National Aeronautics and
Space Administration

ART & THE COSMIC CONNECTION

Elements of Art Inspire Planetary Image Analysis

Created by Monica & Tyler Aiello, Artists & Educators
for NASA's Discovery and New Frontiers Programs

Cool new images arrive from NASA missions to planets, asteroids, comets, moons. What do they tell us? Using the elements of art—shape, line, color, texture, value—make sense of what you see, honing observation skills and inspiring questions. Learners of all ages create a beautiful piece of art while learning to recognize the geology on planetary surfaces. We start with what we know here on Earth and use that awareness to help us interpret features on distant objects in the solar system. *Art & the Comic Connection* offers a terrific bridge between Earth and Space Science, as well as a wonderful dive into the potential of science to inspire art—and art to empower science!

PROGRAM OVERVIEW

For the past three decades, NASA has sent many space missions to the planets, moons and small bodies of our solar system. Spacecraft have acted as robotic explorers, capturing images of mysterious alien landscapes using a range of instruments: spectrometers, gamma ray neutron detectors, cameras. These pictures are studied using a variety of techniques including visual analysis, or "looking to understand." Similarly, visual artists depend on their sense of sight to guide their creativity. Both artists and scientists are keen observers of the natural world and engage in creative problem solving.

Artists utilize a system of concepts to make sense of visual information called the elements of art—line, shape, color, value, and texture. Planetary scientists utilize analogous concepts, and the elements of art can be a valuable tool in planetary image analysis. Fusing art and science education proves an exciting and effective method for inspiring students to explore both disciplines.

PROGRAM FEATURES:

Flexible, can be scaled for K-12 students and informal education settings of all kinds.

- *Art & the Cosmic Connection* PowerPoint Presentation

- Easy to follow presentation notes and science notes for expanded content

- Pastel Art Activity to engage students and reinforce concepts

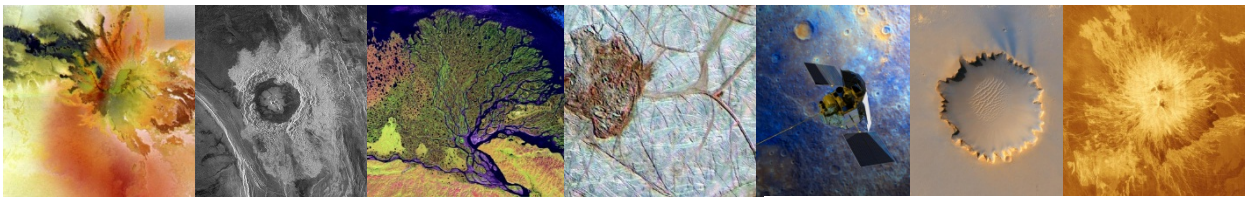
- Beautiful and inspiring NASA images you can print

- **NASA images correlate with current and recent missions to highlight space exploration**
- **Downloadable from the NASA Discovery Program website**

- Program can be a one day or two day activity

-Works with both science and art curricula, providing opportunities for cross-curricular collaboration

-Curriculum has proven success with both youth and adults via schools, universities and museums



Courtesy NASA/JPL

PRESENTATION + ART ACTIVITY

Art & the Cosmic Connection is a 2-part interdisciplinary program developed by artists and educators Monica & Tyler Aiello. Learn more about their work at http://www.studioaiello.net. Designed to engage students in space science education by becoming artist explorers, the project incorporates the use of the elements of art as a tool to investigate and interpret the mysterious surfaces of our celestial neighbors. Students learn to analyze images of planets and smaller bodies such as moons, comets and asteroids with basic art concepts which parallel scientific practice. The project includes a PowerPoint presentation and pastel art activity which teachers can incorporate into their classroom curriculum or out-of-school time program. The project is scalable for different grade levels and blends artistic concepts with the investigation of planetary studies and storytelling. Utilizing art-making as a vehicle for scientific inquiry both inspires and engages students—preparing them for a more rigorous exploration of space science and art theory, while gaining a broader perspective of their own planet, Earth.

MATERIALS & SUPPLIES

- **PowerPoint presentation**
- **NASA image prints**
- **Artist drawing paper**
- **Soft pastels or other drawing media**
- **Gummy erasers**
- **Hand wipes**
- **Q-tips**
- **Fixative, either artists' or hair spray (prone to wrinkling the paper) (optional but very helpful)**

LEARNING OBJECTIVES

Space Science

- Explore the basic structure of the solar system
- Appreciate the diverse planets and small bodies within the solar system, including moons, dwarf planets, asteroids, comets, and Kuiper Belt Objects (KBOs are similar to main asteroid belt objects, beyond the orbit of Neptune)
- Introduce current and recent NASA space missions
- Appreciate the concept of remote sensing and how it is used in scientific research
- Apply the Elements of Art (shape, line, color, value, texture) to planetary image analysis and learn how they can be used to recognize geologic processes in Earth science
- Learn about basic geologic processes including impact cratering, volcanism, erosion, and tectonic activity
- Begin to interpret more complex geologic stories
- Create a beautiful piece of artwork inspired by planetary images!

BACKGROUND INFORMATION

CORE CURRICULM CONCEPT: Art Elements Correspond to Geological Features

The elements of art—shape, line, color, value, texture—offer an amazing way to make sense of the geology of planetary surfaces. The core curriculum connects the elements of art to planetary image analysis. This simple concept shows how basic art forms can be sign posts for specific geologic processes – art depicts geology. The Elements of Art can provide a road map for students to interpret planetary images. When there are exceptions to these rules, or if these rules have multiple interpretations, students can learn to use other factors to infer results, just like scientists. As these concepts build, students can combine these elements to understand more complex images, thus discovering geologic narratives and engaging in storytelling.

SLIDE/PRESENTATION RECOMMENDATIONS

GRADES 3-5
Break the presentation into several lessons.

Lesson 1 60-120 min
Introduction to the Solar System: Slides 1-13
- **Have student teams create a KWL chart, and then build one for the entire class.**
- **Explore books to help students develop understanding of celestial bodies**

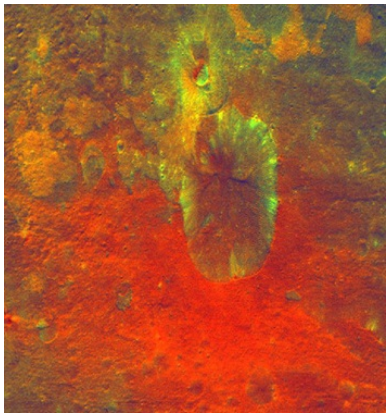
Lesson 2 60-120 min
- **Have each child choose a favorite image. Introduce the elements of art**
- **Choose 2-3 examples of each element of art from Slides 14-58 to illustrate concepts, hiding the rest.**

Pastel Art Activity
- **Suggest a focus on just shape, color, and line to start.**
- **Children are able to appreciate value and texture, too, but try it in context of kids' art creation to keep from overwhelming them with content/talk.**

GRADES 6-10
90-120 min
- **Encourage students to engage actively in the PowerPoint; noting features and writing down ideas are ways to keep participation lively.**
- **Use the PwPt notes to familiarize yourself with the content ahead of the presentation.**
- **Encourage interested students to use the many PwPt links to investigate further.**
- **It is also effective to have small discussions with students about art elements in their particular images in lieu of an extended presentation – the art making leads to rich scientific discourse!**

Elements of Art and their Geology Matches

- **Circle:** When circles are viewed on a planetary image, it often indicates an impact feature, a crater. The size, shape, ejecta blanket (stuff thrown away or ejected from the impact site, material from both the impactor and the area impacted) and number of craters give important clues as to the history of a planetary body. Sometimes circular features are volcanic or tectonic in origin, such as volcanic pancake domes found on Venus, for example.
- **Blobs:** Organic shapes, or blobs, can often be interpreted in two ways. Blobs frequently mean that one is viewing volcanic processes and lava flows. Blobby shapes can also indicate existing bodies of surface liquid (rivers and seas) or ancient bodies of liquid that left remnants of dried beds.
- **Straight Lines:** The presence of straight lines on a planetary body is often indicative of tectonic activity, including faults, ridges, cracks and mountains. On Earth tectonic activity is thought of as a land phenomenon; it can also be present in icy worlds.
- **Squiggly Lines:** The presence of squiggly lines on the surface often tells us forces of erosion are at work, including that of liquid and wind.
- **Color:** In addition to visible light, scientists image planetary bodies in many different frequencies of the electromagnetic spectrum (infrared, radio waves, X-ray, ultraviolet, etc.) They also create colorized images, adding and often exaggerating color differences to show subtle differences that the eye cannot detect otherwise, highlighting distinct aspects of a planet: topography, mineral composition, even gravity! Light and color are critical tools in interpreting and understanding planetary surfaces.
- **Value:** Value is the contrast of light and dark. Its scientific counterpart is called *albedo* - the measure of the reflectivity of a surface (think of snow vs. charcoal—which reflects more light?). Value/Albedo is a critical tool for understanding a planetary body.
- **Texture:** Implied texture is the tactile quality of a two-dimensional surface which we can see with our eyes, yet not touch. Images of planetary bodies are replete with various textures corresponding to eons of geologic history. Geologic processes build over time to create complex textures which can be deciphered with the aid of the other art elements.



