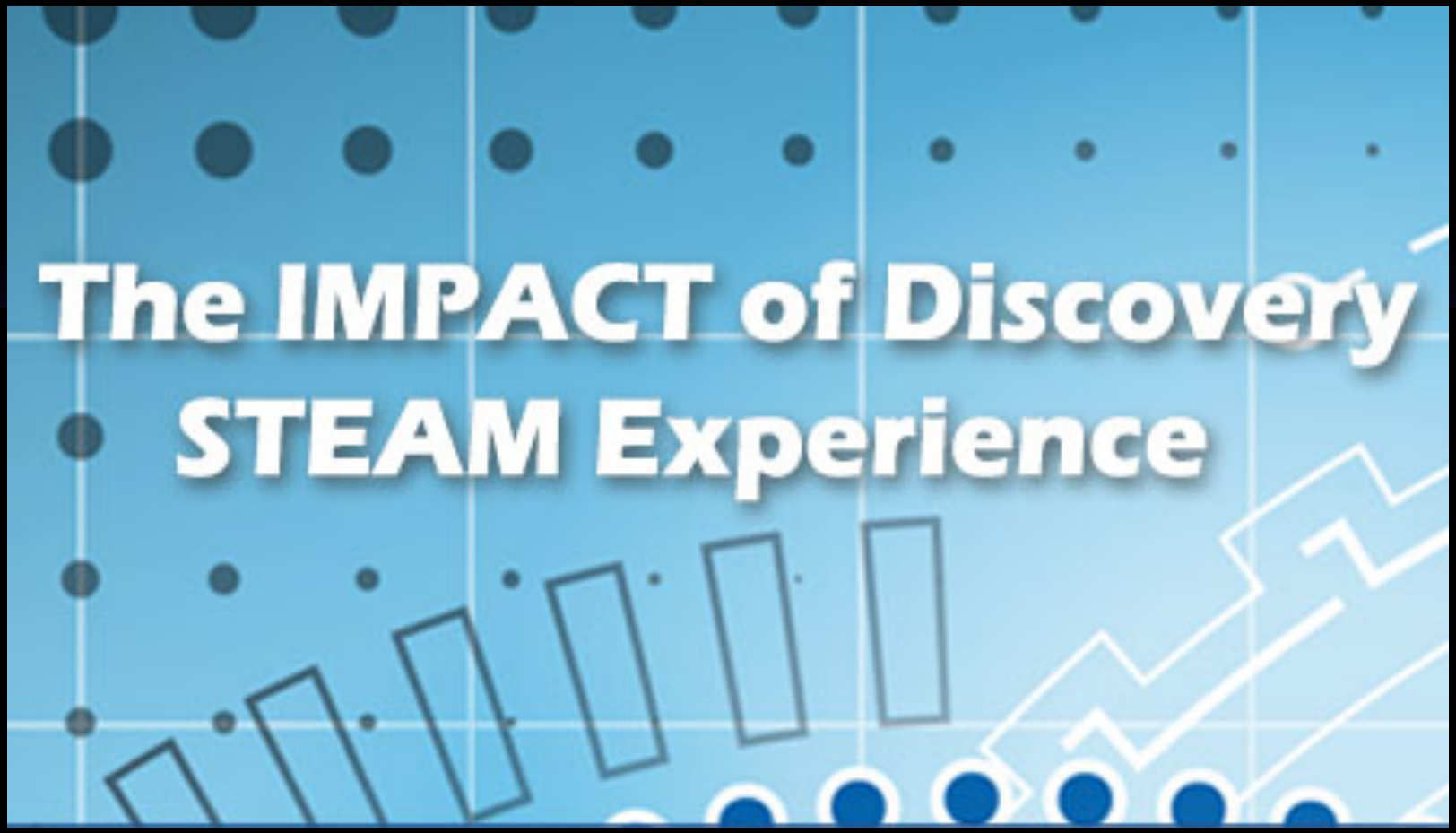
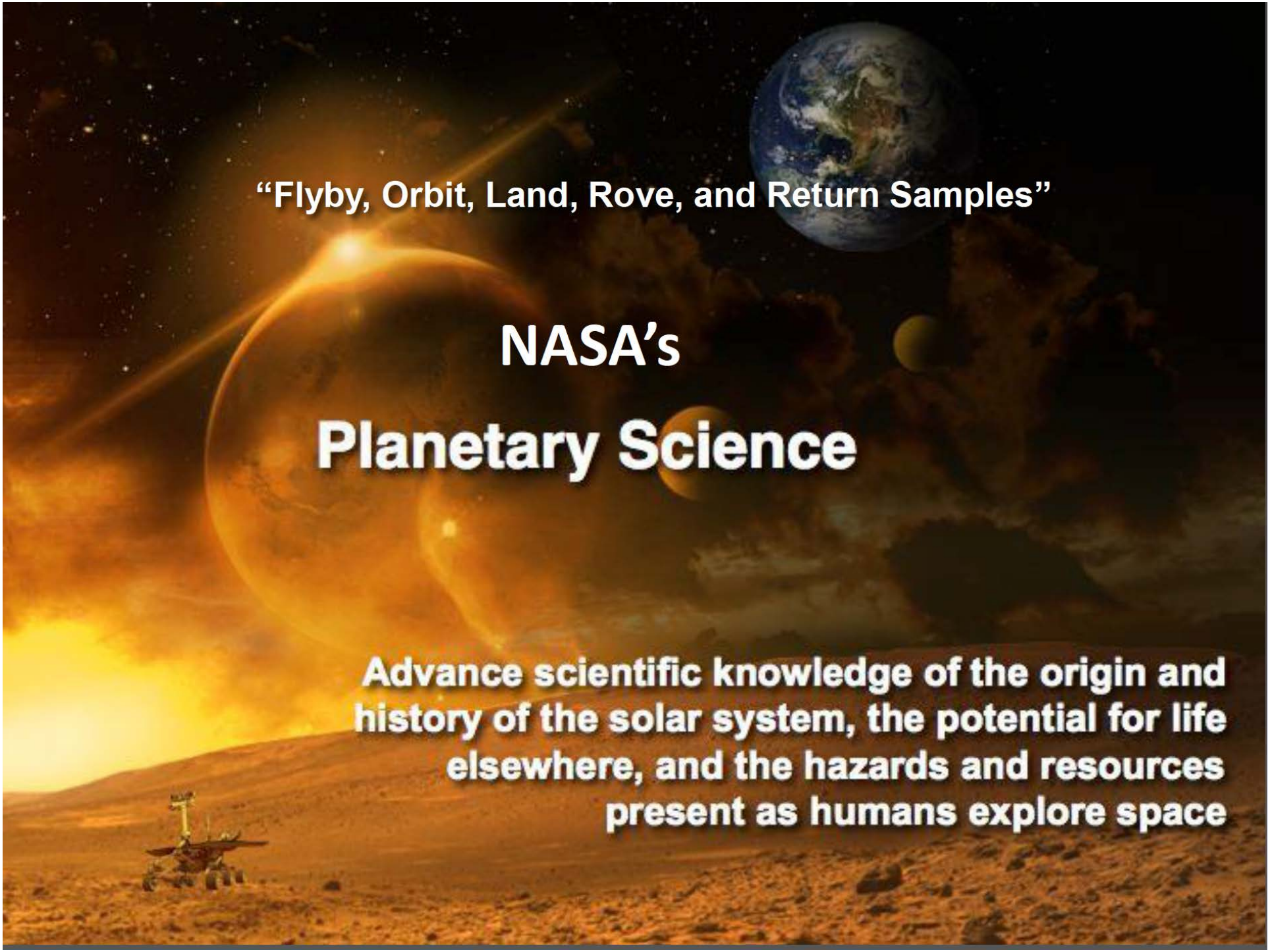
Welcome to



Shari Asplund
NASA's Planetary Missions Program Office
Education and Communications


"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

NASA's Discovery, New Frontiers and Solar System Exploration Programs

- Lower-cost planetary science missions searching for answers
- Challenging long-held theories and revolutionizing our understanding with amazing new images, data and samples

Proposed by a "Principal Investigator" working with a large diverse team

- Scientists asking questions, on a quest for new knowledge
- Engineers seeking innovations and the best ways to find answers

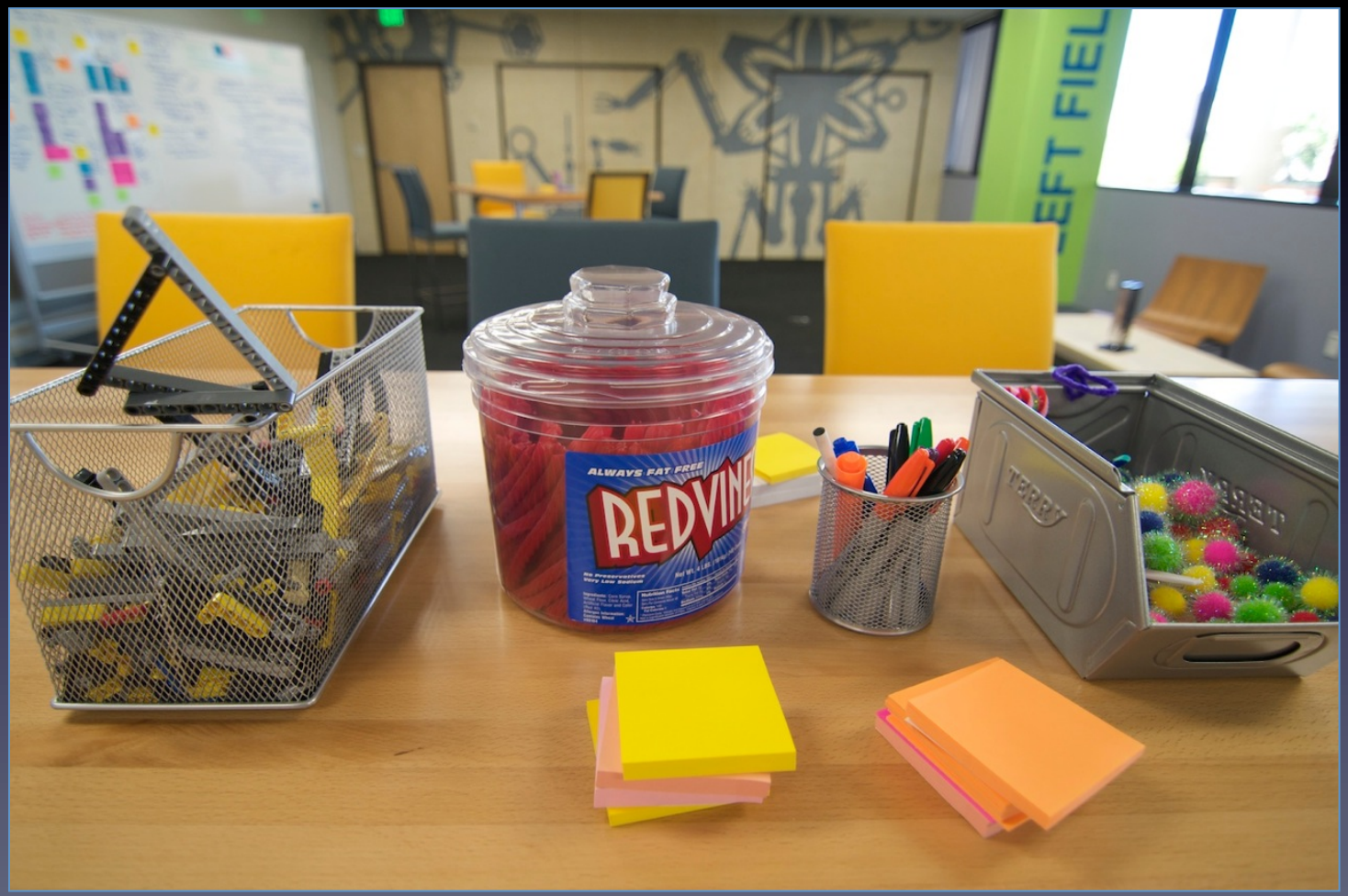
Exploring planets, moons, asteroids & comets

flybys • orbiters • landers

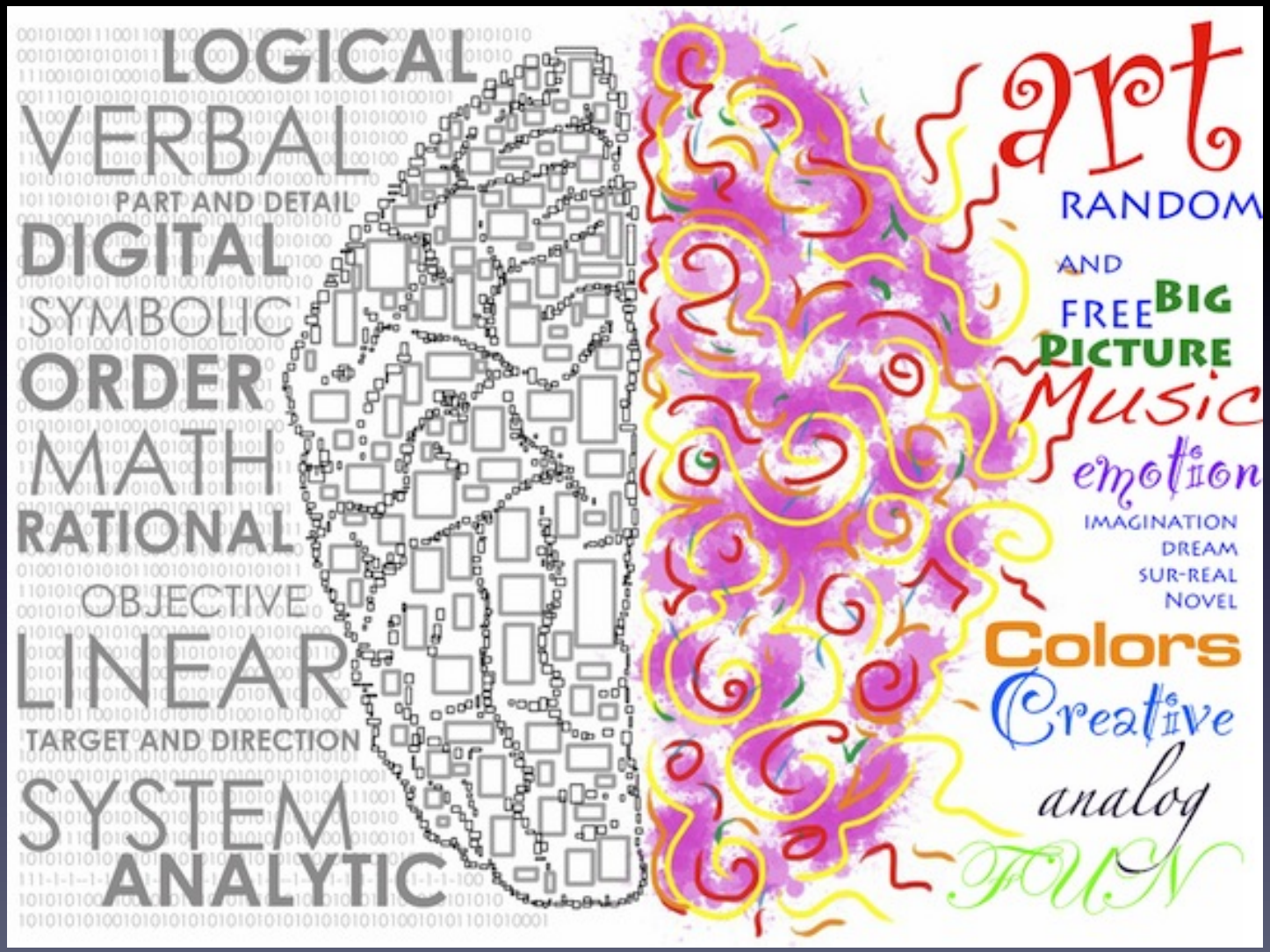
rovers • impactors • sample returns

Creative Mission Design

How would you design your dream mission?



Left Brain, Right Brain?



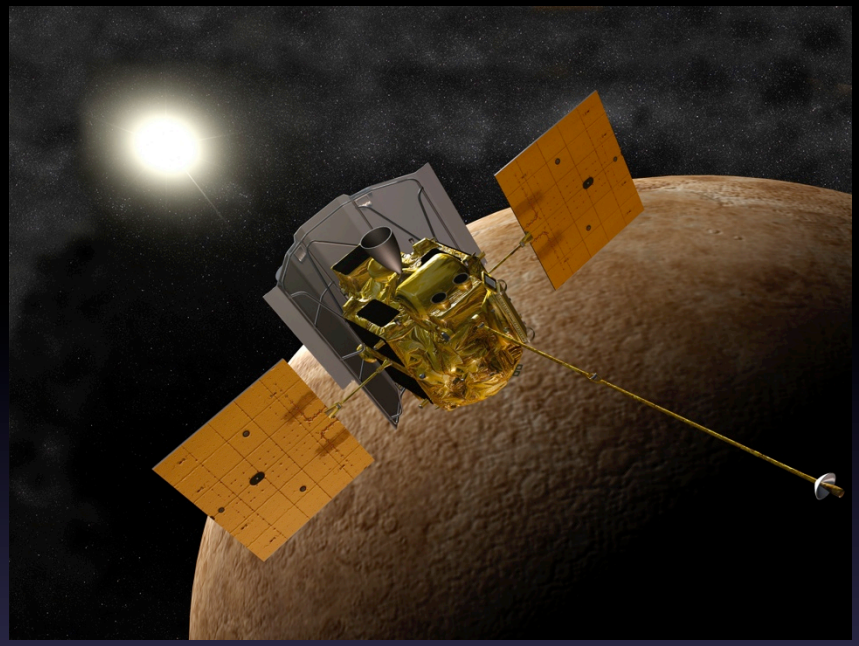
It's a Myth - We use our Brains Equally

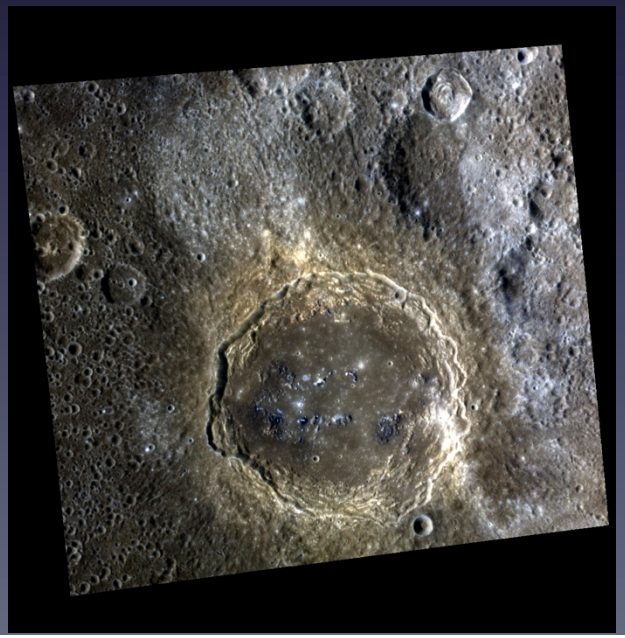
Mercury Revealed!

