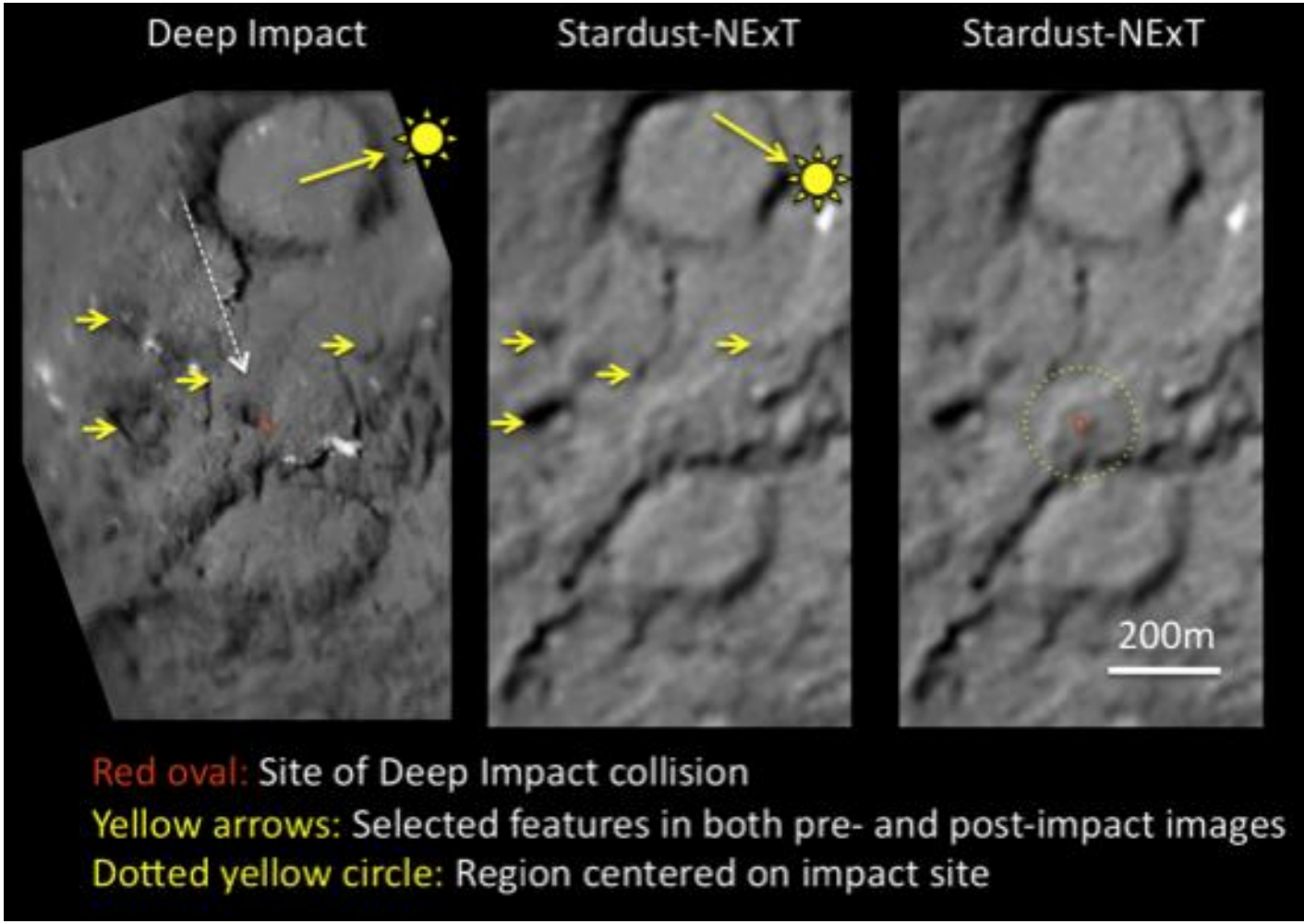
These two images show the different views of comet Tempel 1 seen by NASA's Deep Impact spacecraft (left) and the Stardust spacecraft (right). The two craters are approximately 300 meters (1,000 feet) in diameter.