TEACHING PART 1: Art & the Cosmic Connection PowerPoint Presentation

The presentation uses many beautiful NASA planetary images to illustrate concepts. It is flexible and scalable for various ages, experience levels, and time requirements. To prepare, teachers are encouraged to review the PowerPoint and make appropriate revisions for their particular students (see sidebar page 3), depending on the curriculum you would like to cover. The PowerPoint includes extensive ***Presentation Notes*** to guide teachers through the curriculum. The notes serve as a basic script and also include question prompts to encourage class discussion. There is also a ***Science Notes*** section with links to NASA web resources for educators who wish to expand their lesson plans.

Courtesy McREL

Show the PowerPoint
After reviewing the PowerPoint and the *Presentation Notes*, show the PowerPoint presentation to your students. The PowerPoint has an introduction to the solar system, an overview of remote sensing and space exploration, and the core concept that describes planetary image analysis using the elements of art.

Getting Started: What Do You Know About the Solar System?
Begin by making a KWL (Know, Wonder, Learn) table on the board or chart paper. Take notes (or invite students to) on the chart paper as students answer the following about the solar system:

- What do we ***know***?
- What do we ***wonder*** about?
- What have we ***learned***?

This forms a baseline of classroom knowledge, helps you be aware of your students' prior knowledge, and promotes inquiry. The KWL can be done in pairs or small groups initially to engage participants actively.

- ➢ If a student states something others are uncertain about, or you believe is inaccurate, post it in the Wonder section to return to for verification later.

Avoid major discussion of the structure of the solar system (including the inner terrestrial planets, outer gas giants, and small bodies including moons, asteroids, comets, dwarf planets, and Kuiper Belt Objects [or KBOs]) until after the main presentation. Images there will help support your discussion.

- Make special note that our activity focuses on worlds with visible geology. Thus, the presentation does not focus on the gas giants themselves, but does appreciate their marvelous moons!

Introduction: Science Inspires Art
The beginning of the presentation briefly introduces students to the painting and sculpture of project authors, Monica and Tyler Aiello. The husband and wife artist team collaborate with NASA and the scientific community in the development of their artwork and educational programs. Students are intrigued to view professional artists inspired by science, and are encouraged to become "artist explorers."

Remote Sensing & Space Exploration
A brief discussion of remote sensing incorporated in the PowerPoint explains how NASA sends robotic explorers to planetary bodies and takes pictures of their surfaces. The images used are shown from the aerial or "birds-eye" view. The planetary images provided correlate to recent and current NASA missions to provide an opportunity to build student interest and excitement in space exploration. The beautiful and often unfamiliar images keep students engaged with the content.

Elements of Art & Planetary Image Analysis
The core concept section relates how the Elements of Arts can be used to interpret planetary images. It is useful to have students define (or for the educator to review) the definitions of the Elements of Art. The remainder of the presentation includes sections for each of the Elements of Art and illustrates the how these relate to specific geological processes using examples of gorgeous NASA images.

- Circle – Crater
- Blobs – Volcanoes or Lakes
- Straight Lines – Tectonic Activity
- Squiggly Lines – Erosion
- Color, Value, Texture – Critical Scientific Tools

TEACHING PART 2: Art Activity

The *Pastel Art Activity* is designed to be a simple, yet fun and engaging way for students to explore the concepts they've learned from the PowerPoint presentation. Students enjoy making art in science class or exploring science in art class, depending upon how the project is taught. This reinforces the connections between the arts and the sciences and engages the students in an interdisciplinary learning environment. The art project can be taught during the same session as the presentation or in subsequent sessions.

Time Recommendations

Grades K-5: two or three 45-minute periods
Grades 6-12: one or two 45-60 minute periods

Supplies

- **Drawing paper** – A larger-sized, fine artist drawing paper is recommended, budgets allowing (22"x28" is great, at least 9"x12"). Students enjoy working with fine art materials and tend to take their projects more seriously. The drawing paper should be appropriate for the drawing media.
- **Drawing media** – Soft pastels are recommended for their ease of use and blend-ability. However, they should not be ingested. Water colors, crayons, markers and pencils are more appropriate for K-2 students.
- **NASA Planetary Prints** – Download from the NASA Discovery Program website, http://discovery.nasa.gov. The prints inspire the students' artworks.
    - Images are both in black and white and in color. Slipping them into sheet protectors is essential for future use; laminating them is more costly but more durable.
- **Gummy erasers** – Can be used effectively with soft pastels to lift pigment and create highlights
- **Q-tips** – Are a great blending tool
- **Cleaning or Hand Wipes** – Pastels are messy but easy to clean up, especially with cleaning wipes
- **Fixative (optional)** - A pastel spray fix can be used; however, it is toxic and should only be used by a teacher or with older or experienced students, and by all in a ventilated area. For other students, aerosol hairspray can be used. A light coating will help fix the pastel pigment to the drawing paper.
    - Drawings can also be spray-fixed between layers if they get too heavily loaded with pigment or muddy so that students may work on top of the drawing. This process should be completed or supervised by the educator. A fixative is not necessary.

Implementing the Art Activity

- Have all students select a NASA planetary image to work from; pass out paper.
- Ask students to make pastel drawings inspired by their image.
- Discuss or share images prior to the project, if desired.
- Ask students to pay special attention to the Elements of Art and how they relate to interpreting the geologic history of their image. They may choose to focus on one or two images.
- Explain that students do not have to make their artwork exactly like their image. They are making "art" and should feel free to interpret their image by altering their composition, cropping, color, orientation, etc. This is effectively done using question prompts, such as, *"Do you have to make your artwork black and white like your image? No, feel free to explore color!" or, "Focus on the details that intrigue you."*
- Encourage artists to explain their interpretation. For example, a student may have noticed especially bright areas and picked them out in a certain color.

TIP: Distribute drawing supplies AFTER you explain the assignment above so that students do not work ahead or get distracted. ☺

Artists and activity authors at work, Monica & Tyler Aiello

Wrap Up and Formative Assessment

- At the conclusion of the art activity, display artwork and discuss the project. Here are two possible approaches.
  a) Conduct a **gallery walk**, where student art is hung up, with its inspiring image beside it, and students spend time viewing all. Ask all present, kids and adults, to offer observations about what strikes them about the drawing on sticky notes to leave for the artist.
     - Examples: "Really nice example of texture!" "What is your interpretation of that feature?" "Your blending really made those colors pop out!"
  b) Break students into small groups (mix up the class so kids see others' work). Ask students to do a **think-pair-share**, where they write about their experience for a couple of minutes on a sticky note, share their ideas with a partner, and then with a small group.
     - Reflect on the selected planetary image: interpret the geology of their image, and discuss how they used that image to inspire their artwork.
- Ask students to share something new they have learned from the activity with the entire group.
- Conclude by returning to the KWL chart to record:
  - What have we ***learned***?
  - What do we ***wonder*** – what **new** questions do we have?
- Clean up studio or classroom.

Storytelling & Geologic History

- Interspersed within the Elements of Art sections are images with multiple art elements/geologic features. These examples provide students with the opportunity to combine what they have learned to decipher more complex geologic history *(i.e., circles and blobs might be interpreted as craters and volcanoes)*.

NATIONAL EDUCATION STANDARDS

ART & THE COSMIC CONNECTION

Elements of Art Inspire Planetary Image Analysis

SCIENCE

Source: http://www.nap.edu/openbook.php?record_id=4962

K-4

Earth and Space Science
- Objects in the Sky
- Changes in the Earth and Sky

History and Nature of Science
- Science as Human Endeavor

5-8

Unifying Concepts and Processes
- Evidence, models and explanation
- Form and Function

Earth and Space Science
- Structure of the Earth System
- Earth in the Solar System