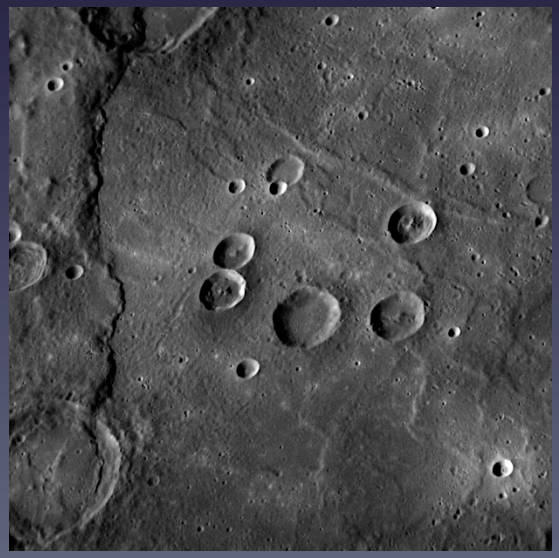
MESSENGER

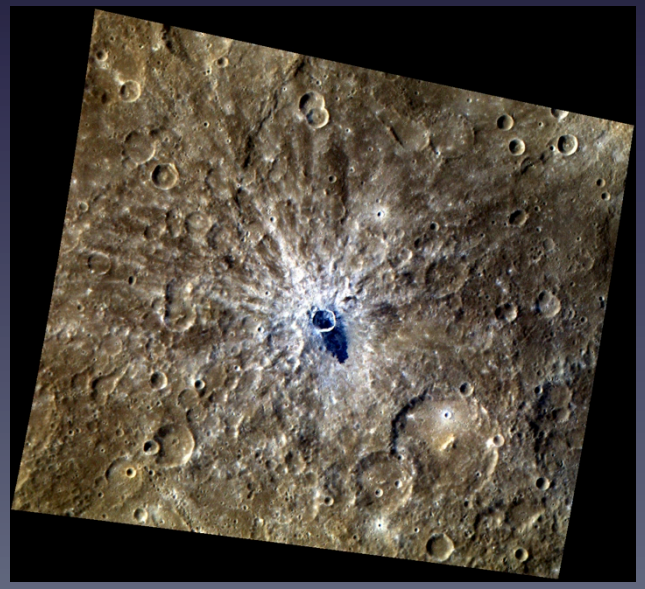
First spacecraft to orbit the planet closest to the Sun, beginning in March 2011

One year mission - extended until it ran out of fuel and impacted the surface on April 30, 2015

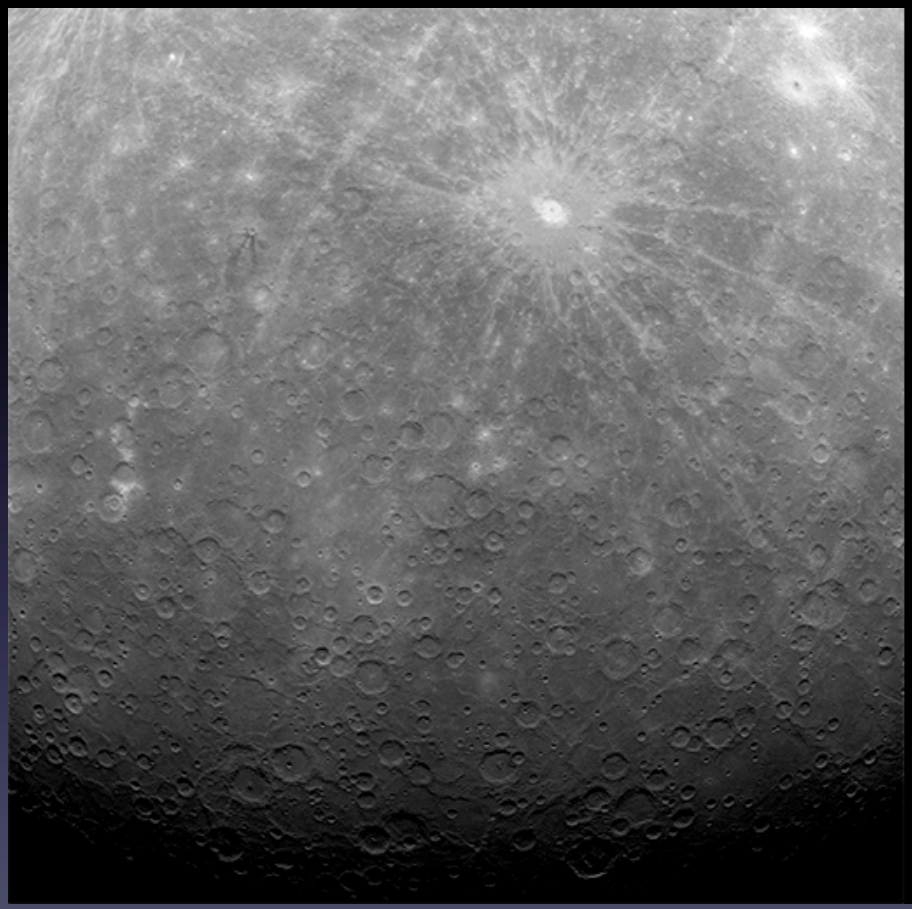




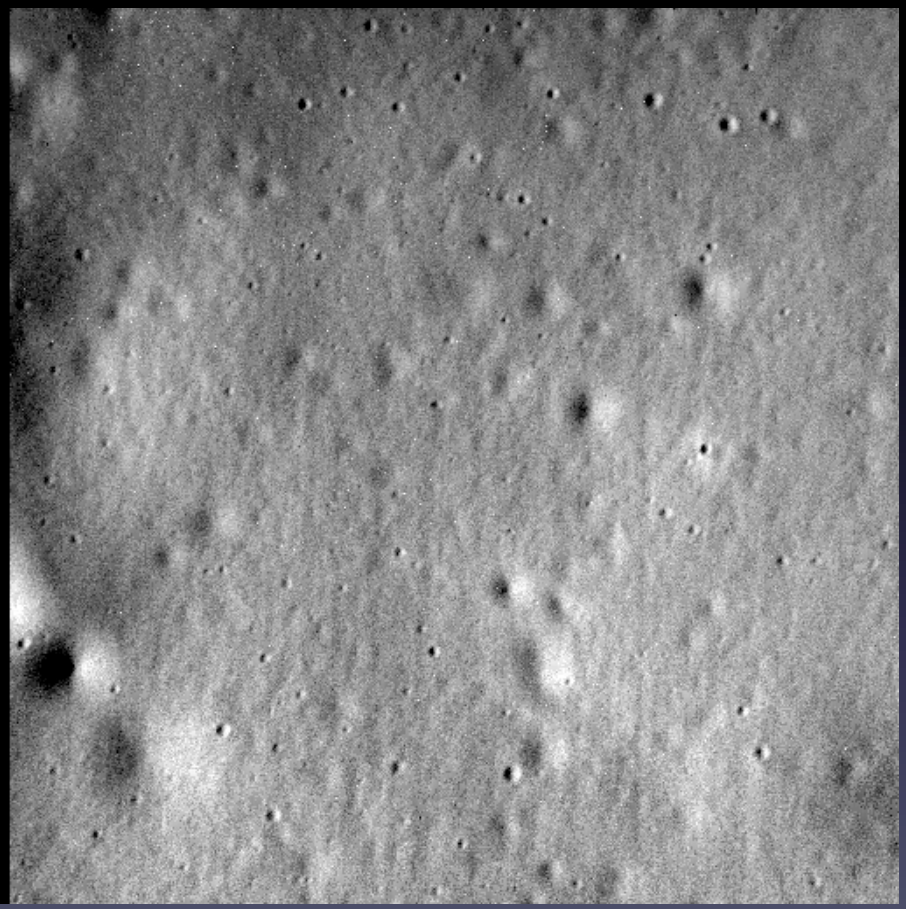




First and Last Images

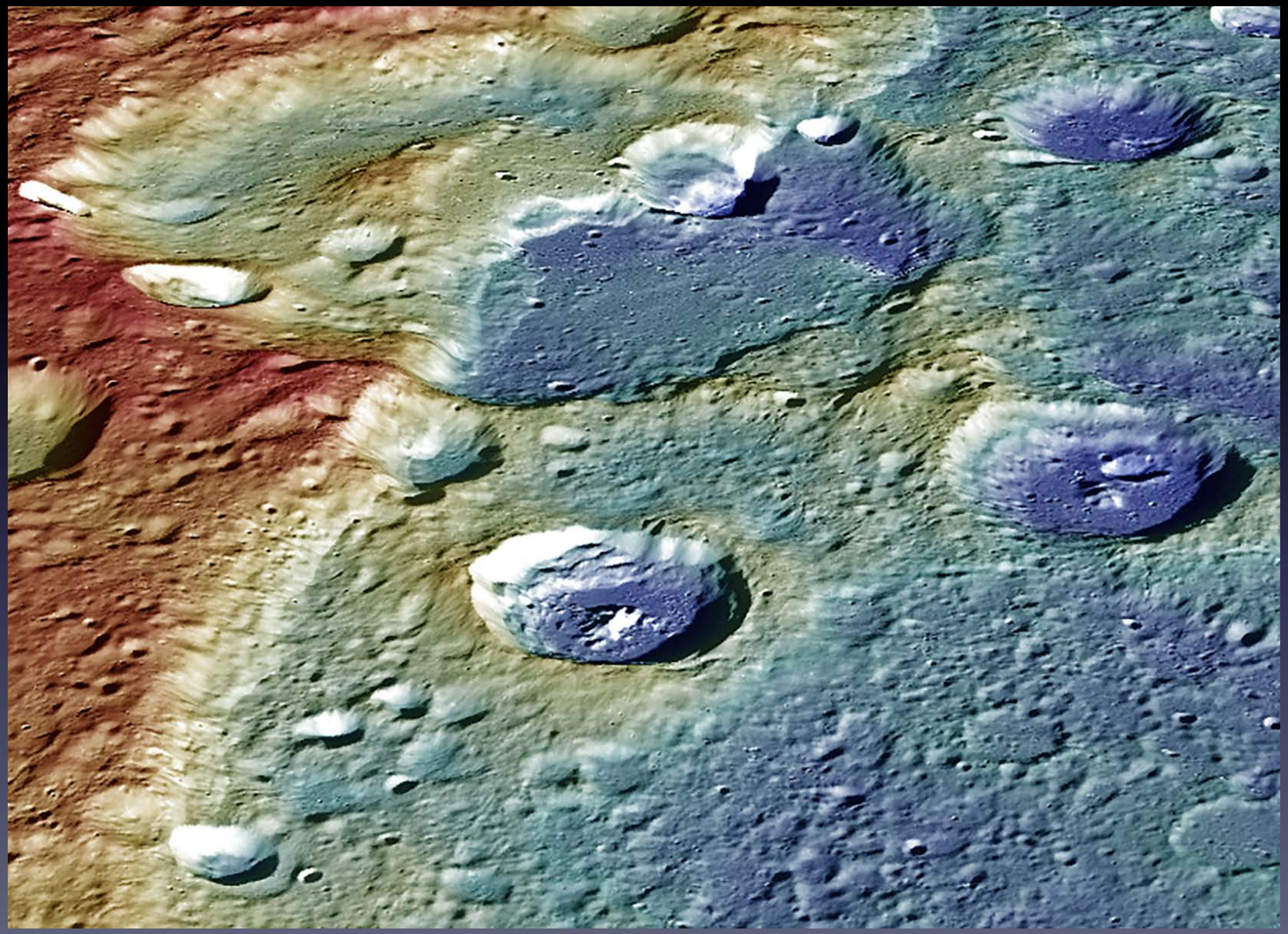


March 18, 2011



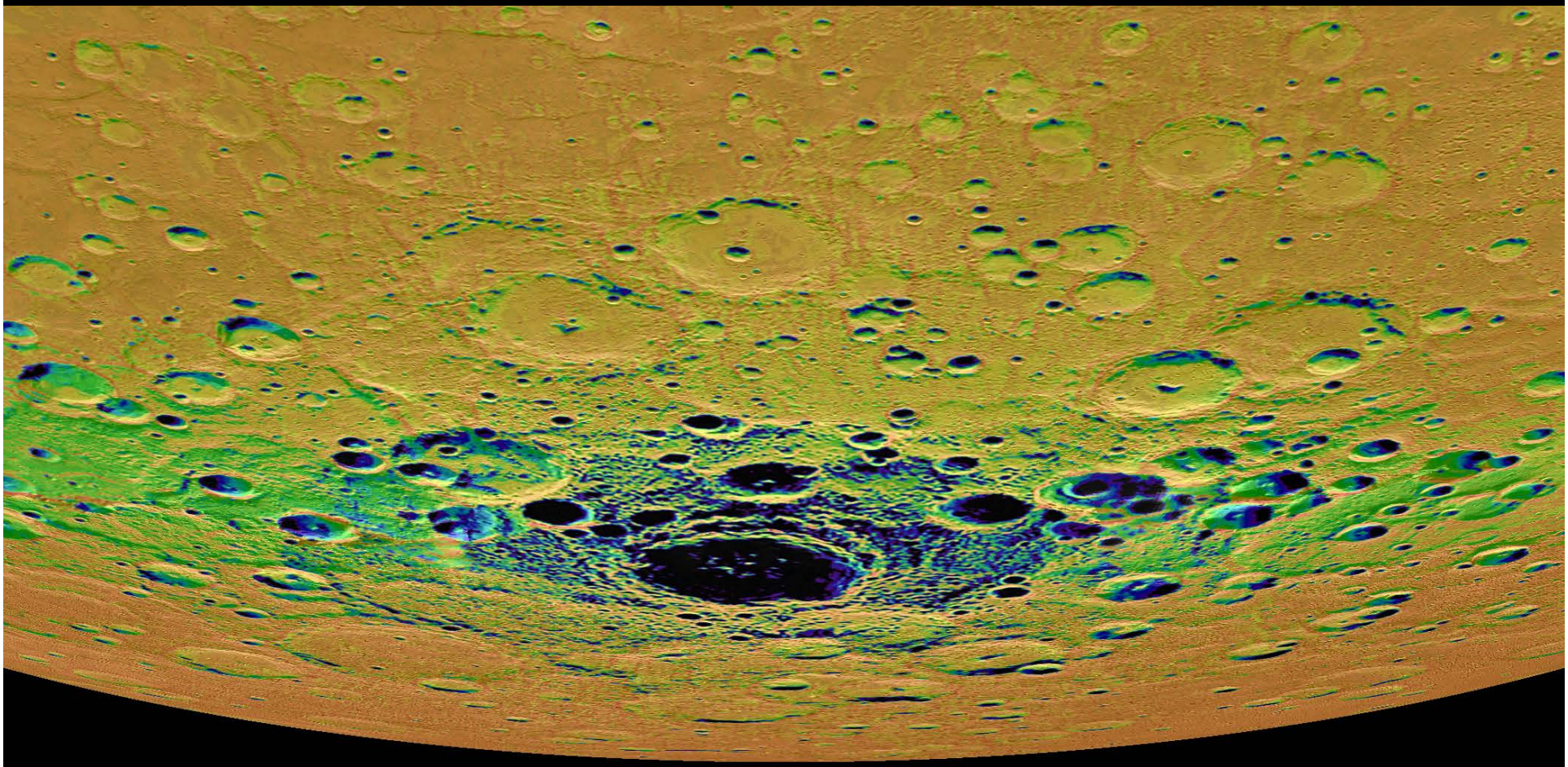
April 30, 2015

Carnegie Rupes - a tectonic landform



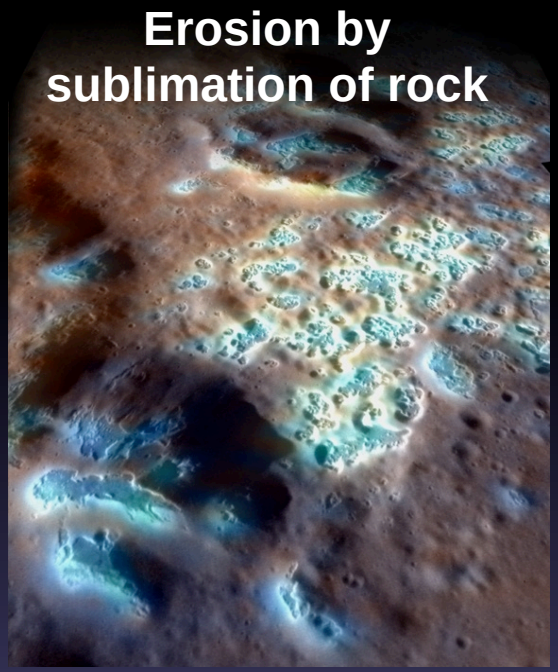
red = high standing terrain, blue = low lying terrain