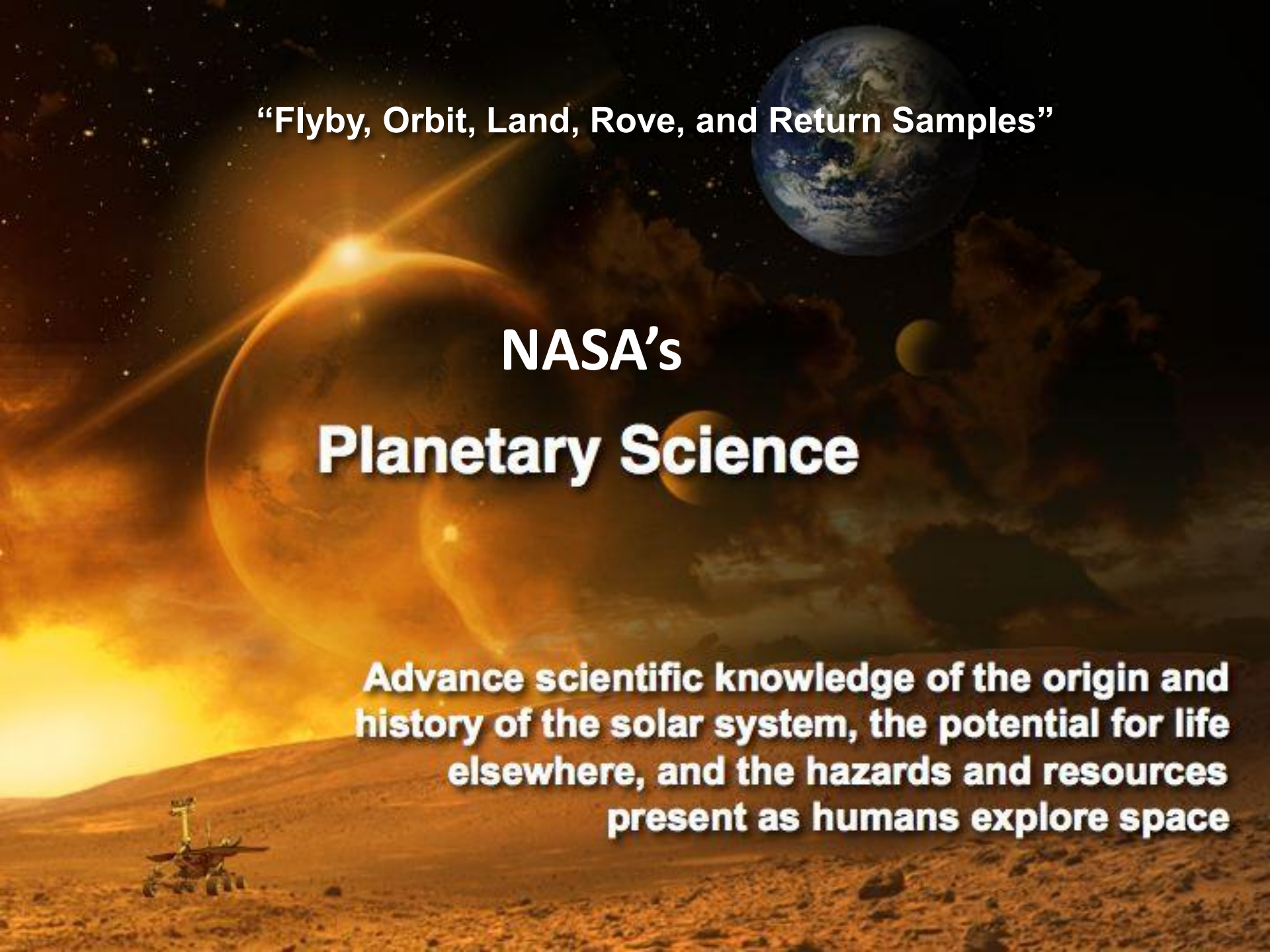
Comet Tempel 1 – Impact Region (3)

Left: DI shows a dark mound about 50 meters (160 feet) in size. Red circle shows the area hit by the impactor released by Deep Impact.

Middle: NExT shows that the impactor erased the dark mound and flattened the area.

Right: The outer yellow circle shows the outer rim of the crater. The crater is estimated to be 150 meters (500 feet) in diameter.




"Flyby, Orbit, Land, Rove, and Return Samples"
NASA's
Planetary Science
Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space