ART

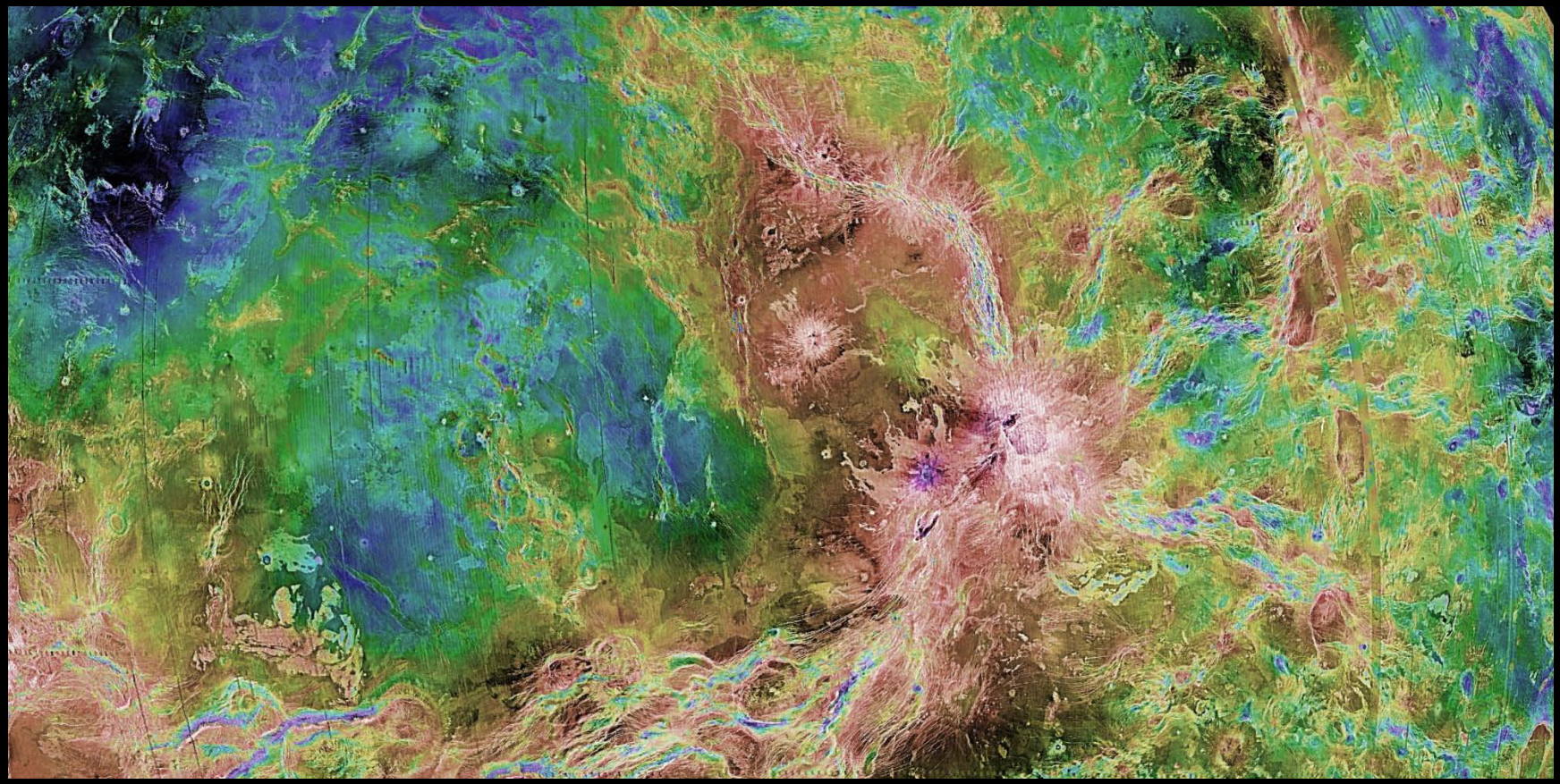
Visual Arts

K-4 **Source:** http://artsedge.kennedy-center.org/teach/standards/standards_k4.cfm
- Content Standard #1: Understanding and applying media, techniques, and processes
- Content Standard #2: Using knowledge of structures and functions
- Content Standard #5: Reflecting upon and assessing the characteristics and merits of their work and the work of others
- Content Standard #6: Making connections between visual arts and other disciplines

5-8 **Source:** http://artsedge.kennedy-center.org/teach/standards/standards_58.cfm#04
- Content Standard #1: Understanding and applying media, techniques, and processes
- Content Standard #3: Choosing and evaluating a range of subject matter, symbols, and ideas
- Content Standard #5: Reflecting upon and assessing the characteristics and merits of their work and the work of others
- Content Standard #6: Making connections between visual arts and other disciplines

ART & THE COSMIC CONNECTION

Viewing NASA Images Through the Elements of Art



Created by Monica & Tyler Aiello, Planetary Artists and Educators

For NASA's Discovery and New Frontiers Programs

http://discovery.nasa.gov http://newfrontiers.nasa.gov

SCIENCE INSPIRES ART

MONICA & TYLER AIELLO

CREDIT: NASA/JPL

GANYMEDE

CREDIT: NASA/JPL

DENVER MUSUM OF NATURE & SCIENCE: Gates Planetarium

PROGRAM HIGHLIGHTS

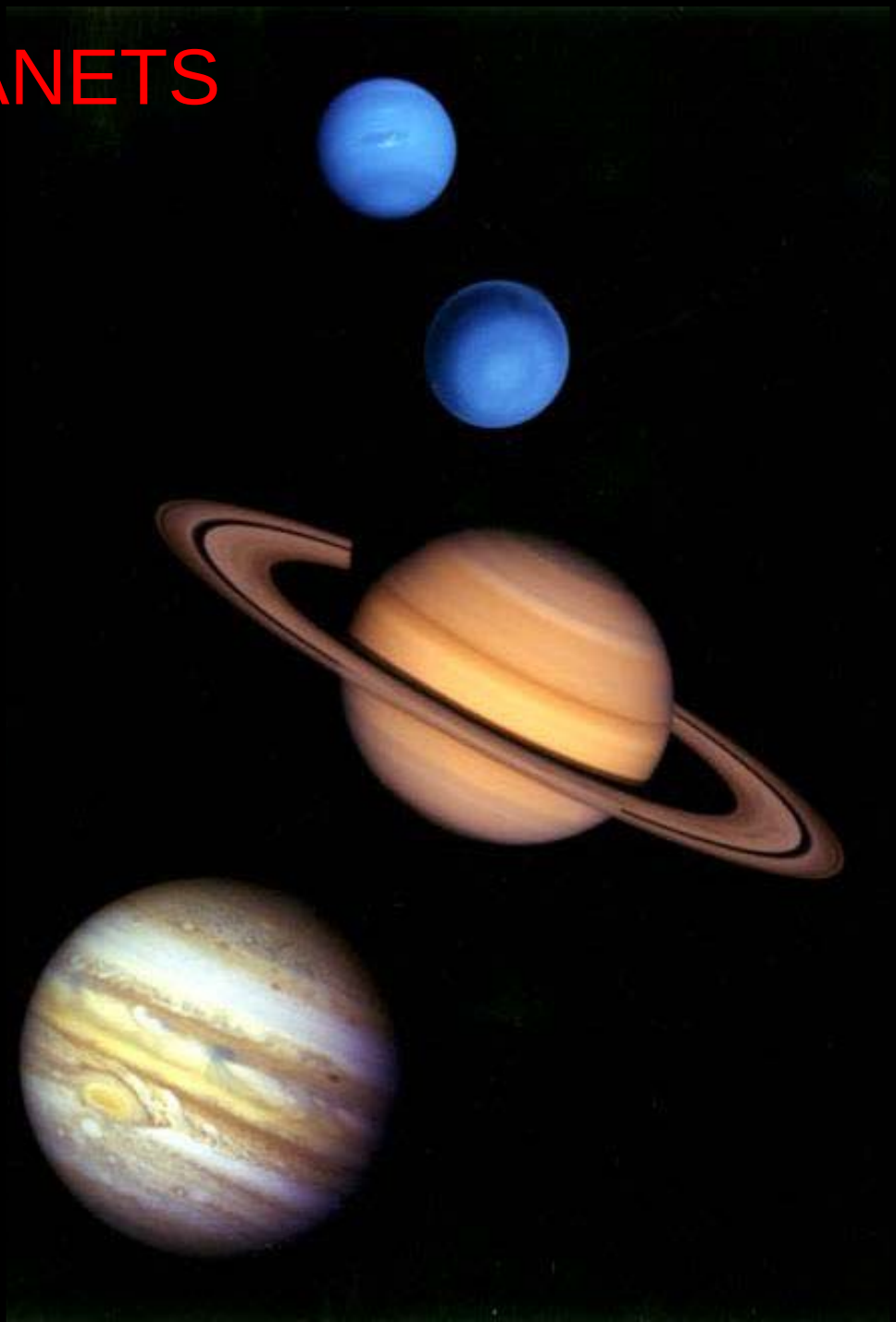
- PowerPoint Presentation
- Easy to follow Presentation and Science Notes
- Correlates with current and recent missions
- Scalable for K-12 students…and beyond
- Art Activity to reinforce concepts
- Beautiful NASA image prints
- 1 or 2 day program
- In-depth Teacher Training Guide
- Works in both art & science class
- Proven success with both youth and

OUR SPACE COMMUNITY

What do you know about the solar system?