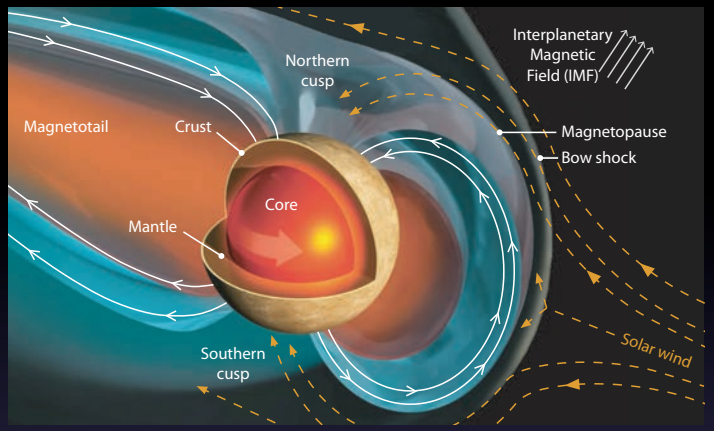
Shadows at the South Pole



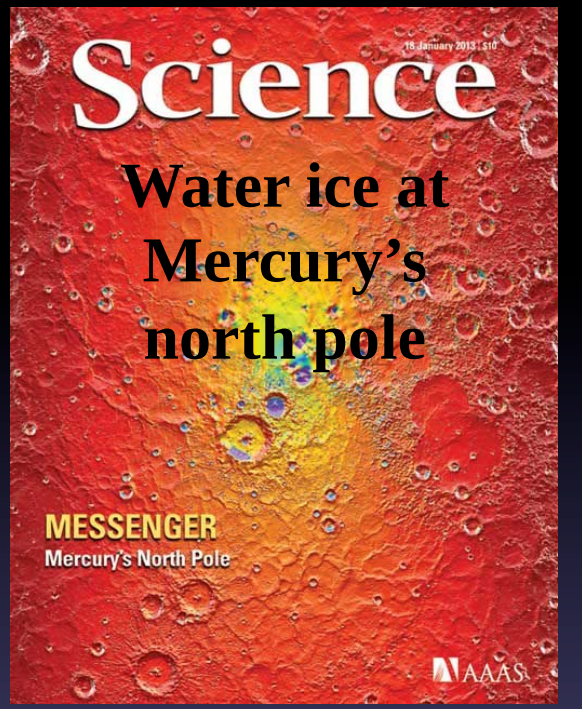
Area in black are permanent shadows

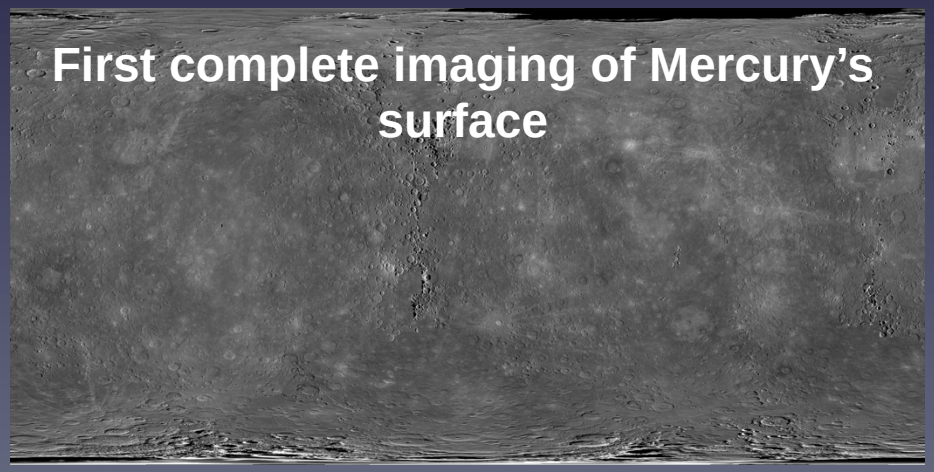
Key Findings and Achievements

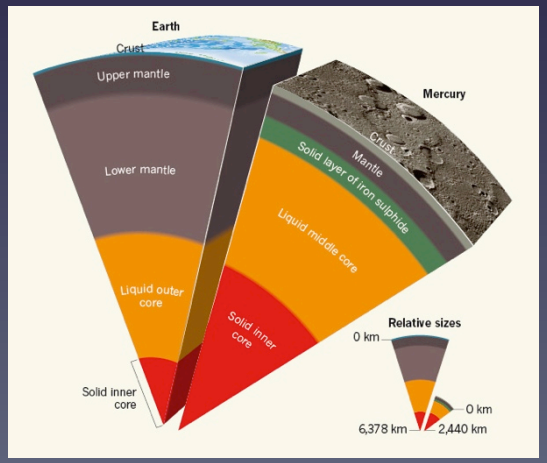




Mercury's offset magnetic field







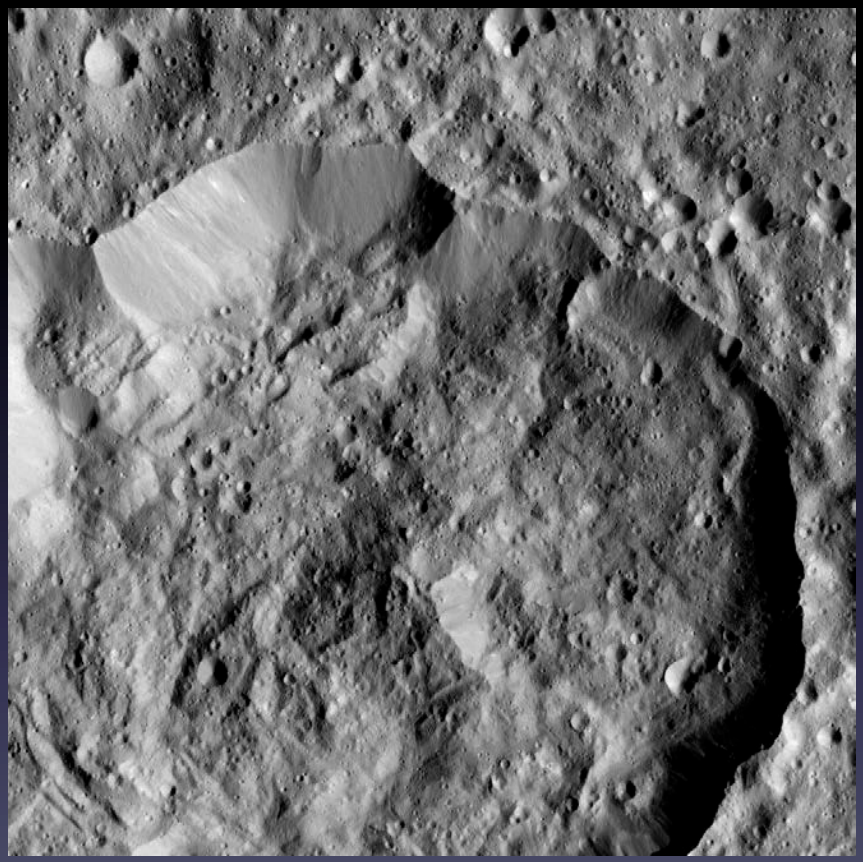
Mercury's internal layers

It Takes a Village

Comparing Asteroids

Dawn
Orbited Vesta for 12 months

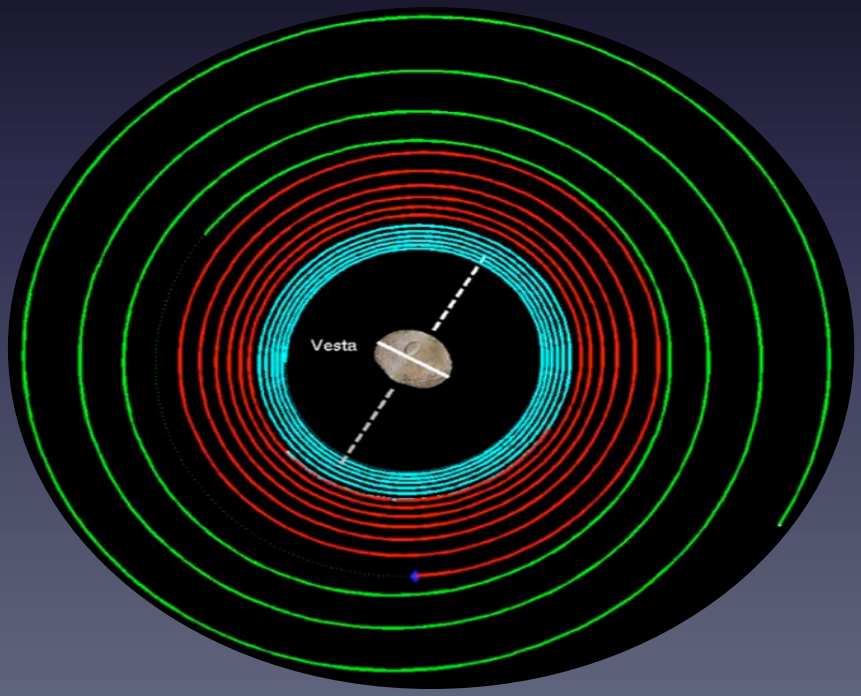
Now circling Ceres for a close-up comparison of these two very large and very different asteroid belt objects

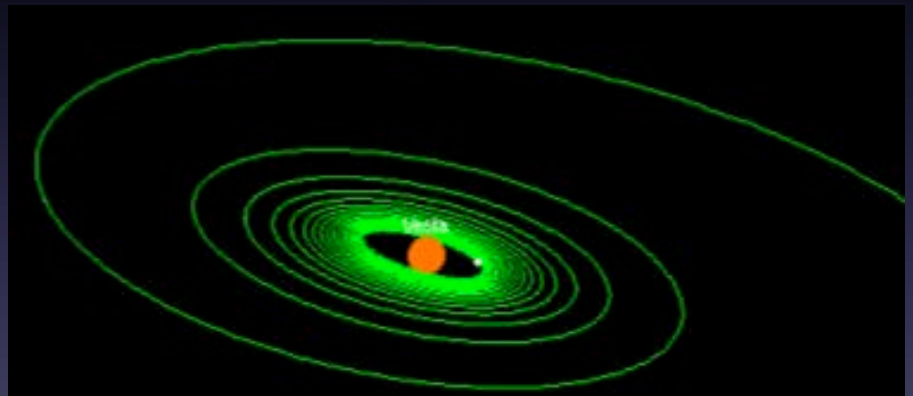


Dawn is the first mission to orbit and explore *any* two extraterrestrial destinations

Vesta

July 2011 – September 2012





Ceres

March 2015 – June 2016

Science Objectives

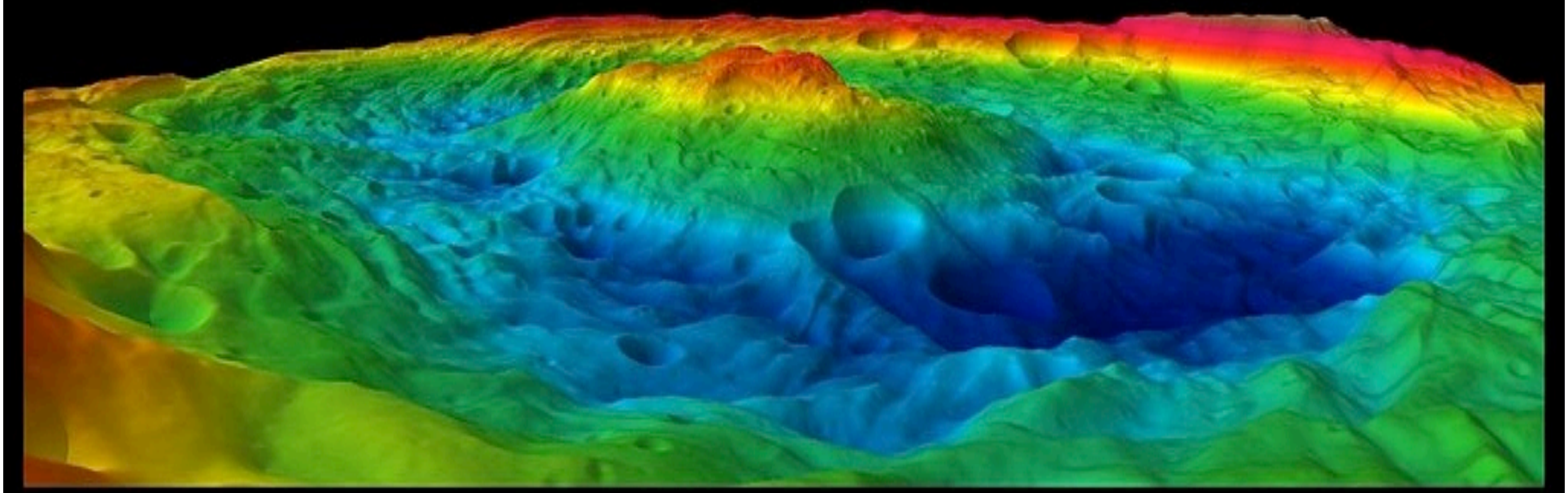
- Acquire color images
- Compile a topographic map
- Map the elemental composition
- Map the mineralogical composition
- Measure the gravity field
- Search for moons

Remnants of Impacts

Massive impacts rippled through Vesta, leaving giant scars across the surface

Largest Mountain

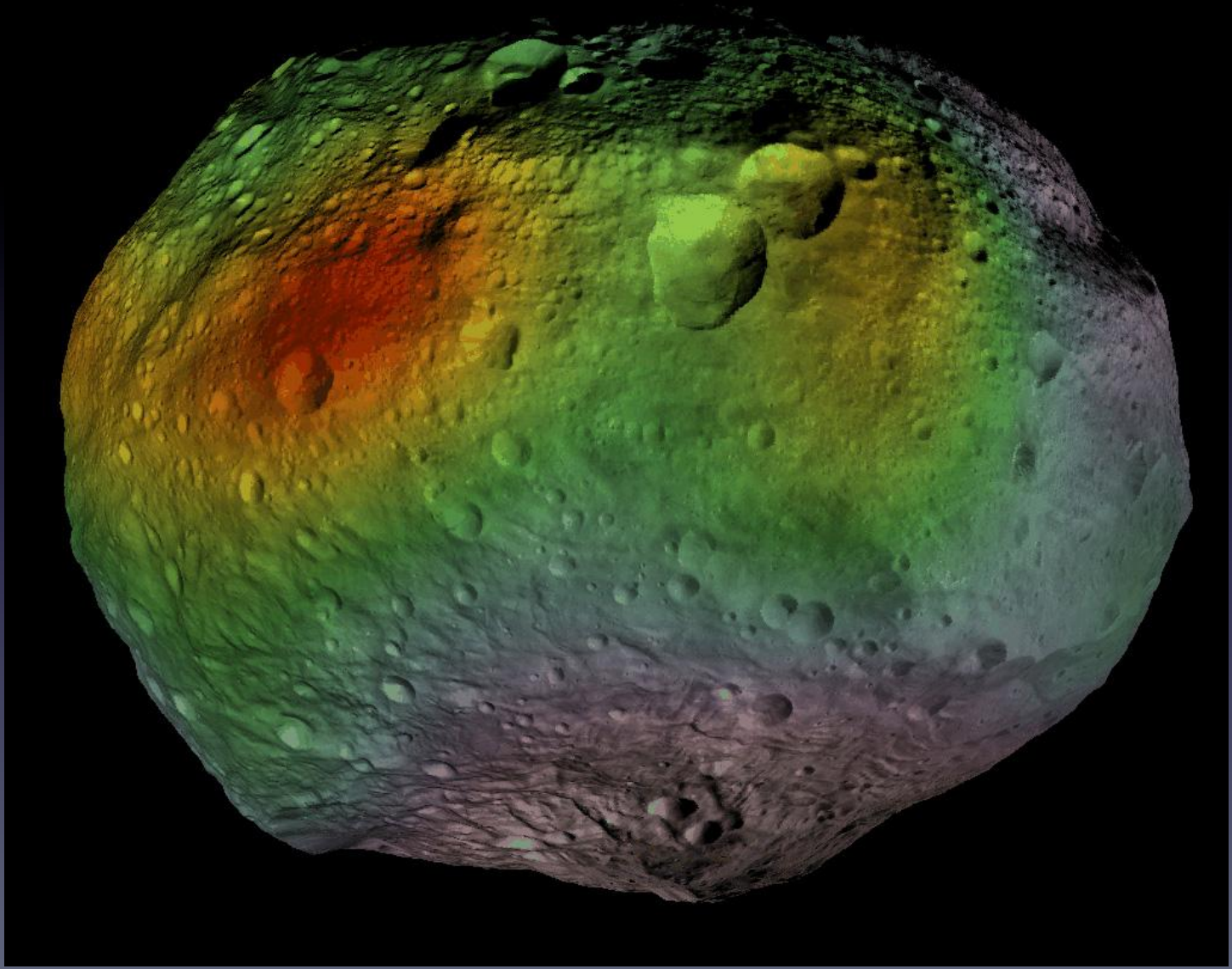
Rheasilvia's central peak is more than twice as high as Mt. Everest – rivaling Olympus Mons on Mars as the tallest mountain in the solar system