INNER PLANETS

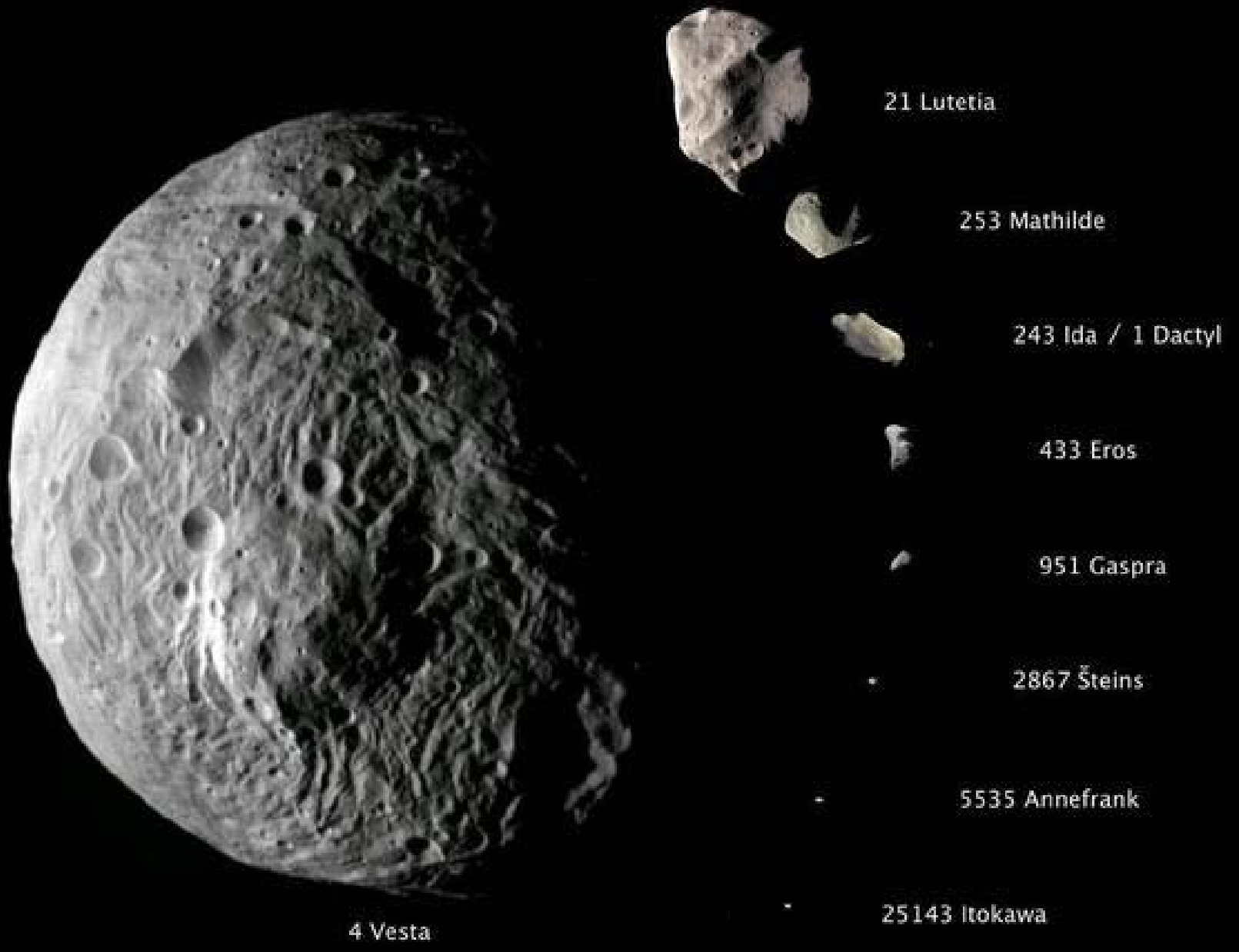
OUTER PLANETS



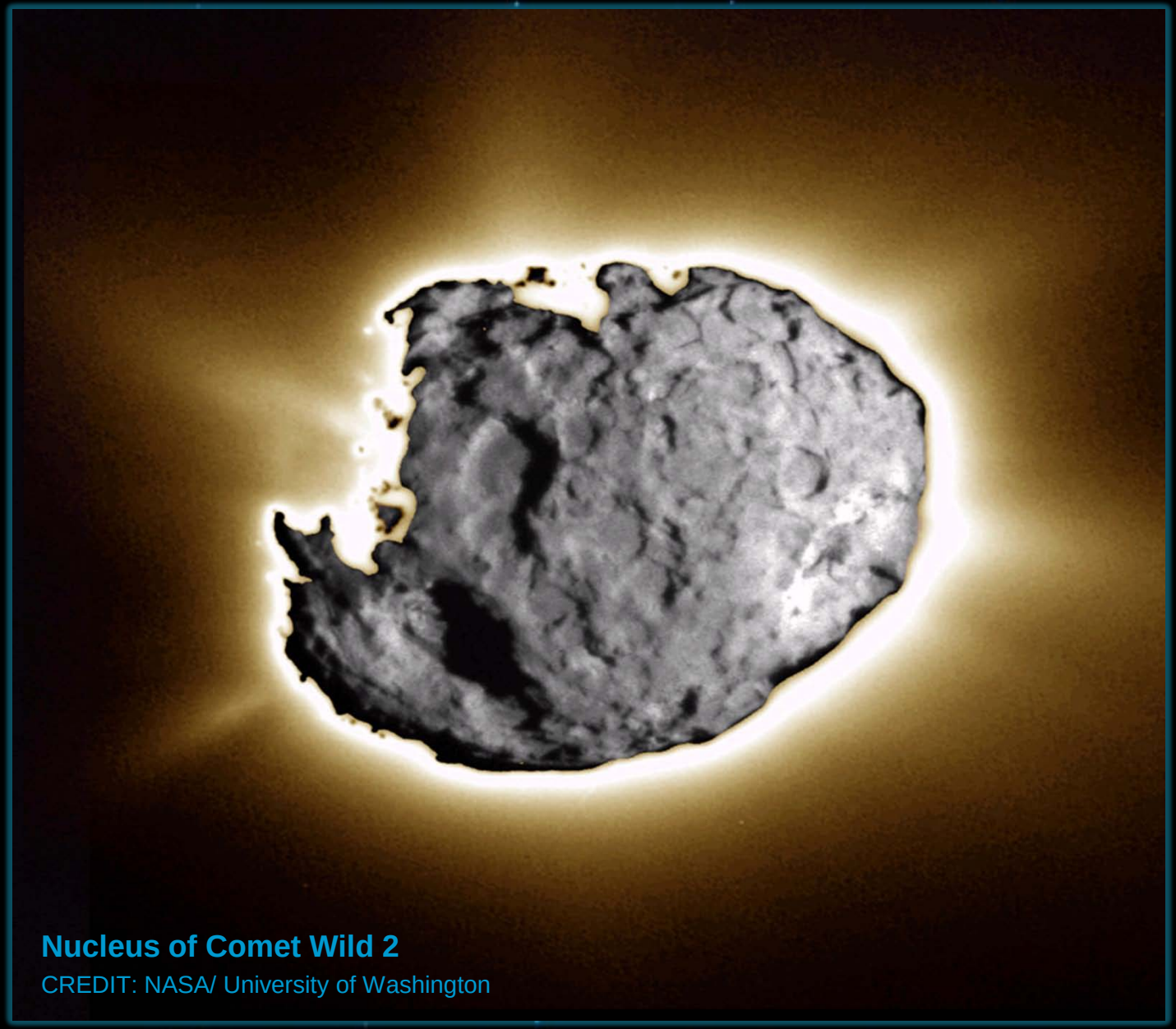
SMALL BODIES: Moons

CREDIT: NASA/JPL

SMALL BODIES: The Asteroid Belt



SMALL BODIES: Comets

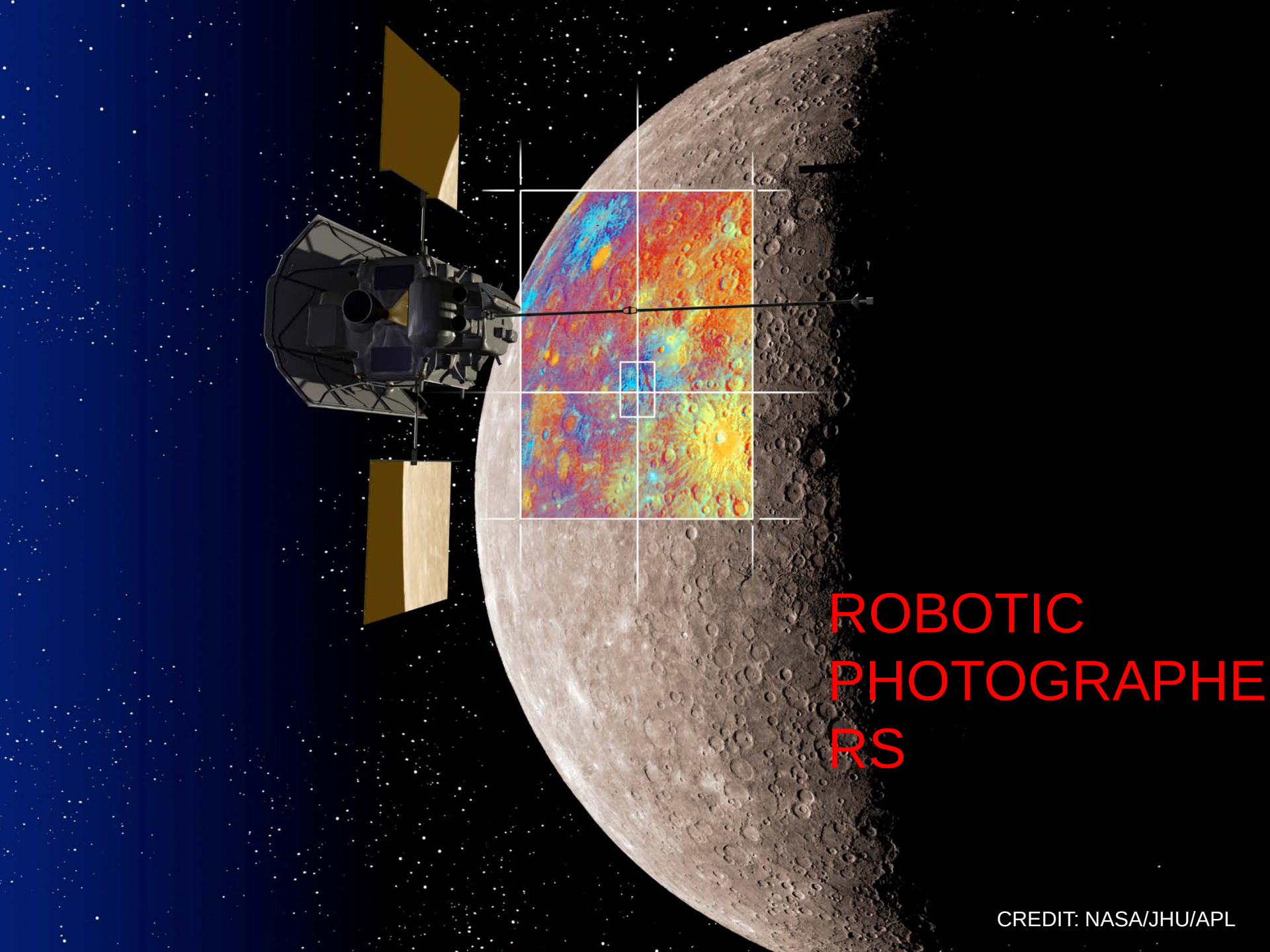


Nucleus of Comet Wild 2

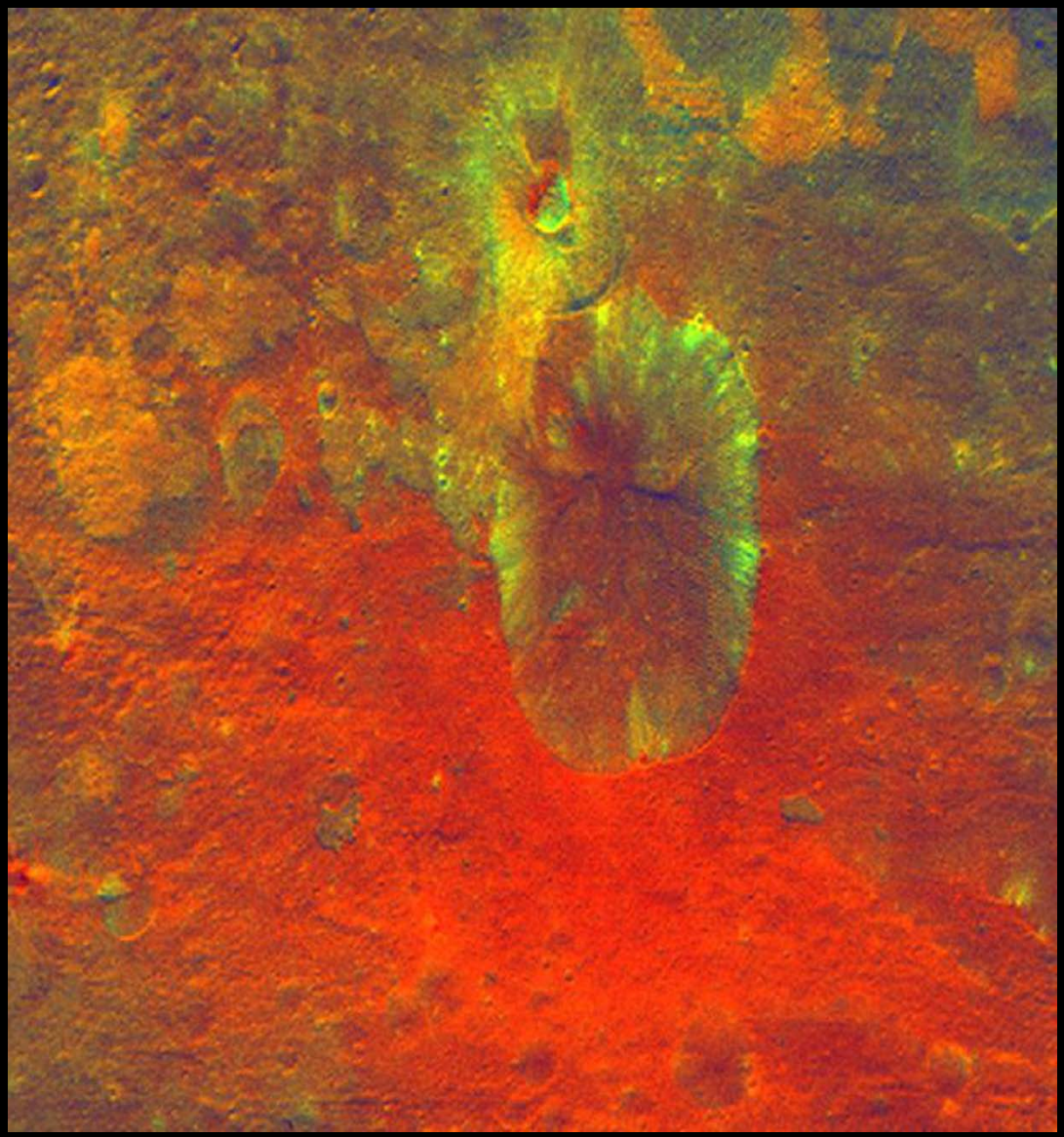
CREDIT: NASA/ University of Washington

What happened to Pluto?

Notice some have moons - We now know of 5 moons orbiting Pluto!


ROBOTIC
PHOTOGRAPHE
RS
CREDIT: NASA/JHU/APL

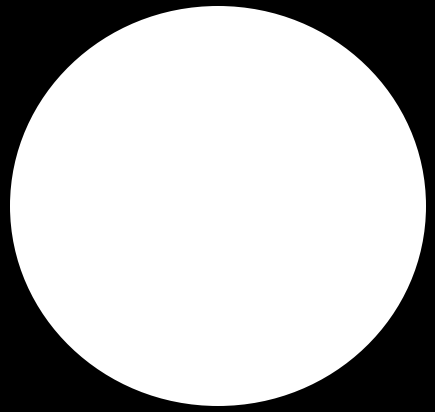
GEOLOGY & THE ELEMENTS OF ART



- LINE
- SHAPE
- COLOR
- VALUE
- TEXTURE

GIANT ASTEROID VESTA CREDIT: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