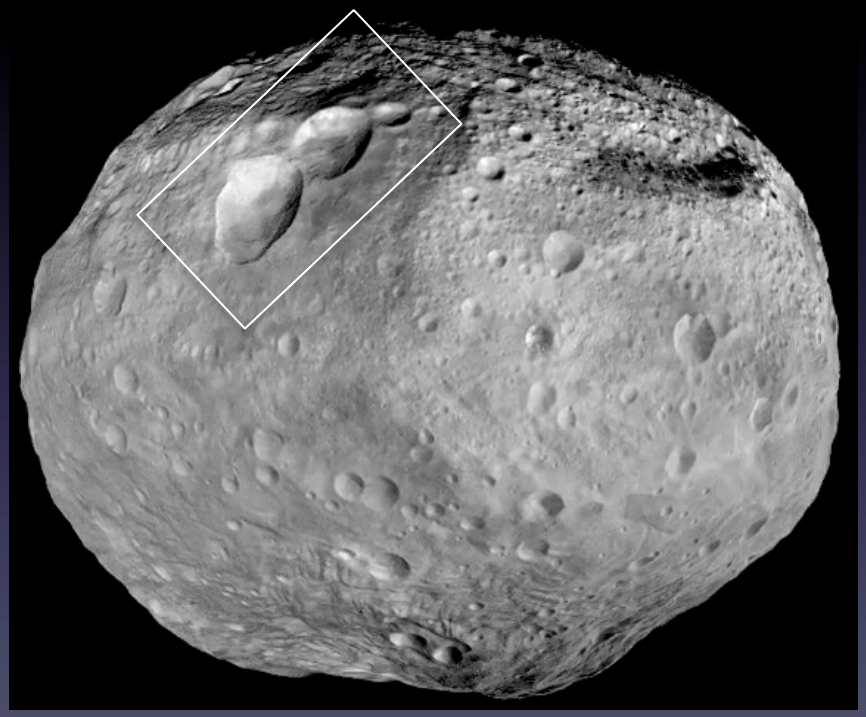
-14 miles

+12 miles

Hydrogen Hot Spots on Vesta



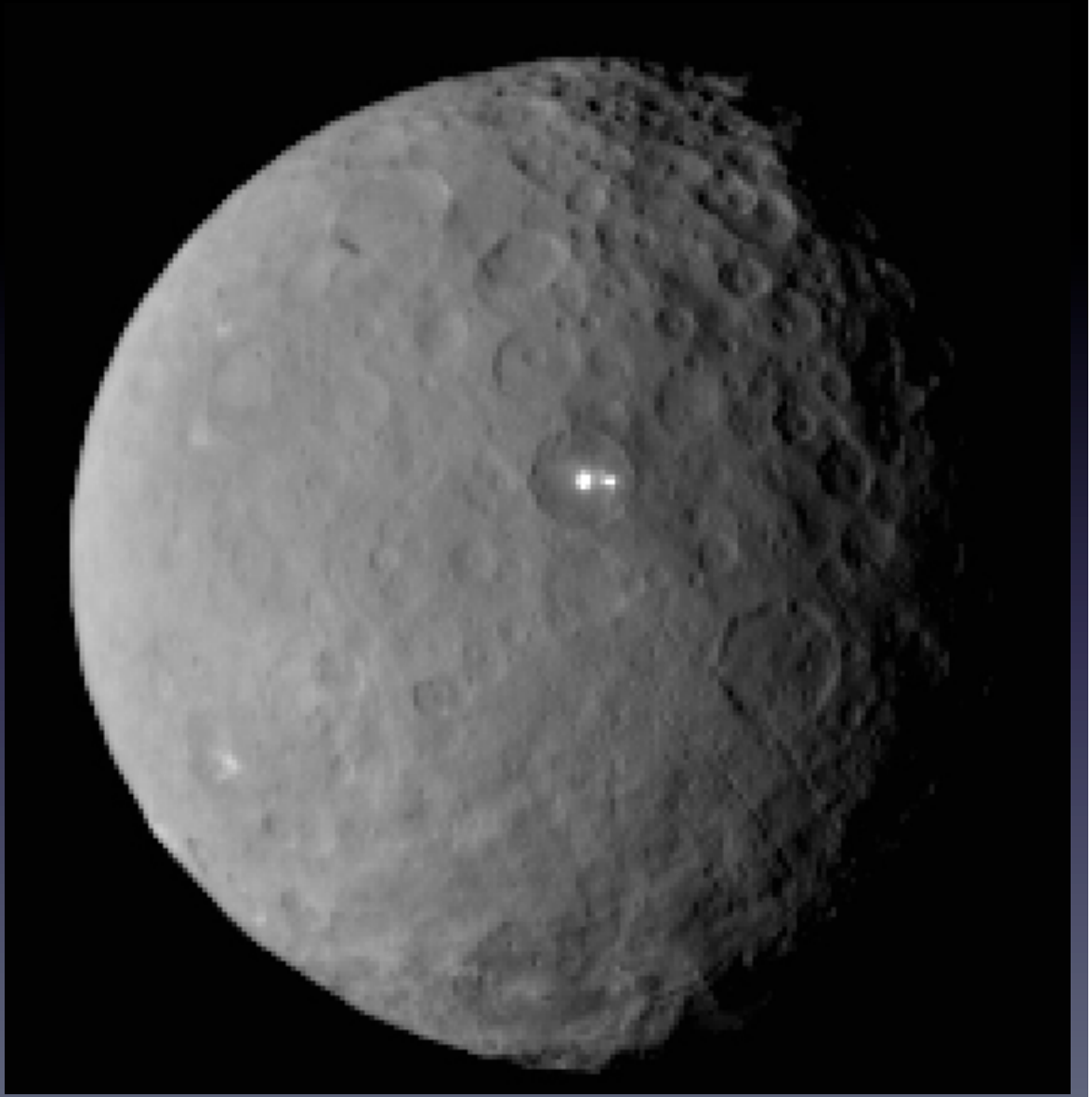
The Snowman



Mysteries on Ceres

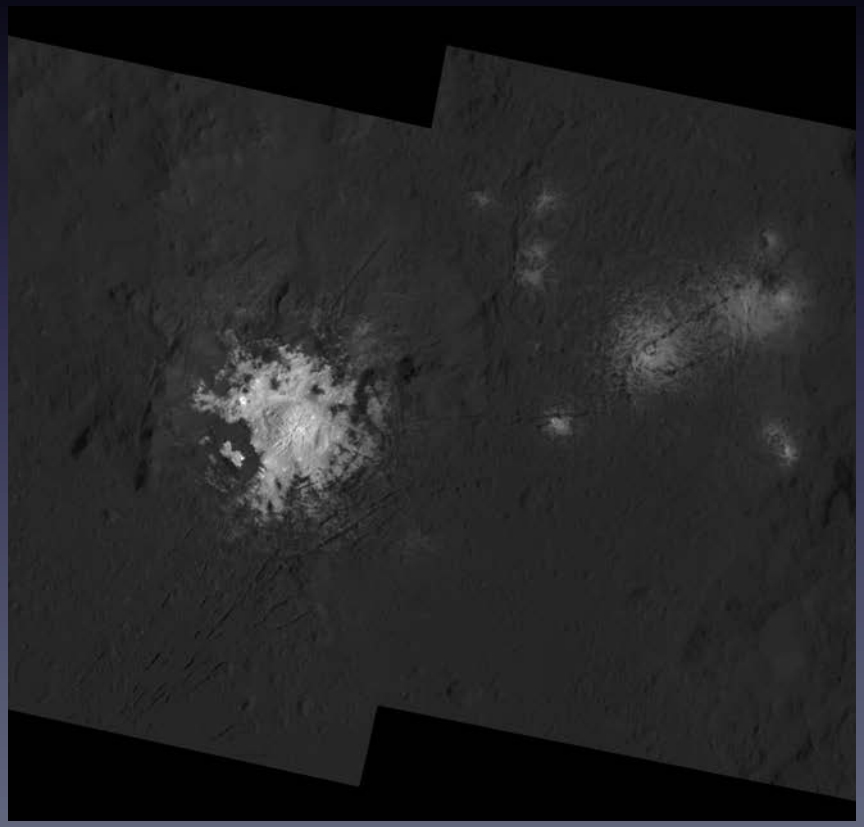
Bright spots revealed from 29,000 miles away

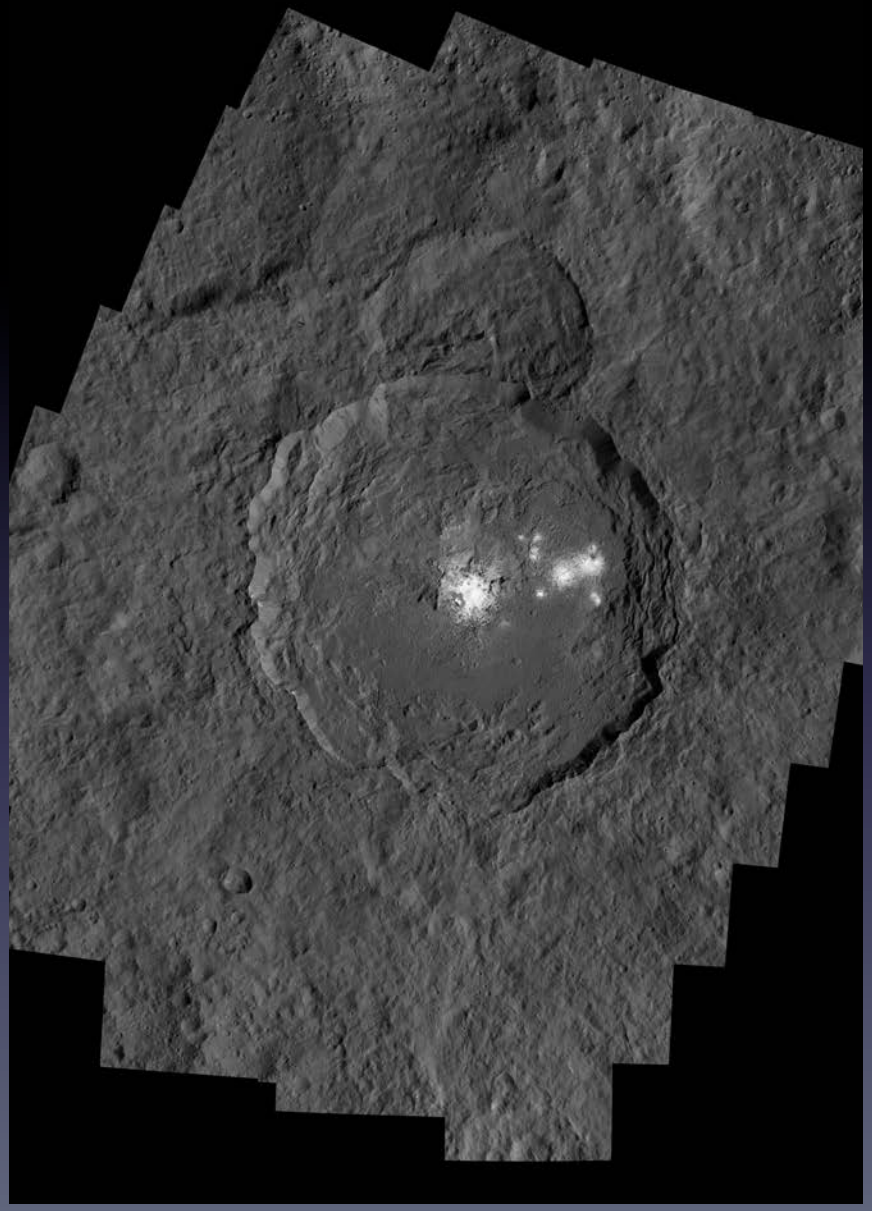
- Volcanic origin?
- Ice?



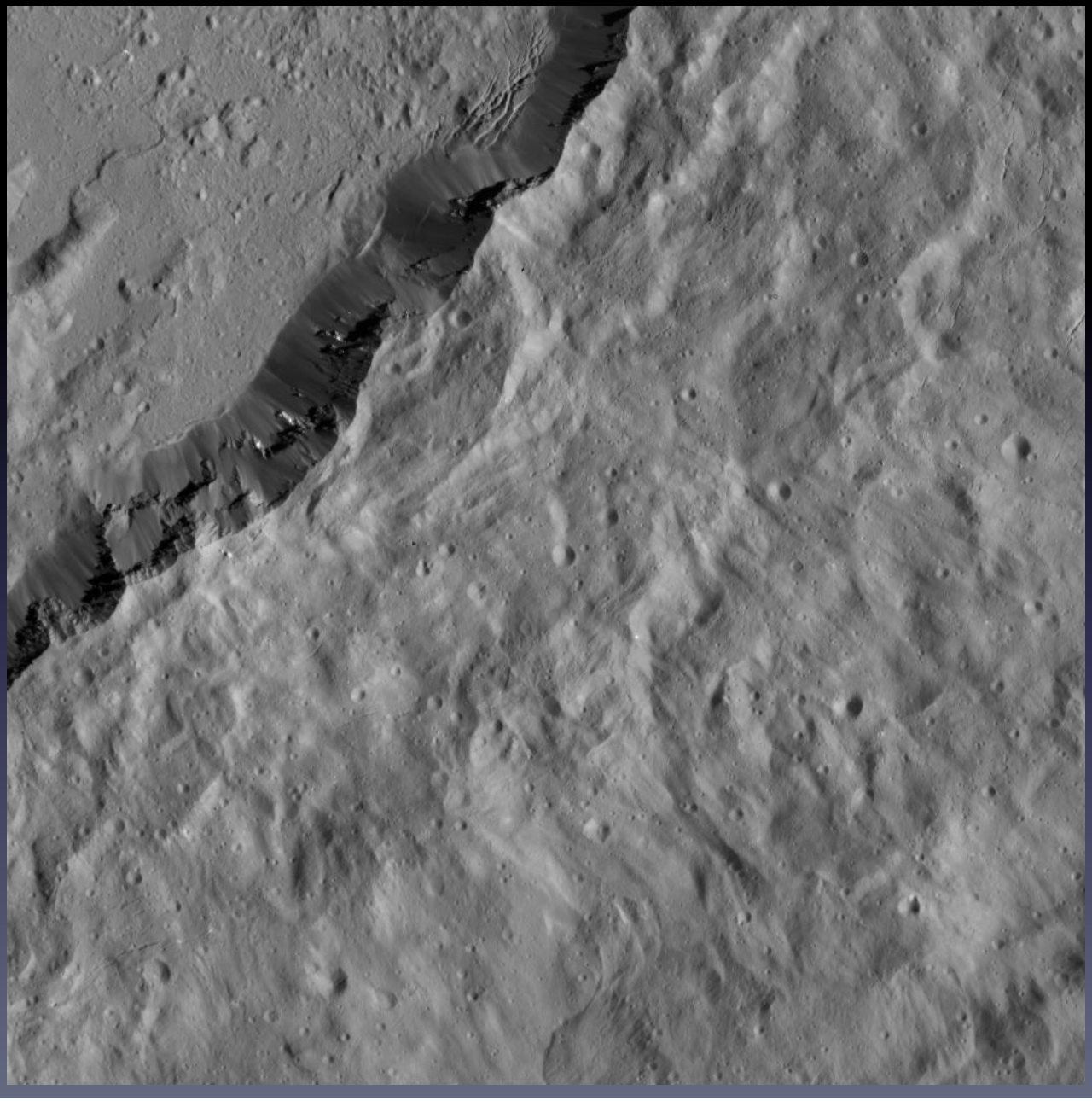
Occator Crater

- The brightest areas on Ceres
- Close-up mosaic taken from 240 miles above the surface
- Bright spots are……

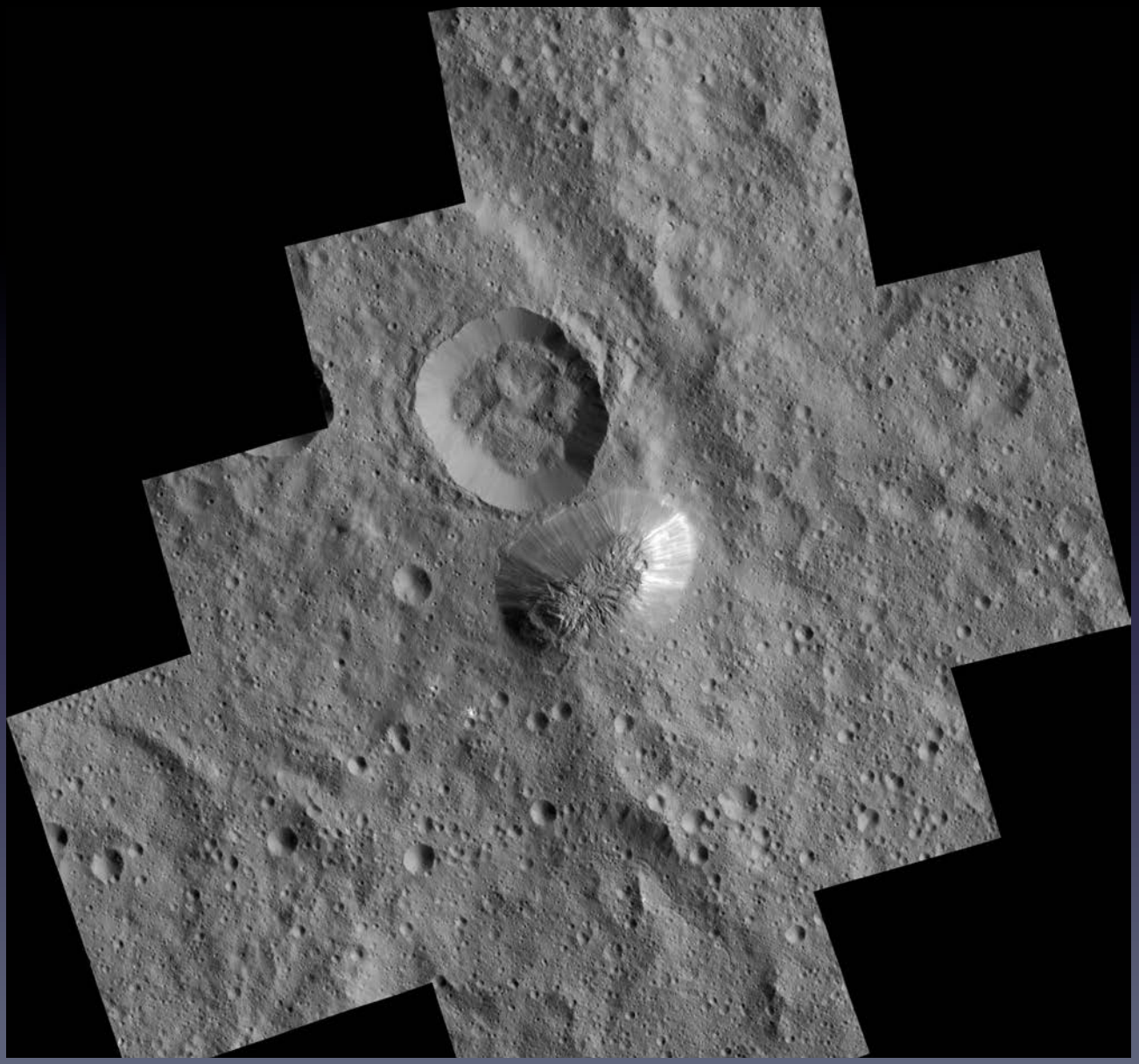




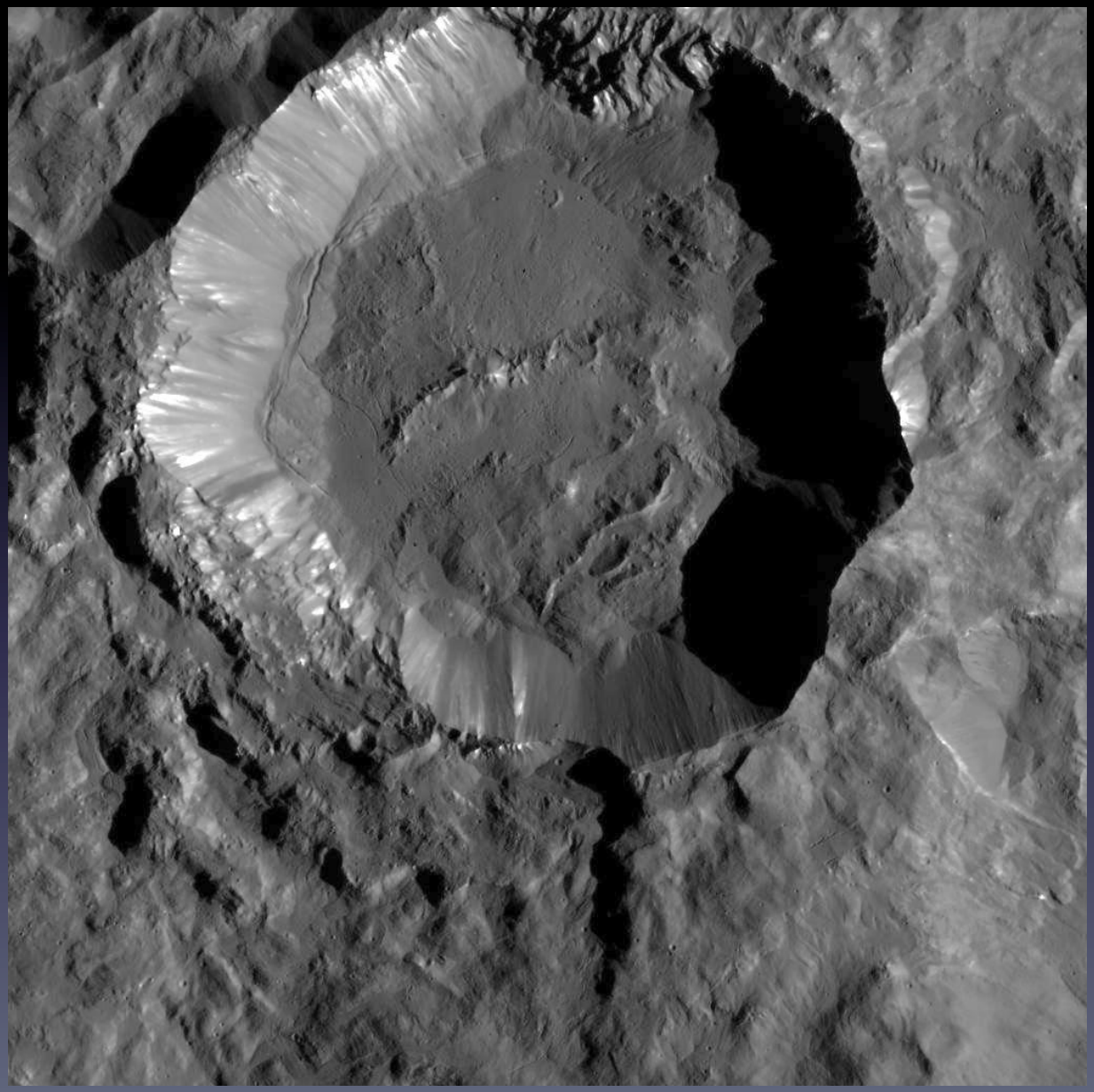
Southeastern Rim of Occator Crater



Ahuna Mons - Ceres Surprise Mountain



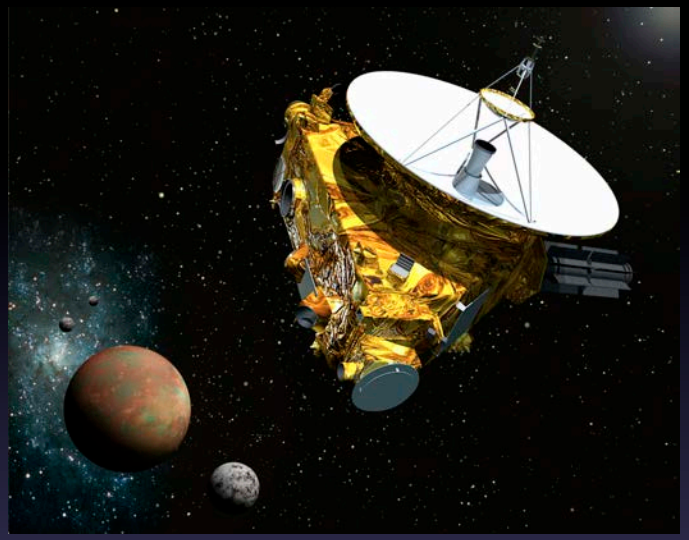
Kupalo Crater

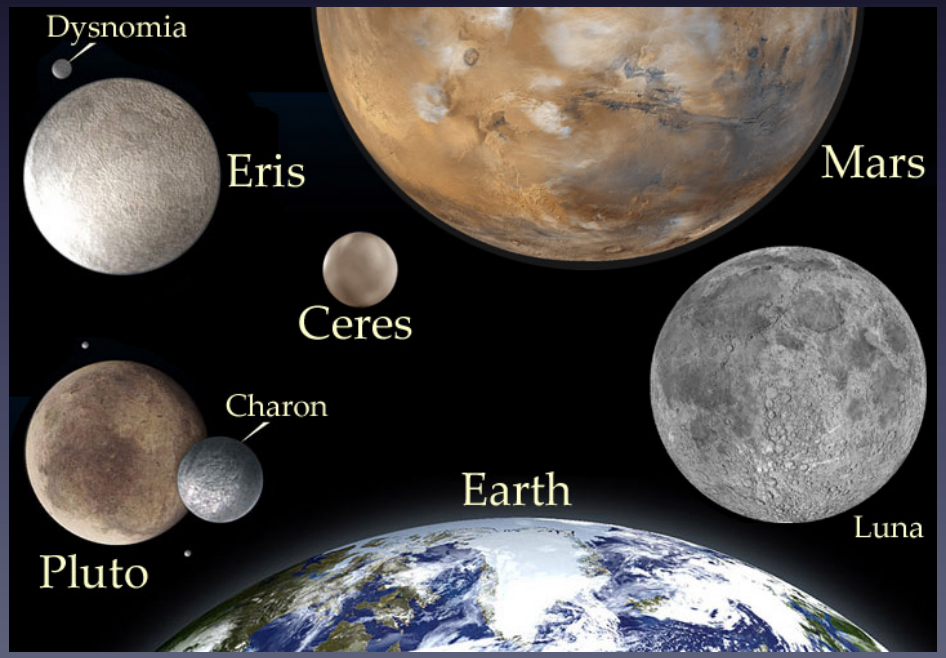


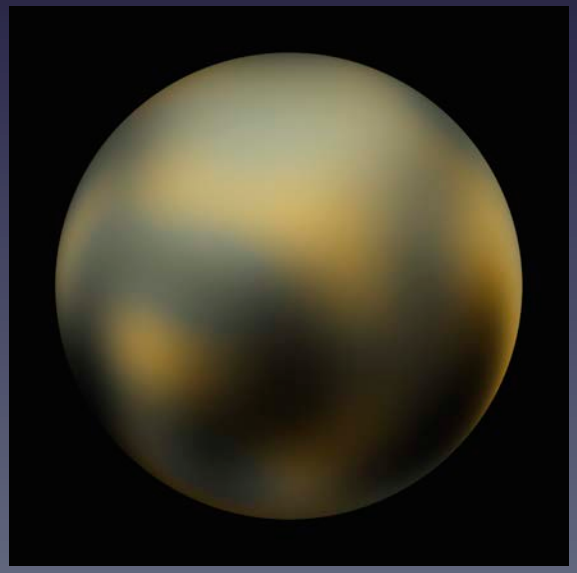
Pluto – WOW!!

New Horizons

First mission to study Pluto, its moons and Kuiper Belt objects, to reveal how ice dwarf planets formed and have evolved over time and where they fit in with other solar system objects