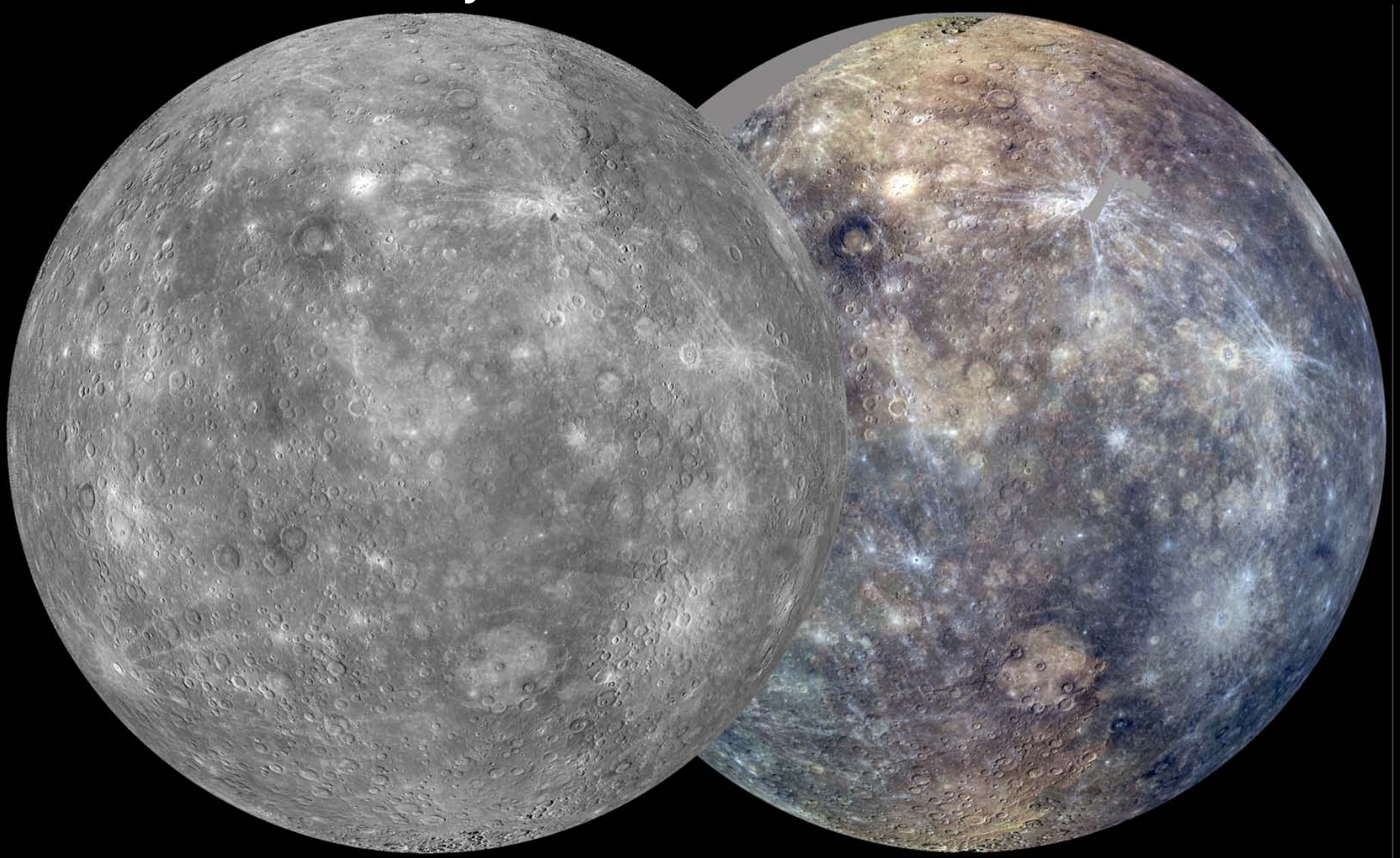
SHAPE



Circle - Craters

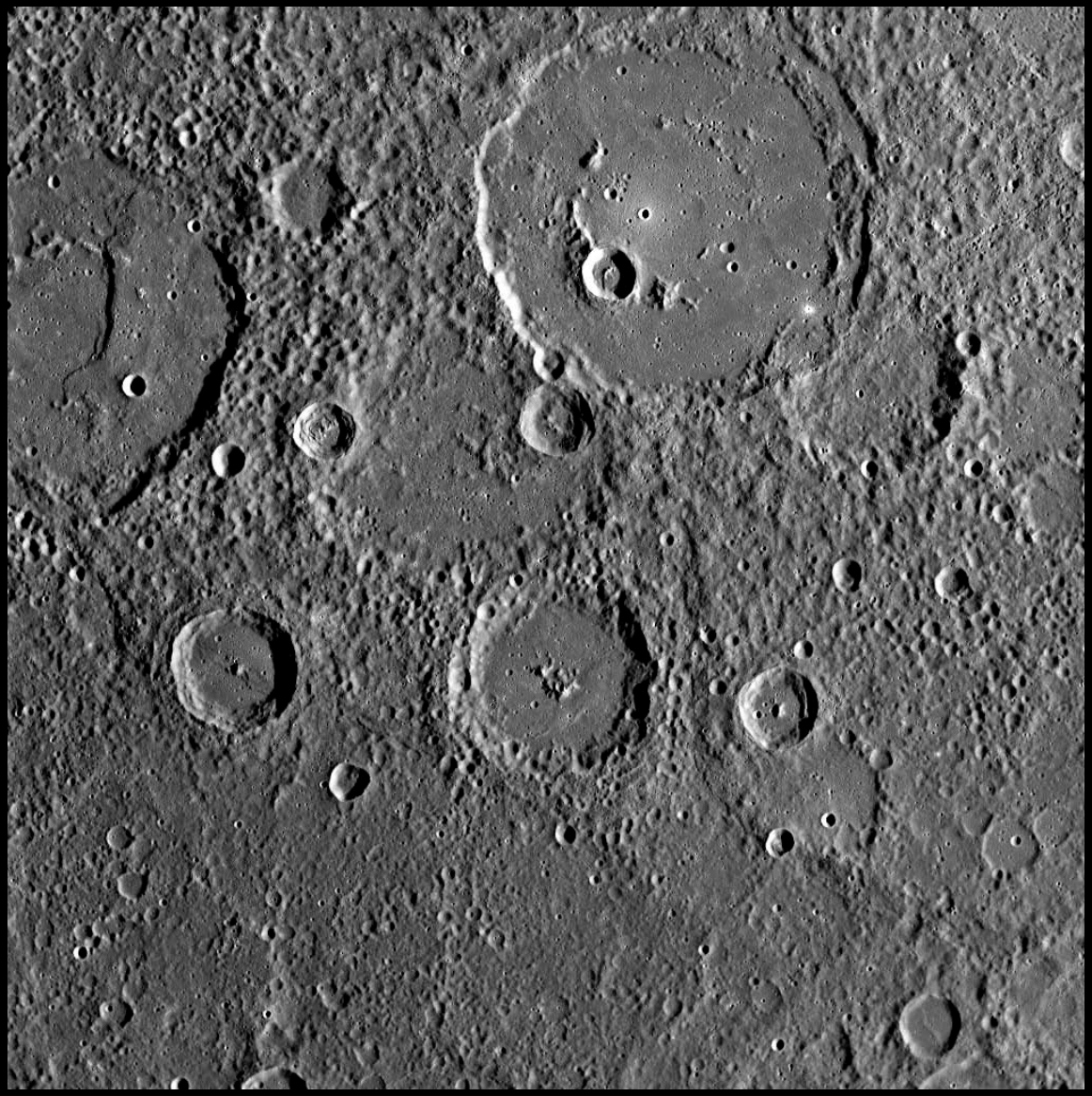
MARS CREDIT: NASA/JPL

CIRCLES: Mercury



CREDIT: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

MERCURY



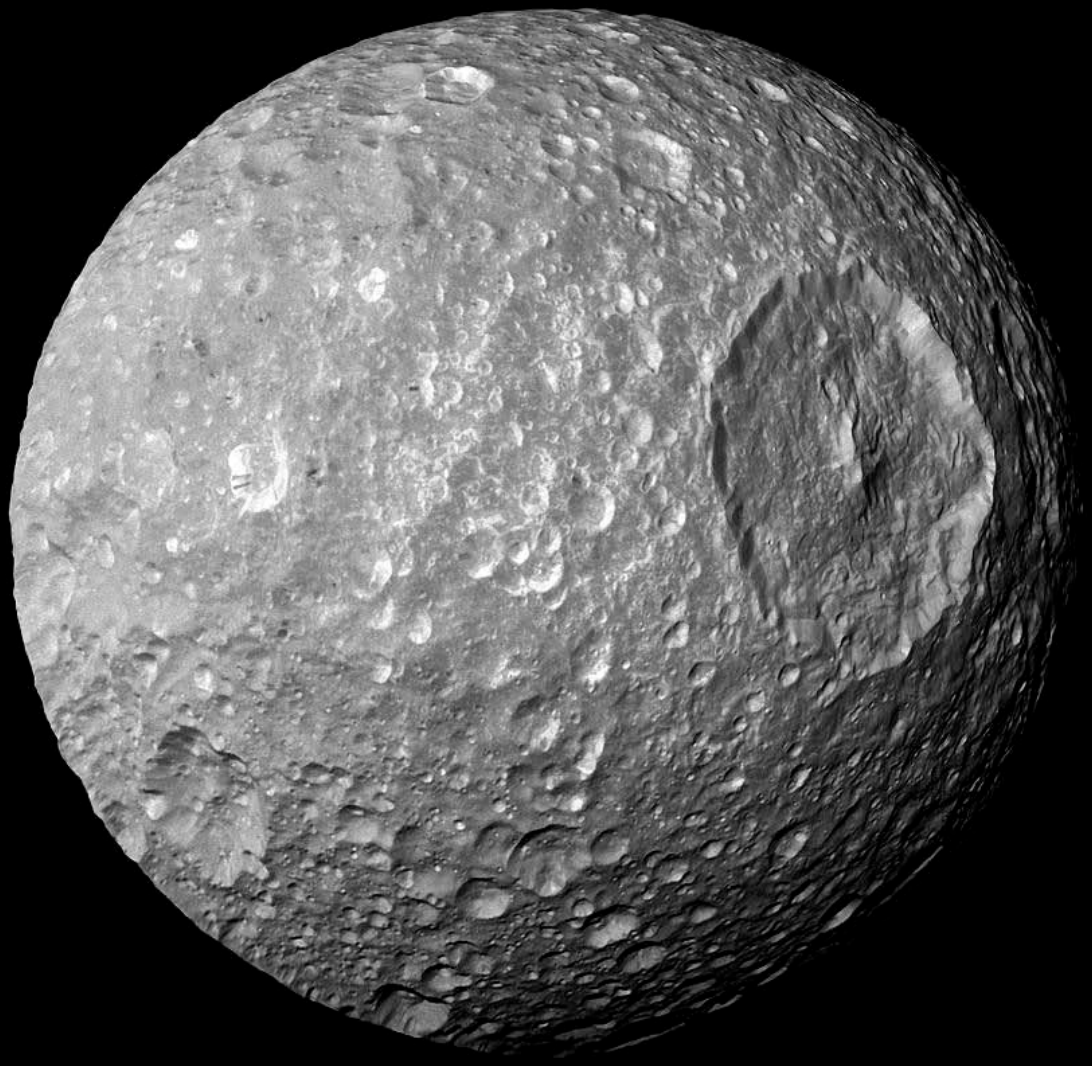
CREDIT: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

MANY TYPES OF CRATERS: Venus vs. Ganymede

VENUS's DICKINSON CRATER CREDIT: NASA/JPL

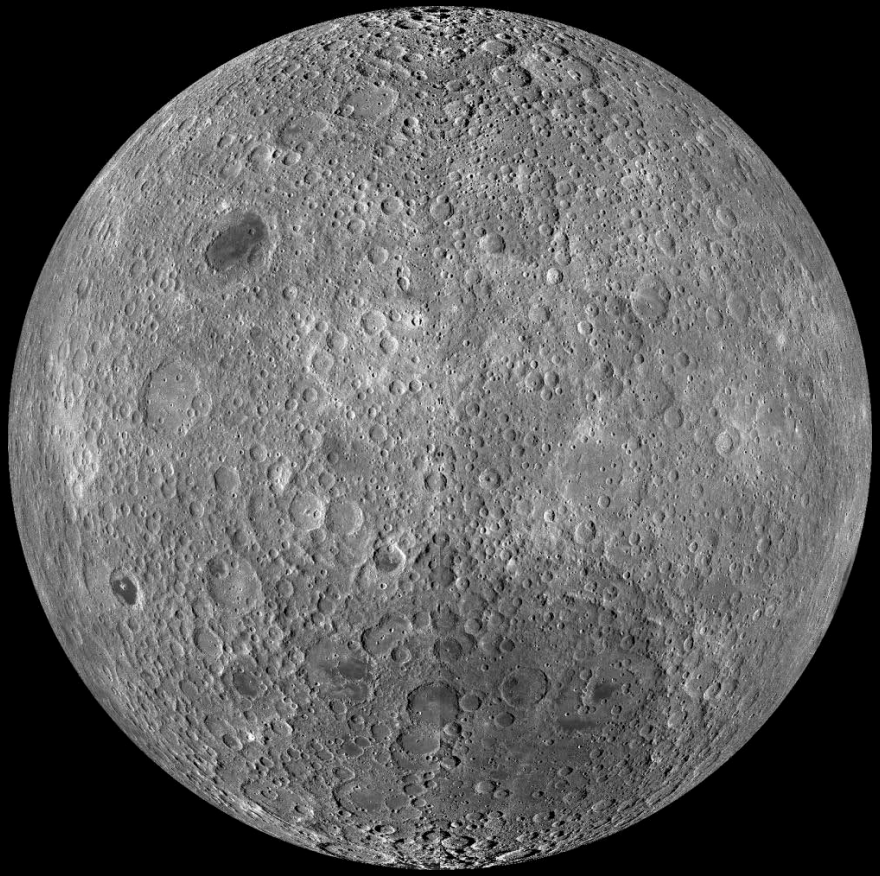
JUPITER's MOON, GANYMEDE
CREDIT: NASA/JPL/USGS