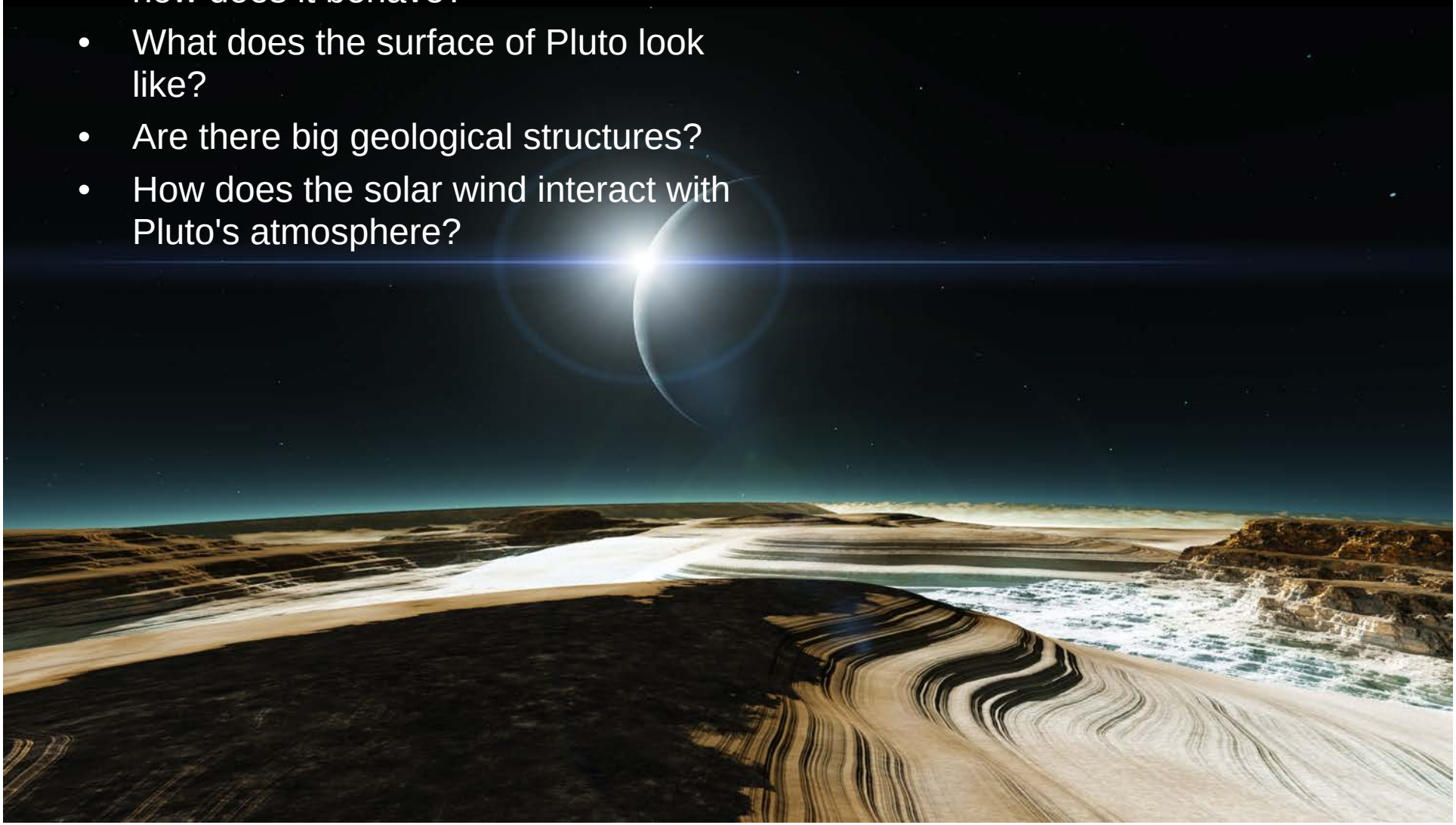


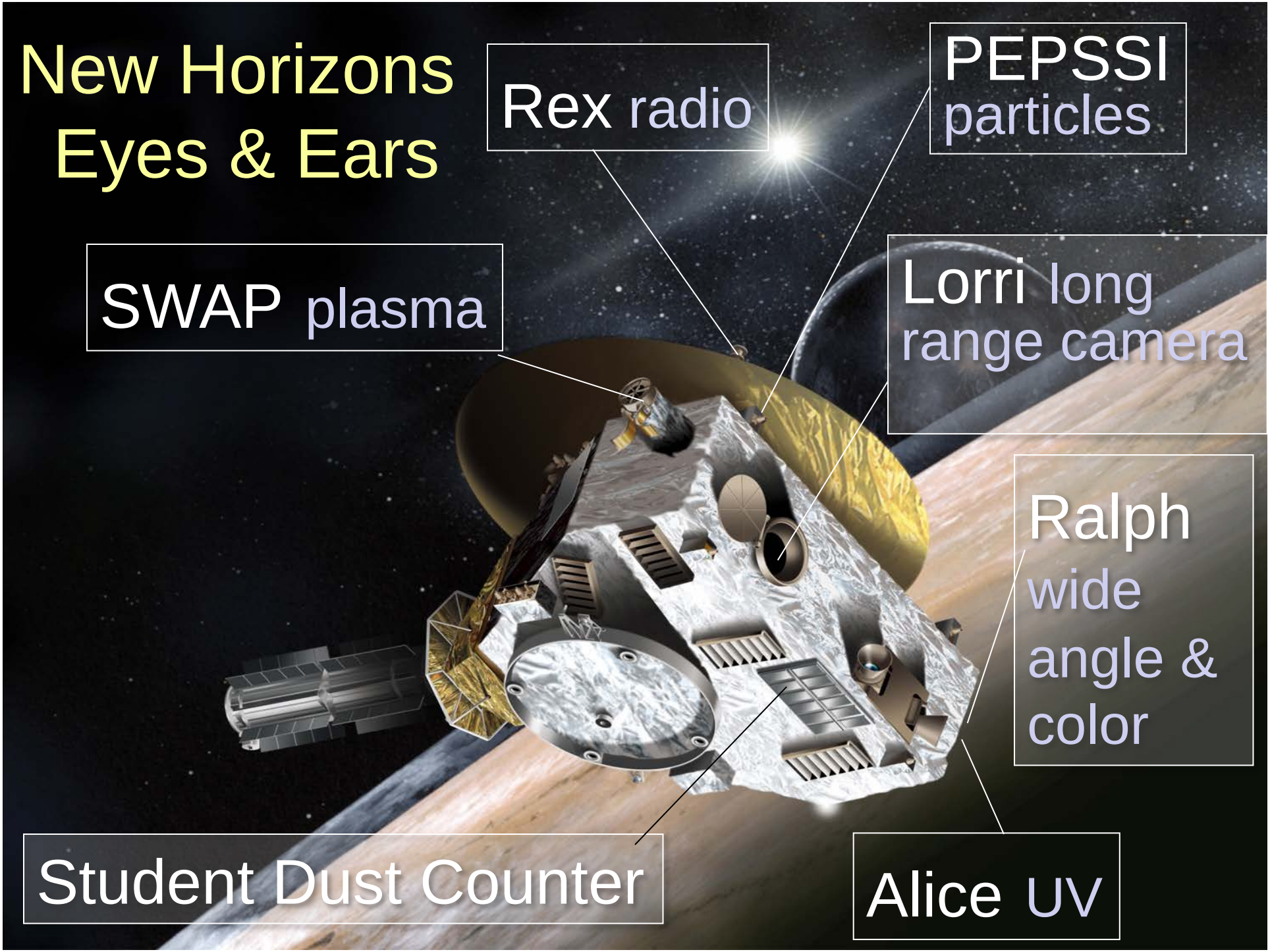




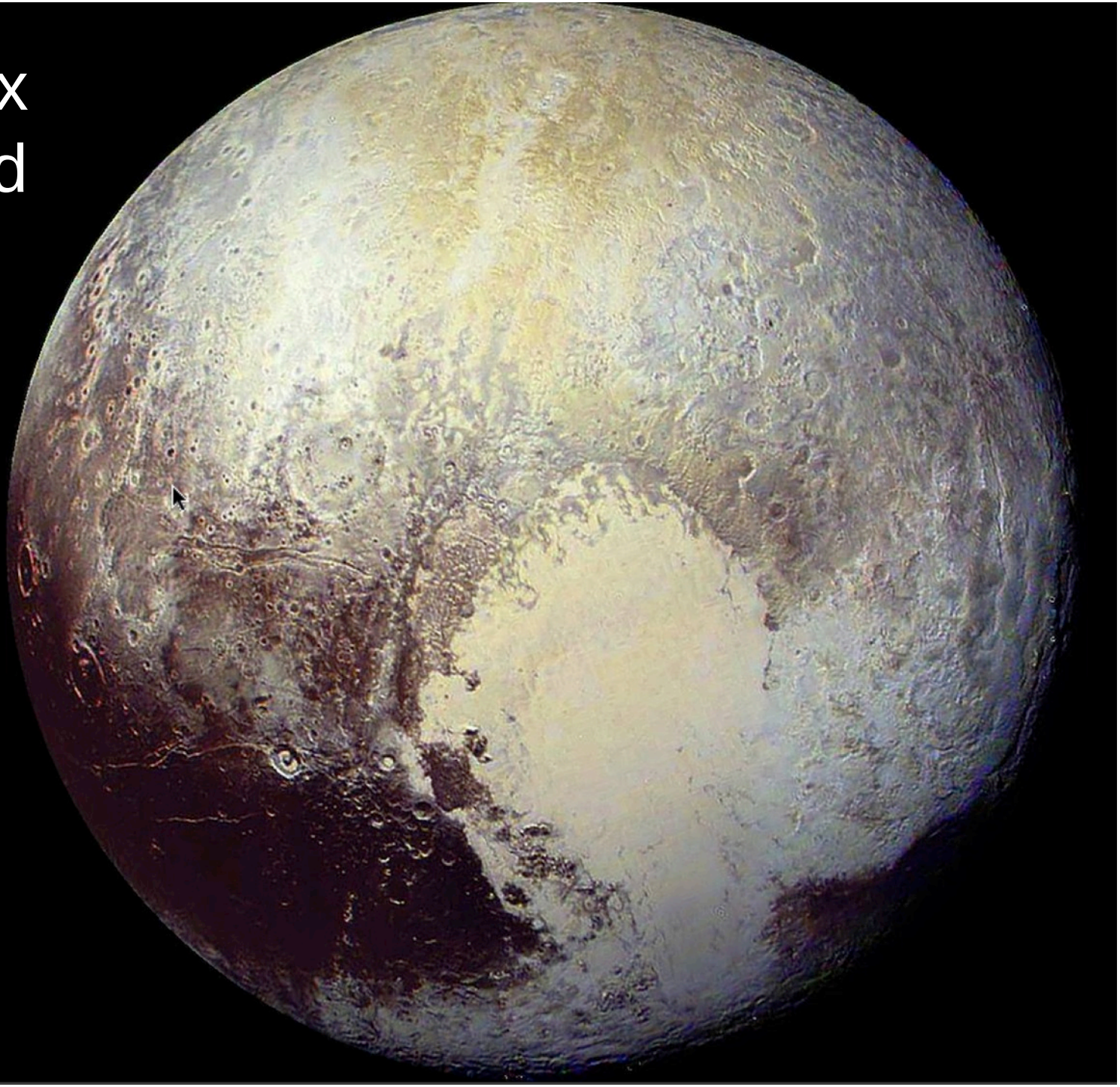
Science Questions

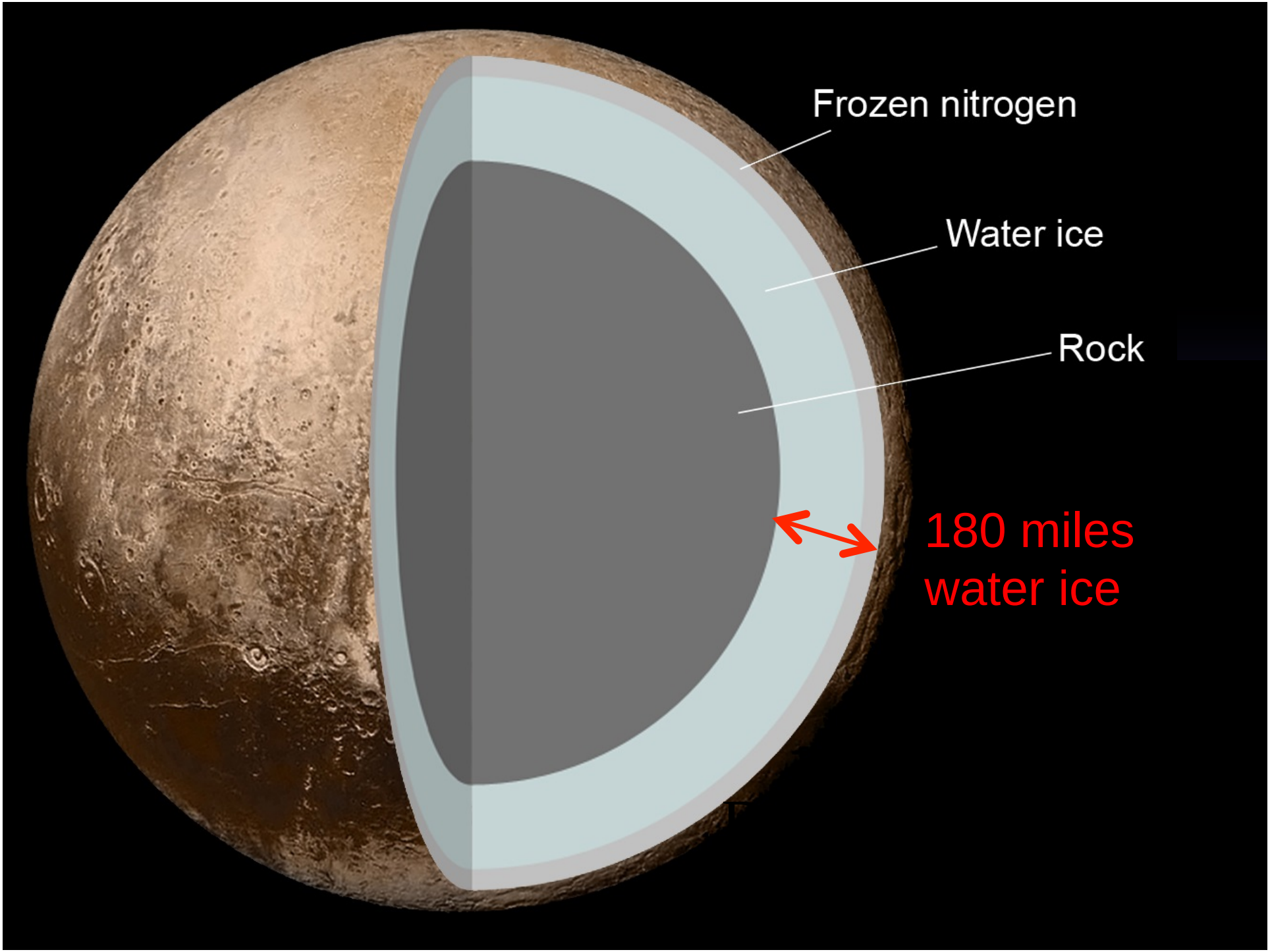
- What is the atmosphere made of, and how does it behave?
- What does the surface of Pluto look like?
- Are there big geological structures?
- How does the solar wind interact with Pluto's atmosphere?



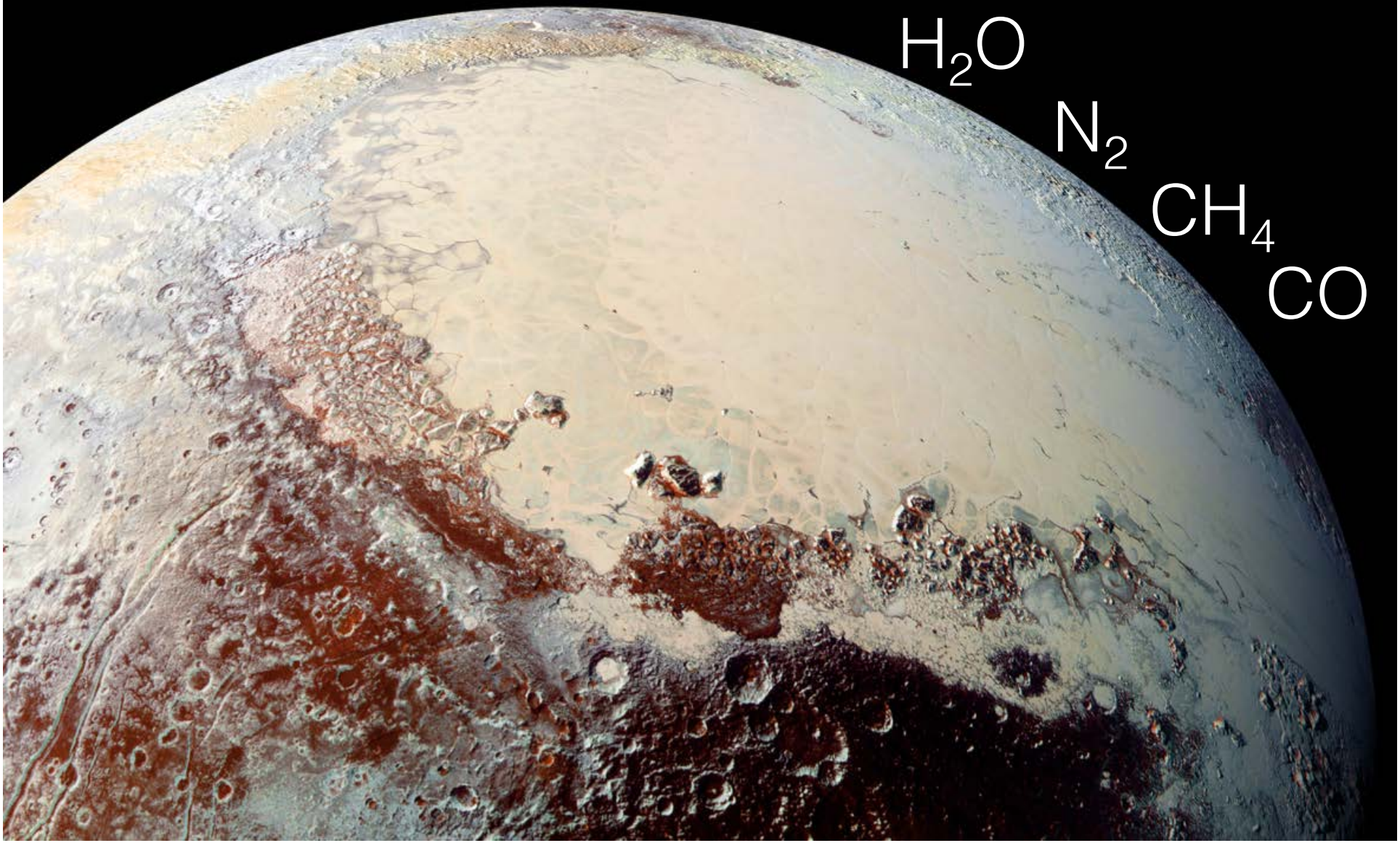

New Horizons
Eyes & Ears
Rex radio
PEPSSI particles
SWAP plasma
Lorri long range camera
Ralph wide angle & color
Student Dust Counter
Alice UV

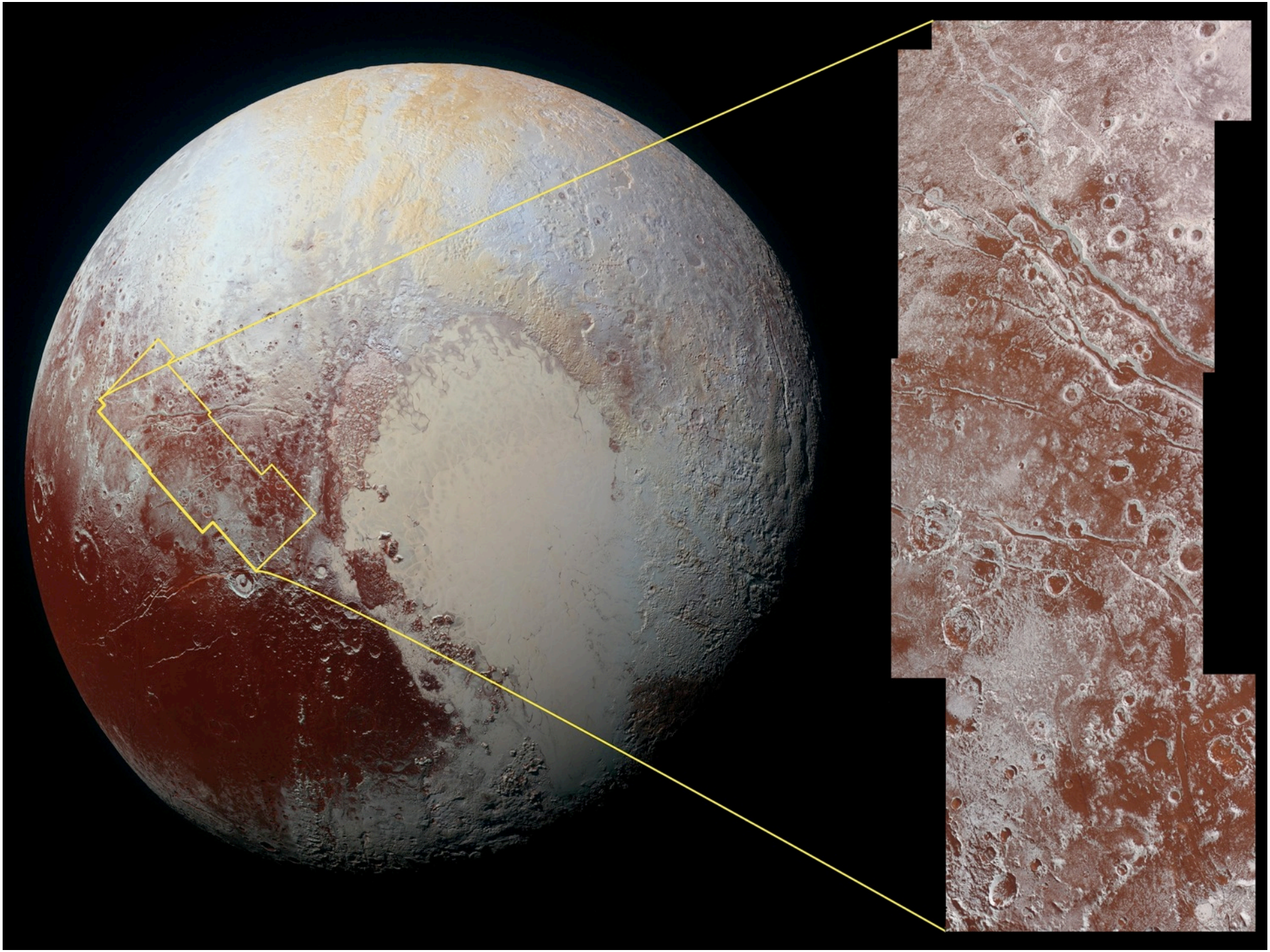
Complex
Ice World
with
a Heart!



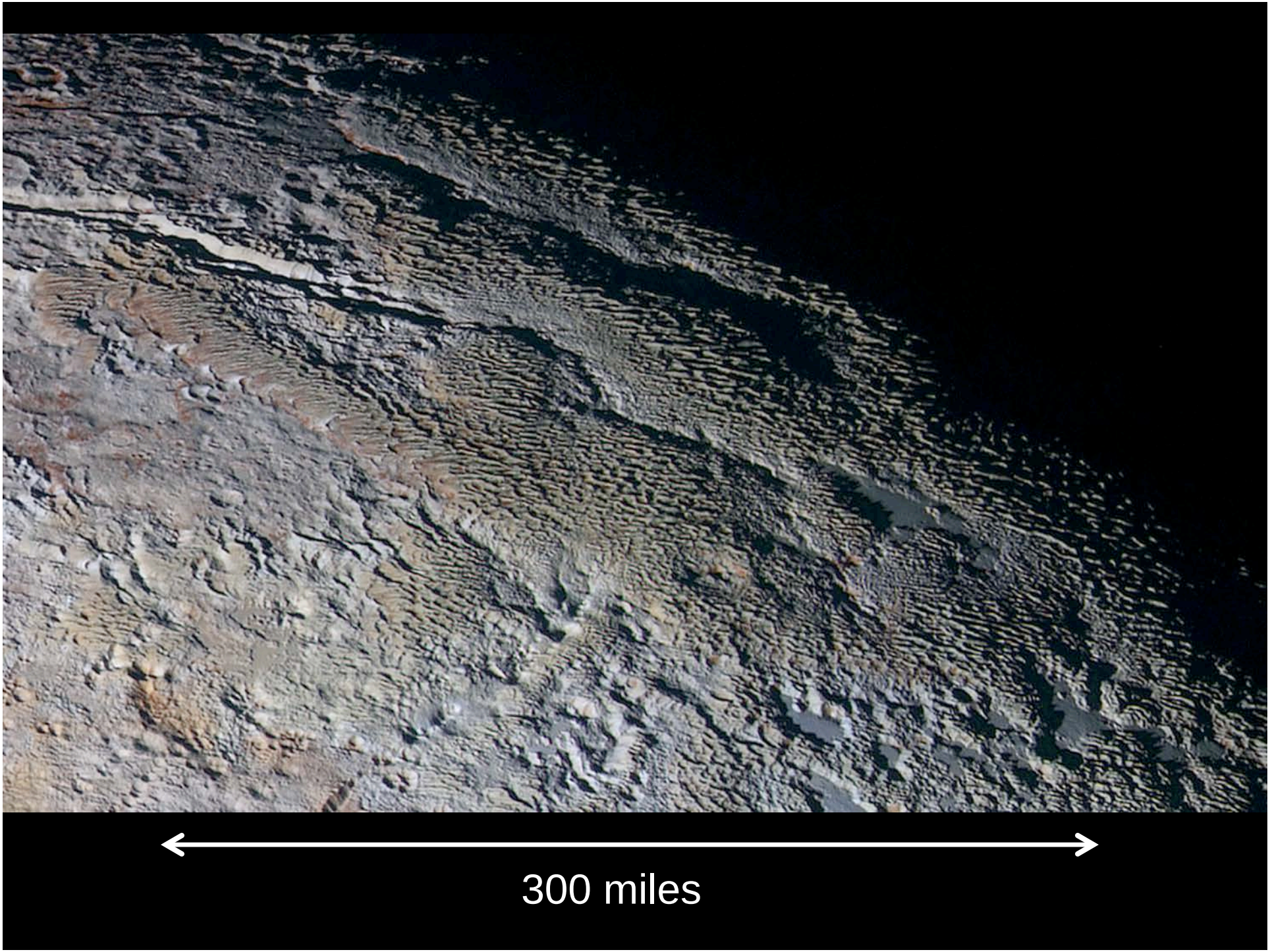

Frozen nitrogen
Water ice
Rock
180 miles
water ice

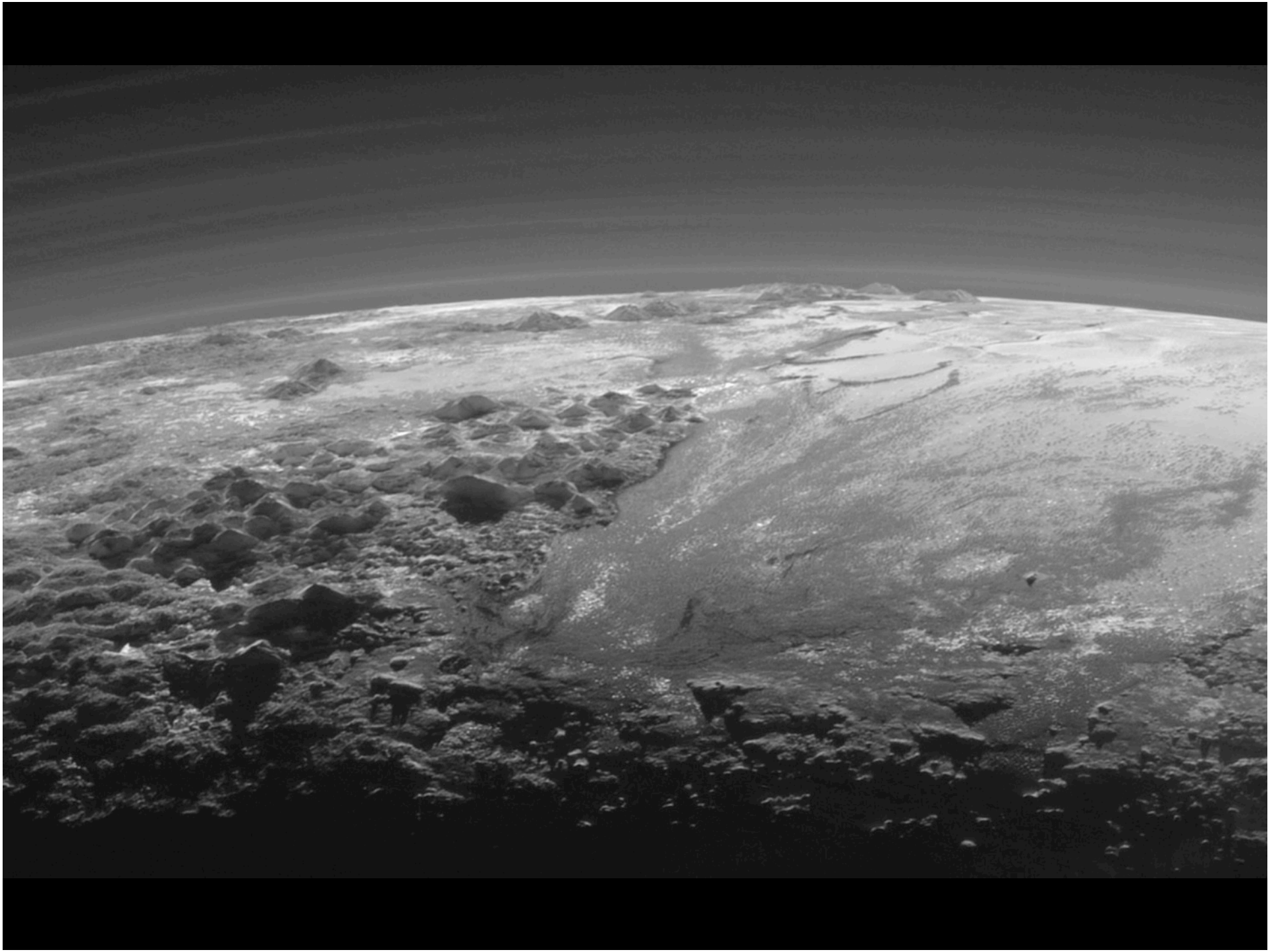
Ice, Ice, Ice!

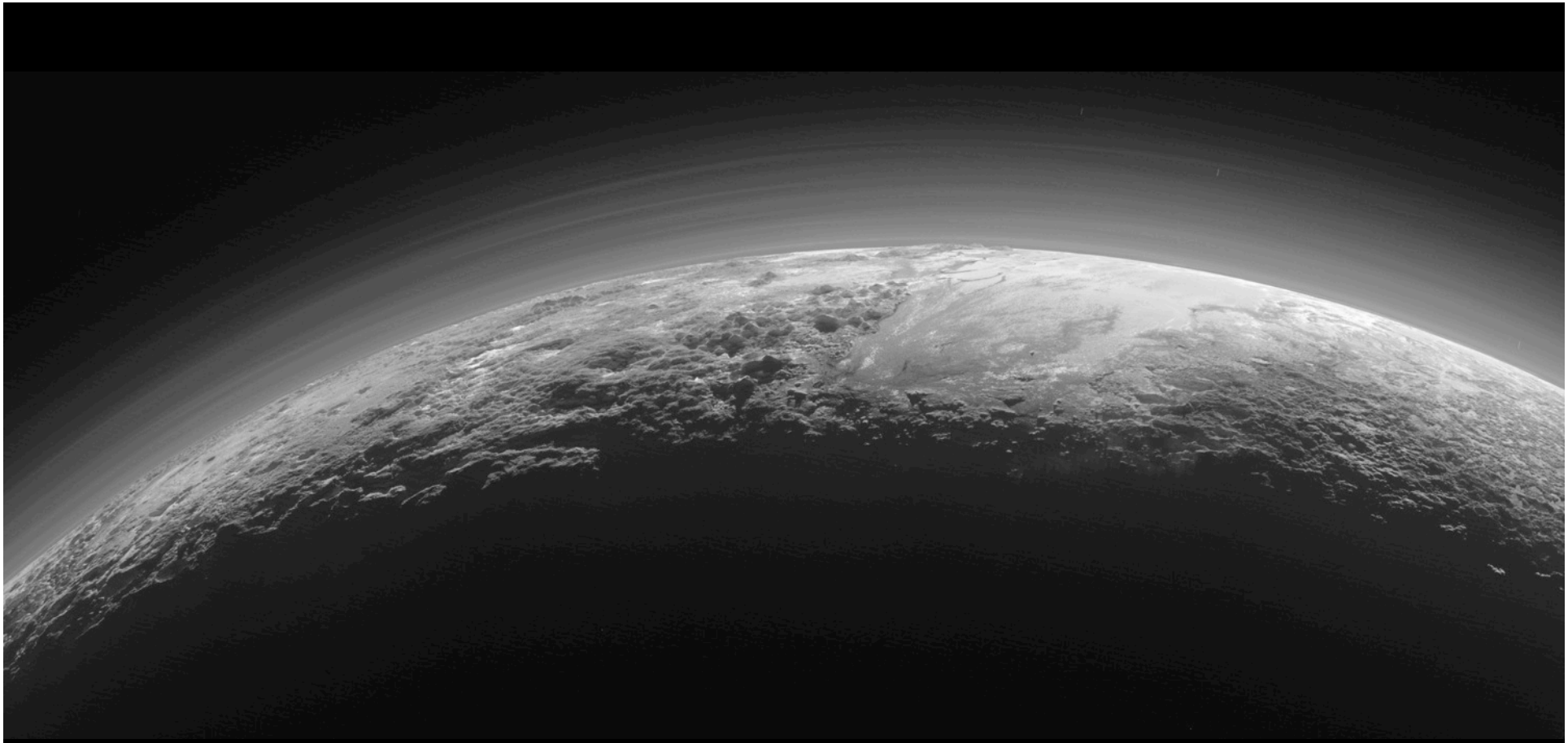




What are these features ??!!


300 miles



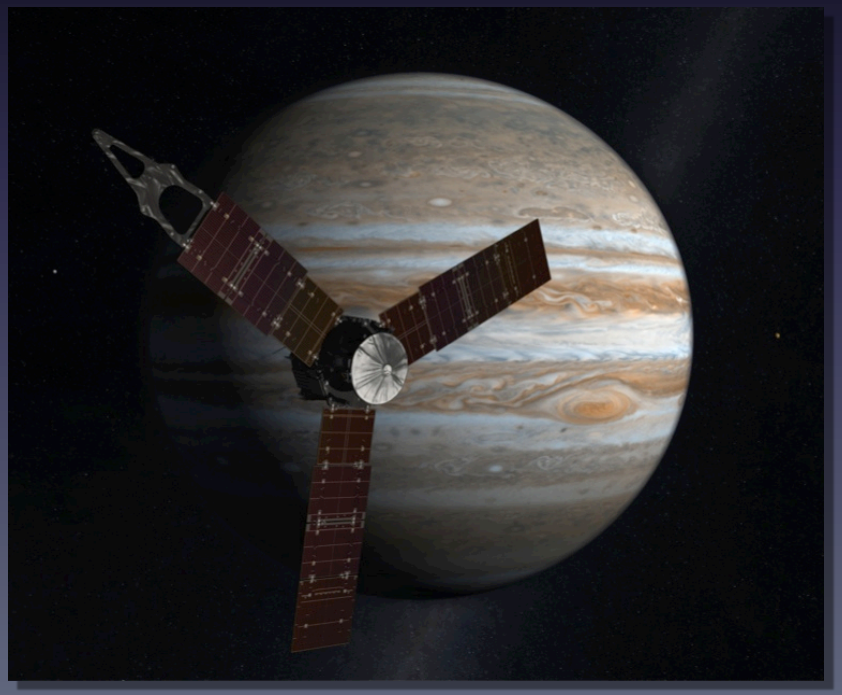


Goodbye Pluto!

Jupiter Orbiter

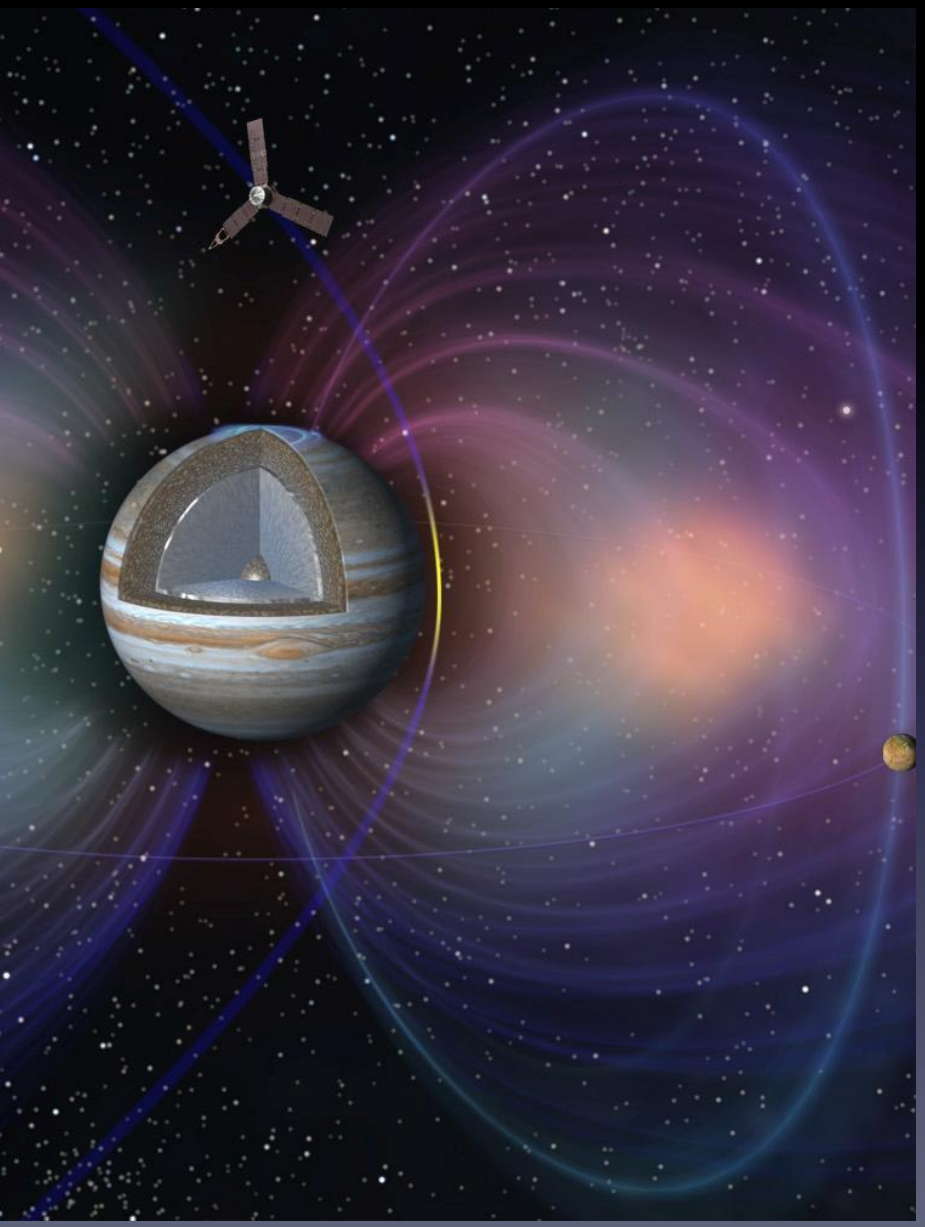
Juno

- How and where did Jupiter form?
- Juno will peer through the clouds to reveal hidden secrets from the formation and early evolution of the our solar system



Juno

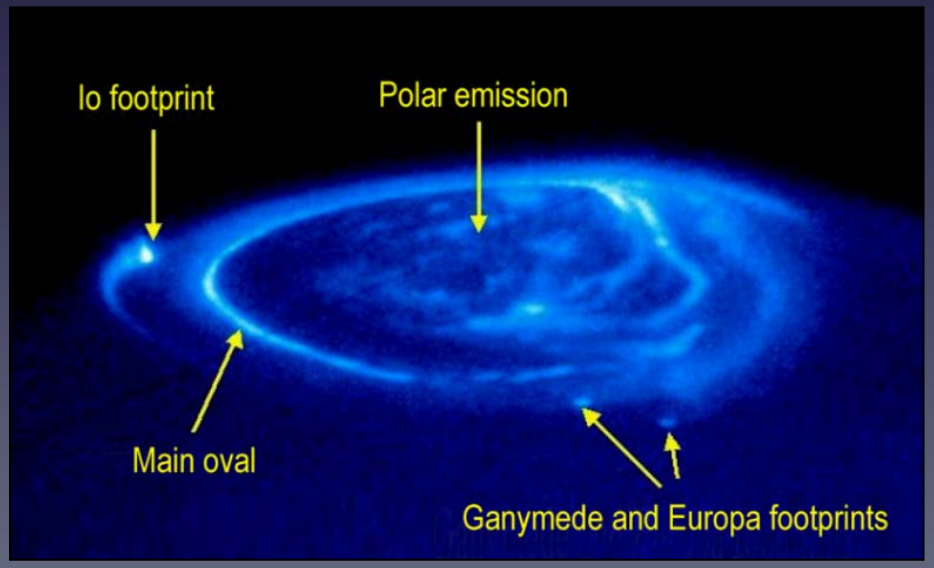
- First solar-powered mission to Jupiter
- Eight science instruments conduct gravity, magnetic and atmospheric investigations, plus the citizen science JunoCAM camera
- Spinning, polar orbiter spacecraft launched in August 2011
  - 5-year cruise to Jupiter, arriving July 4, 2016
  - 16 months of science operations, 32 polar orbits, ending with de-orbit into Jupiter in Feb. 2018
- Elliptical 14-day orbit swings below radiation belts to minimize radiation exposure



Searching for Origins

Gravity Science
Does Jupiter have a core of heavy elements?

Water Abundance
How does the enrichment of Oxygen compare with the other heavy elements?



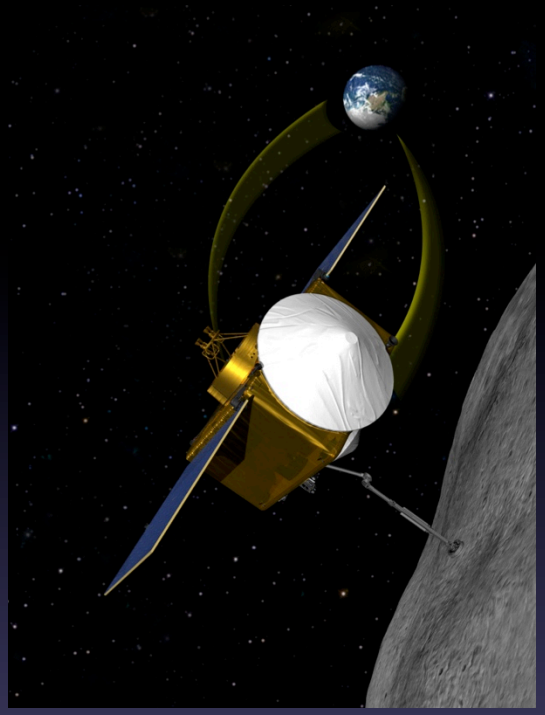
How does the planet's enormous magnetic force field generate the aurora?