MIMAS: The Death Star Moon

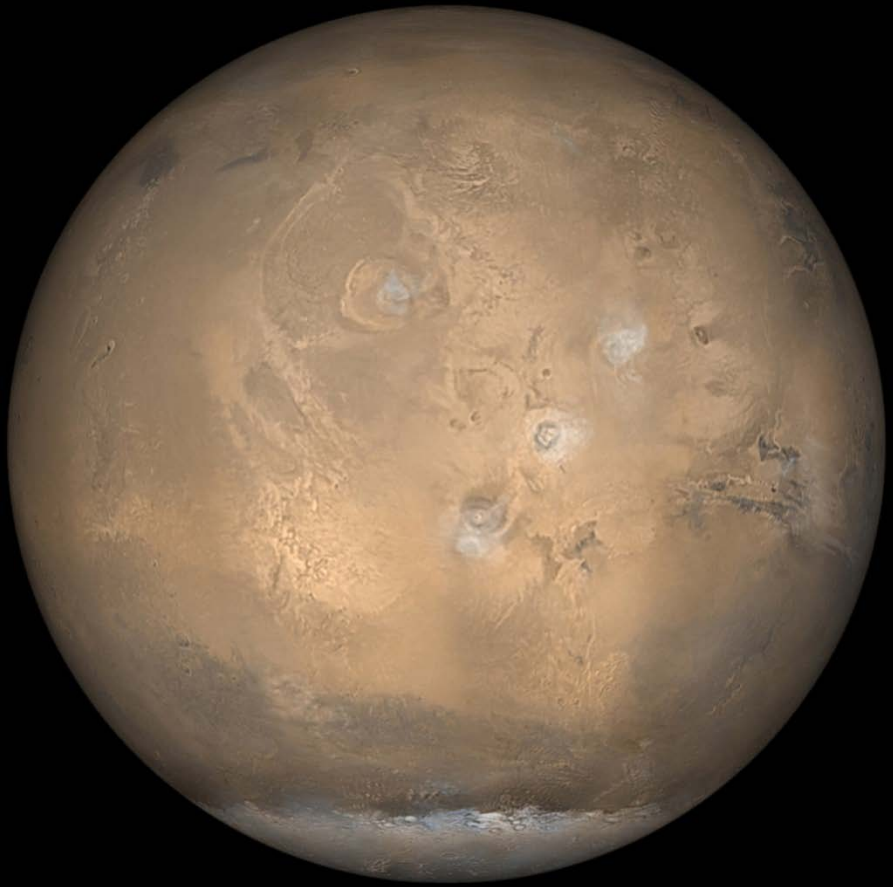


SATURN'S MIMAS CREDIT: NASA/JPL/SSI

COUNTING CRATERS: The Moon vs. Mars

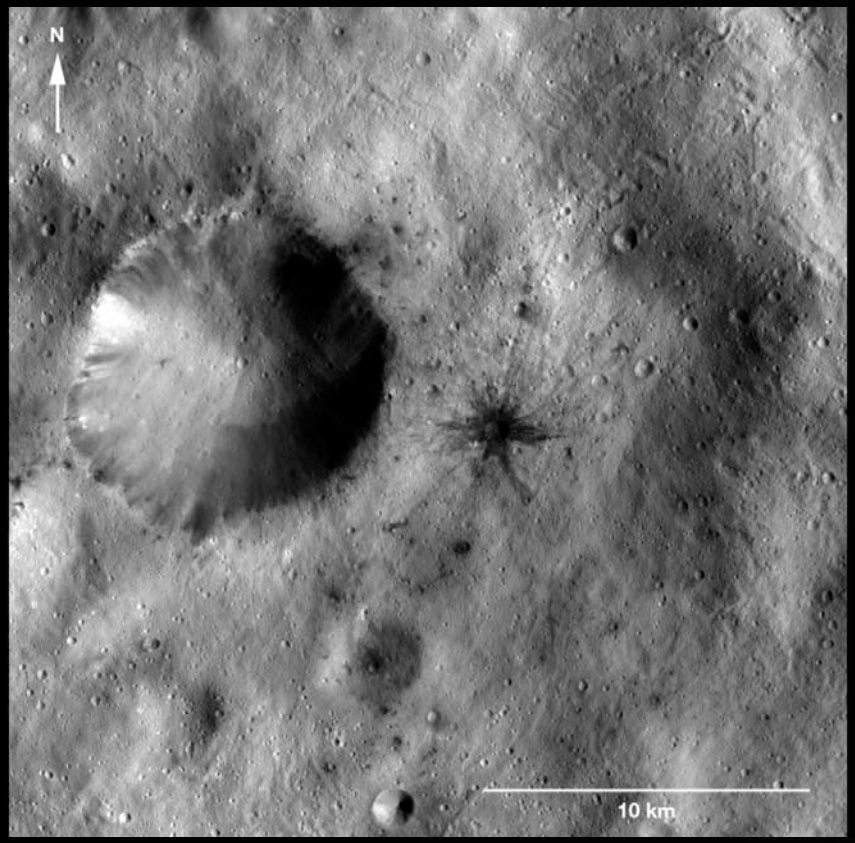


CREDIT: NASA/GSFC/Arizona State University



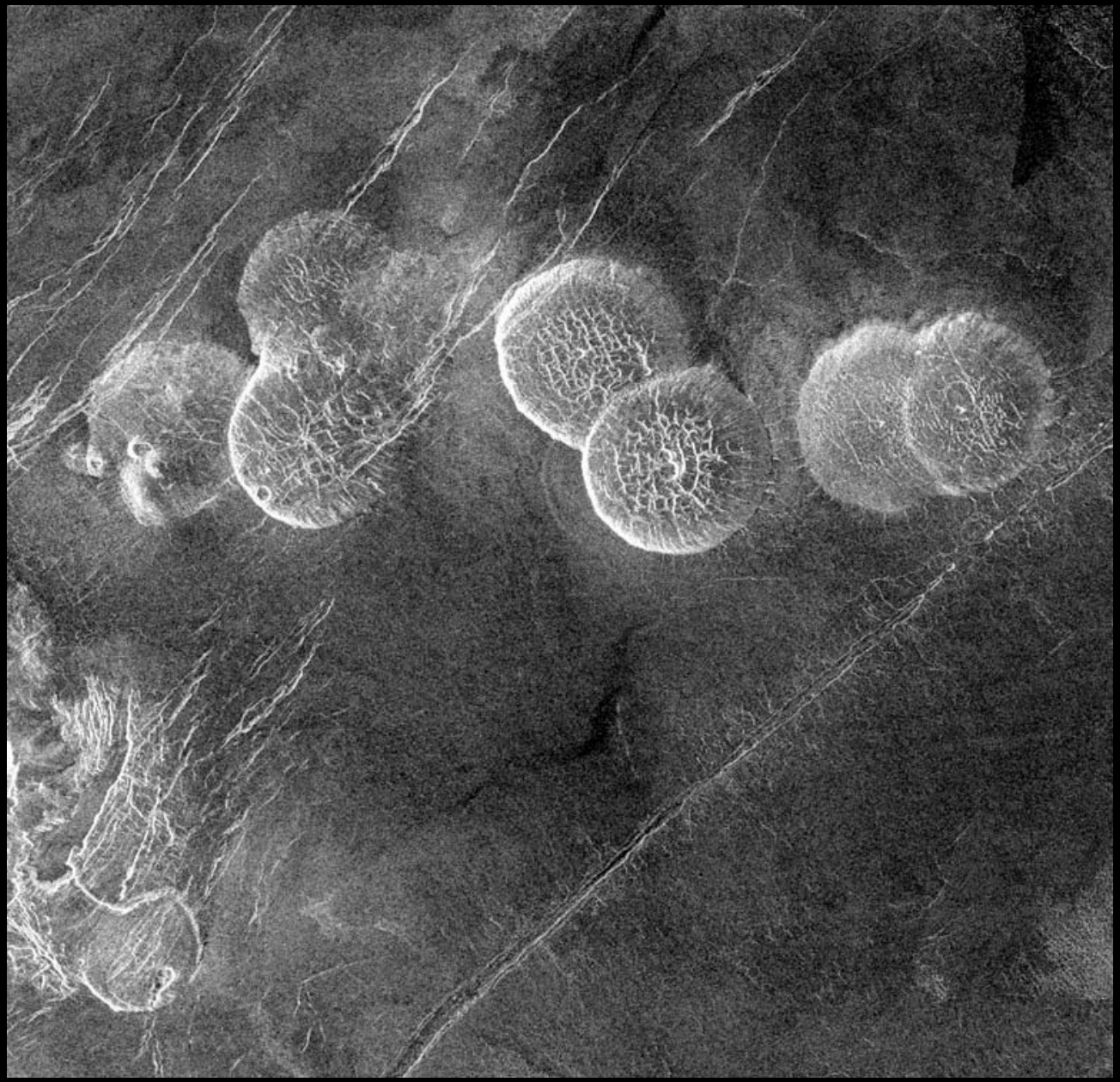
CREDIT: NASA/JPL/Malin Space Science Systems