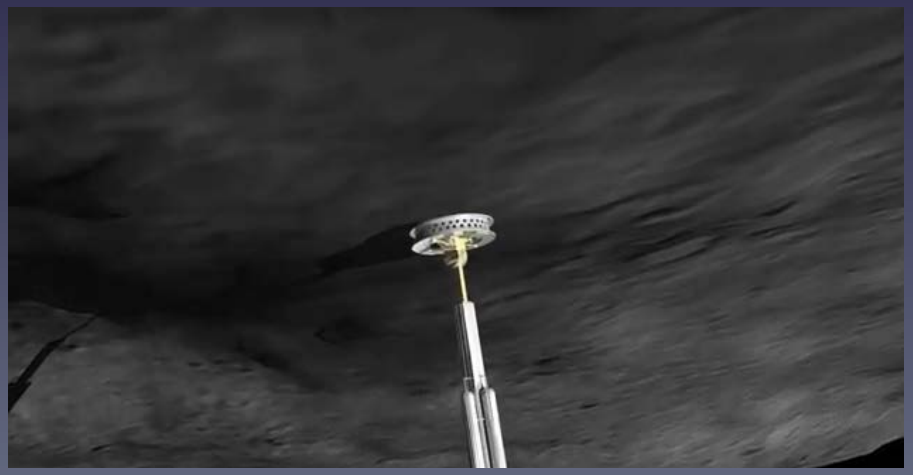
Bringing Asteroid Dirt to Back Earth

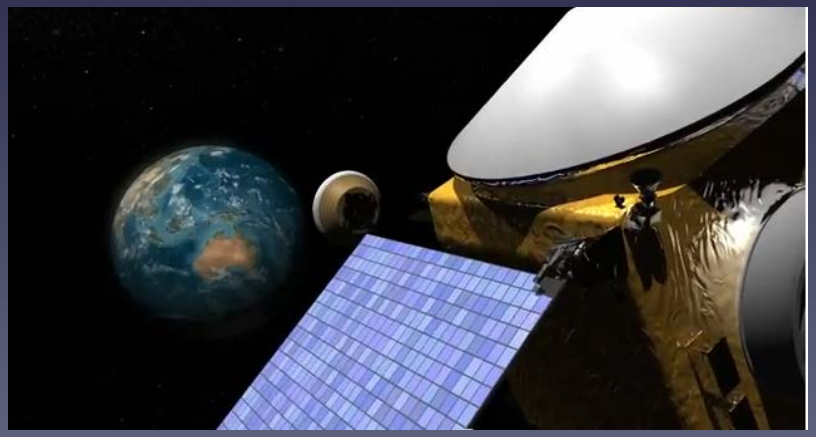
OSIRIS-REx

NASA's first asteroid sample return

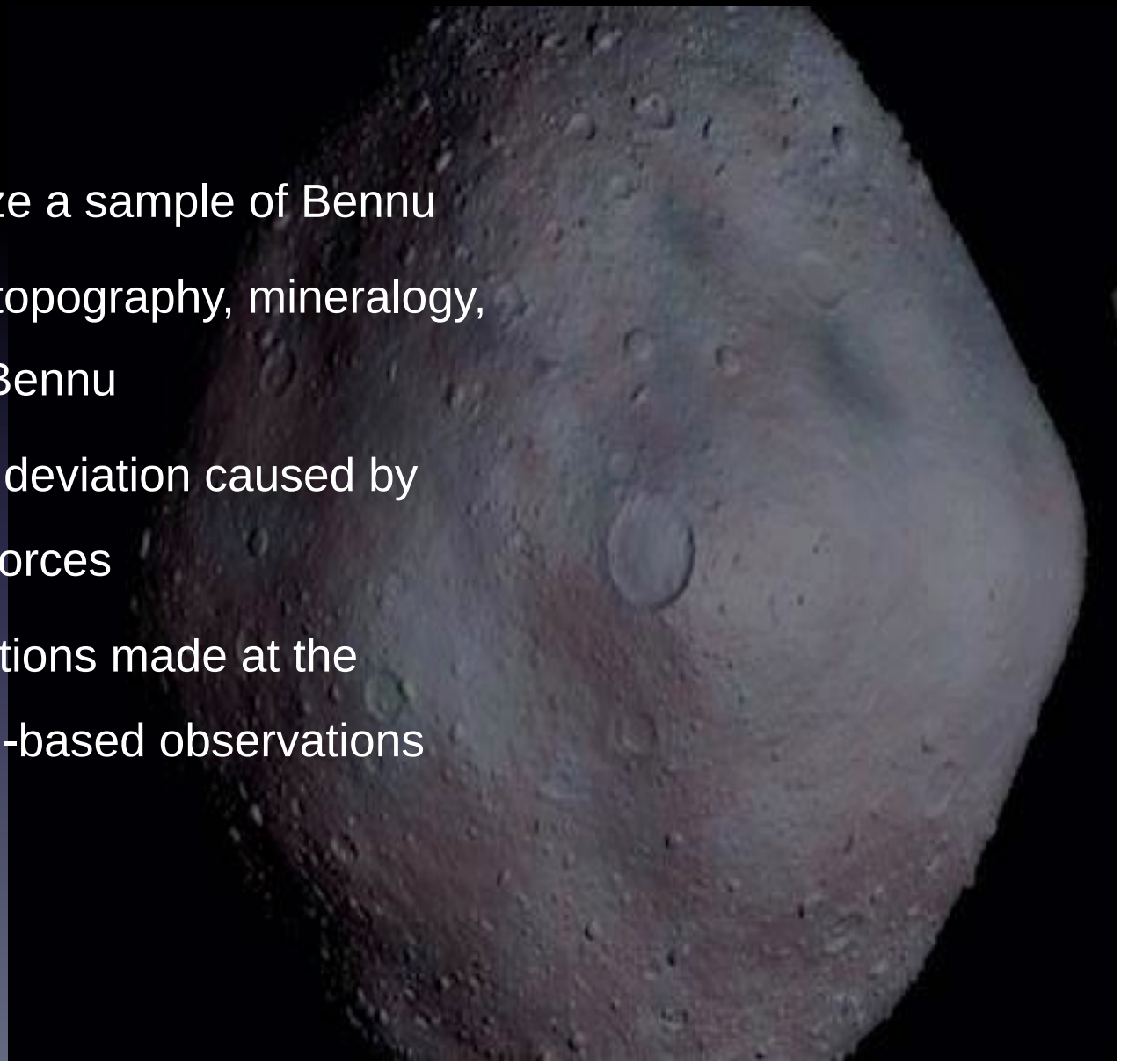
- Sept. 2016 launch
- 2019 arrival at Asteroid Bennu to map, measure, then grab a soil sample
- 2023 return to Earth after a journey of 800 million miles







Science Objectives



- Return and analyze a sample of Bennu
- Globally map the topography, mineralogy, and chemistry of Bennu
- Measure the orbit deviation caused by non-gravitational forces
- Compare observations made at the asteroid to ground-based observations

Instruments

Laser Altimeter provides ranging measurements and global topographic maps, plus maps of candidate sample sites

Regolith X-ray Imaging Spectrometer determines what elements are present on the surface and how abundant they are,

Visible and Infrared Spectrometer produces global mineral and organic spectral maps and spectral information on candidate sample sites

Thermal Emission Spectrometer provides mineral and temperature information to identify physical surface properties

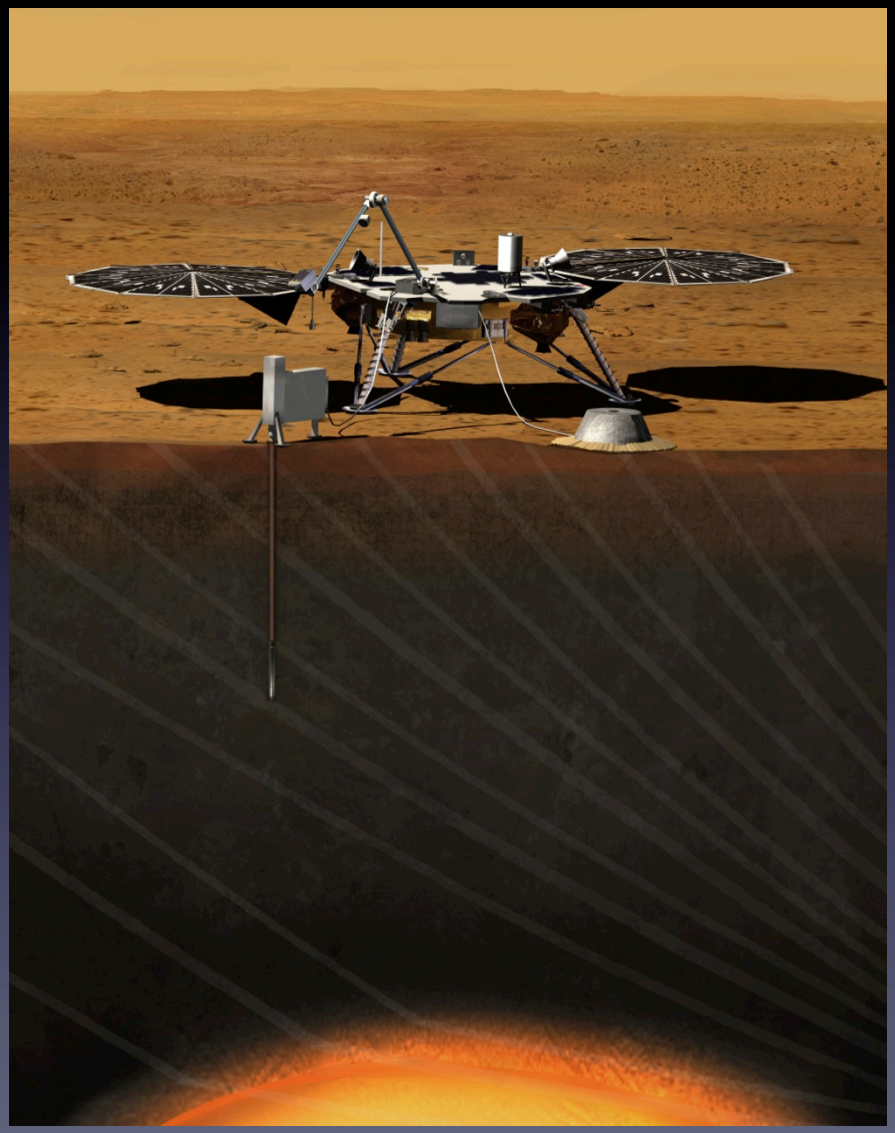
Suite of Three Cameras will capture images of Bennu for global mapping and sample site details, including recording the sample capture

Touch-And-Go Sample Acquisition Mechanism (TAGSAM)

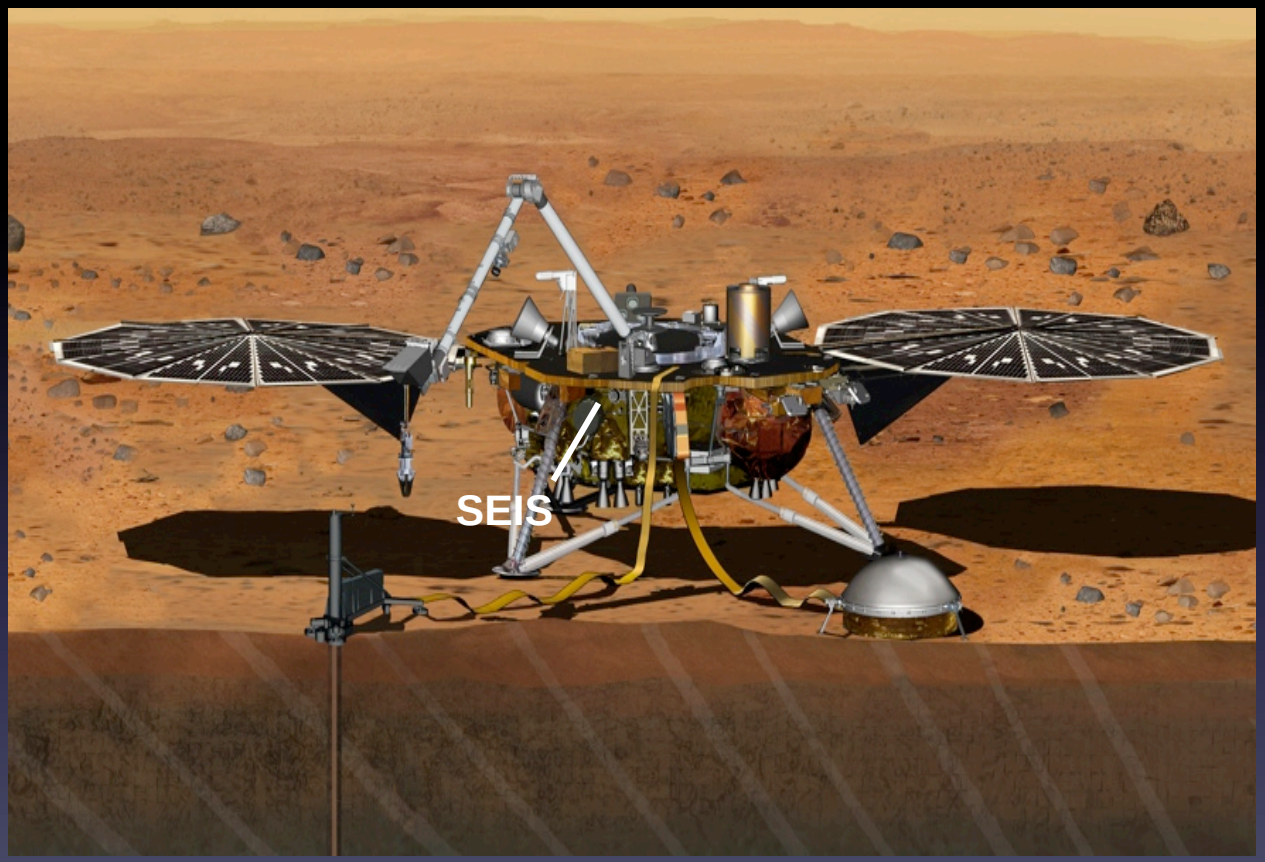
InSight into Mars Quakes!

Interior Exploration using Seismic Investigations, Geodesy and Heat Transport

- Will place a geophysical lander on Mars to study its deep interior
- **InSight** into the processes that shaped the development of Mars
- Increase our understand of how all the rocky planets of the inner solar system, including Earth, formed and evolved



SEIS (Seismic Experiment for Interior Structure)



InSight will carry a seismometer to take precise measurements of quakes and other internal activity on Mars to better understand the planet's history and structure.

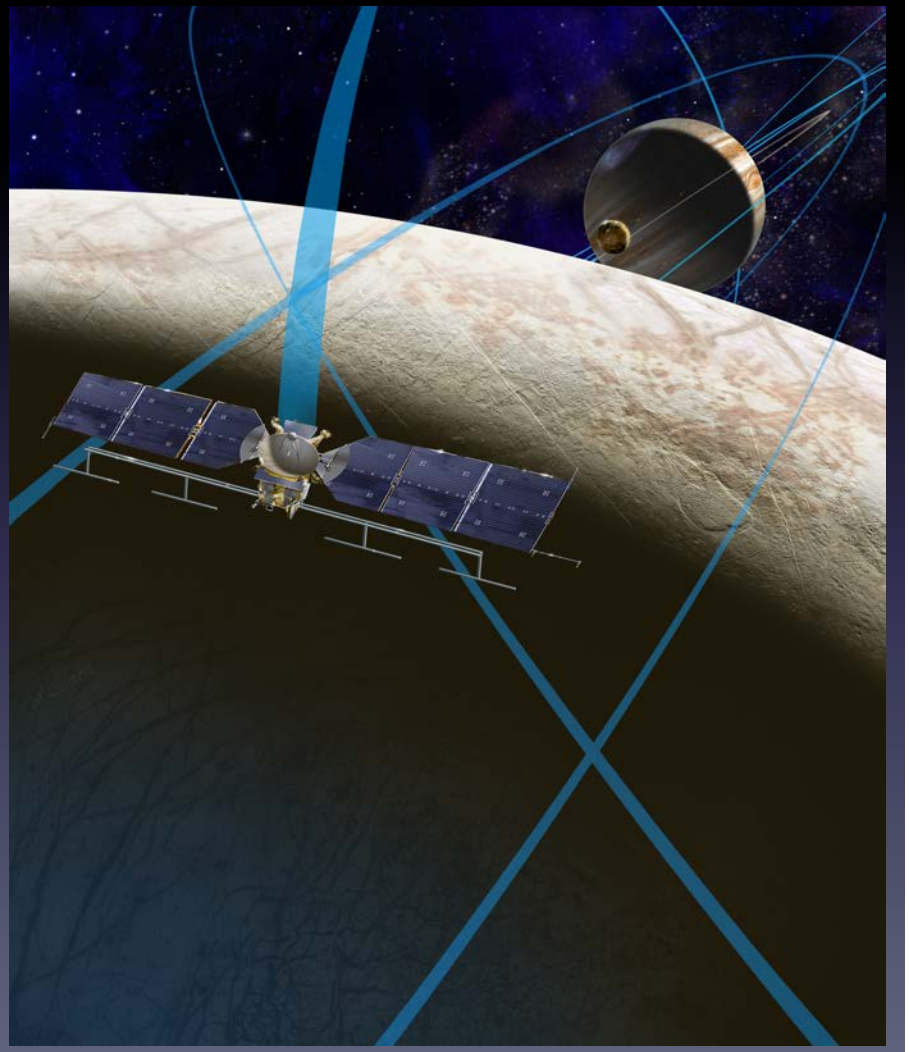
Europa – At Last!

NASA's Mission to Europa

Will orbit Jupiter to conduct a detailed investigation of her fascinating giant moon, Europa

Strong evidence indicates an ocean of liquid water beneath the icy crust - could these conditions be favorable for life?

Launch in early 2020's on a six-year journey to Jupiter



Still in the Very Early Stages

Science instruments selected

- Cameras and spectrometers to produce high resolution images
- Ice penetrating radar
- Magnetometer

Multiple flybys at altitudes varying from 1,675 miles to 16 miles

Opportunities to Participate

Each mission requires hundreds of people to formulate the science questions, build the machines, design the flight path, develop the software, program the computers, create graphics and animations, tell the story and get it launched into space!

Learn More

Find out much more about all these missions that are visiting **New Worlds** and making **New Discoveries**

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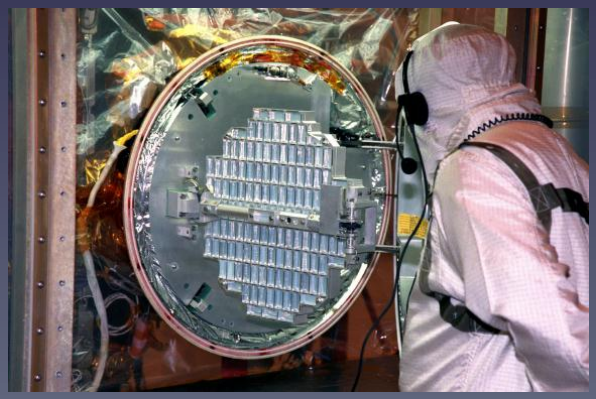
Today's STUDENTS can be part of NASA's exciting work tomorrow!