GIANT ASTEROID VESTA



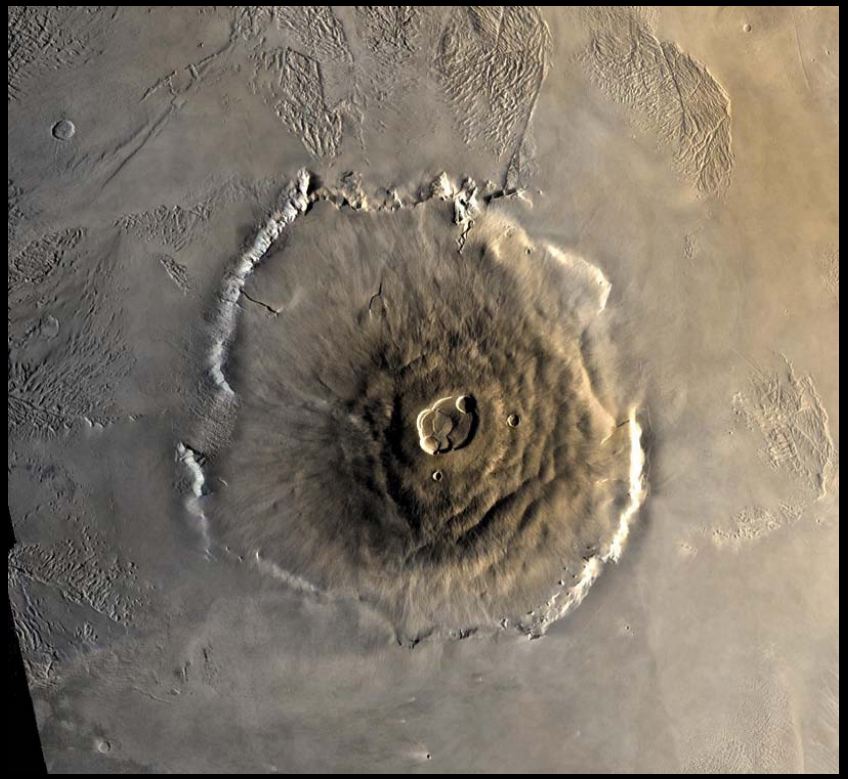
CREDIT: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

VENUS



CREDIT: NASA/JPL

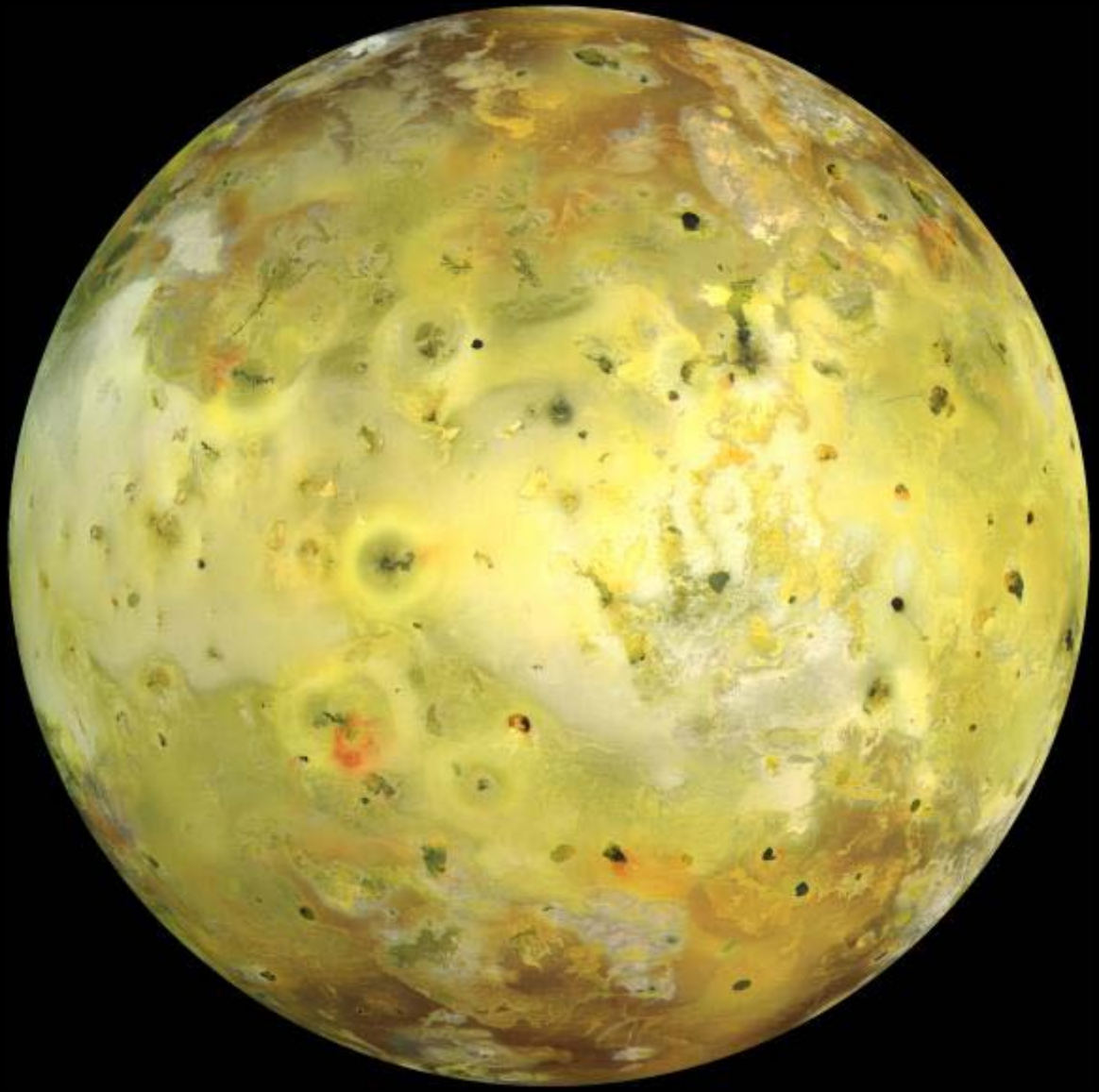
SHAPE



Blobs – Volcanoes (or Lakes)

CREDIT: NASA/JPL

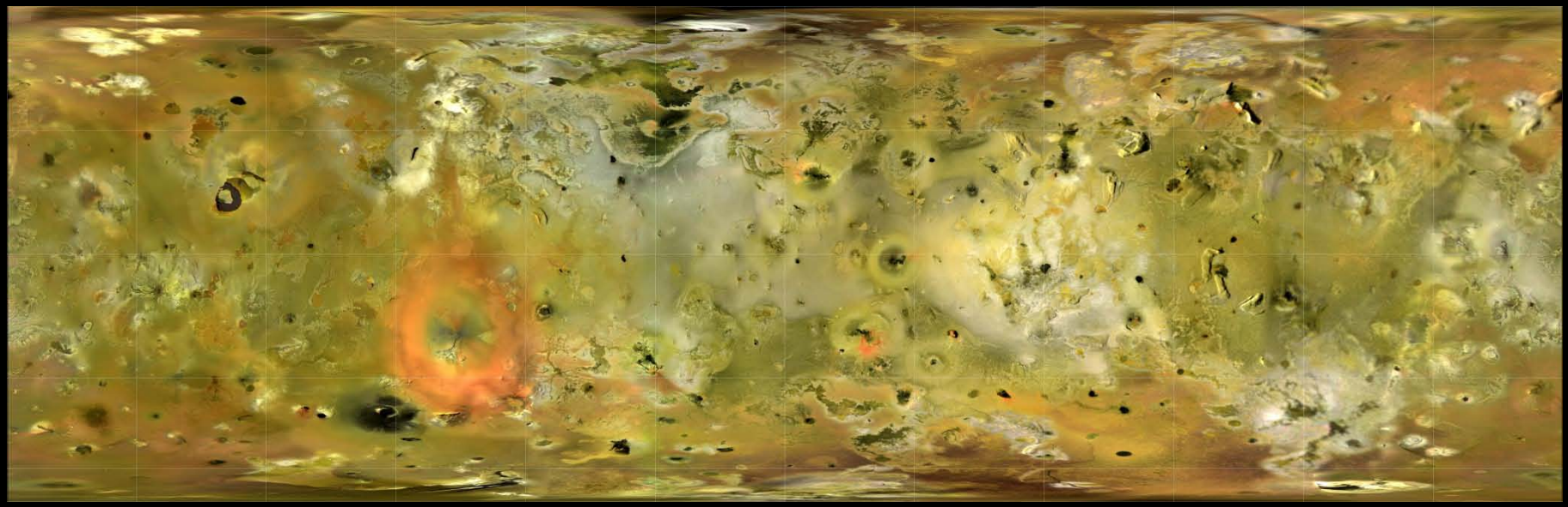
Jupiter’s moon, IO



CREDIT: NASA/JPL/University of Arizona

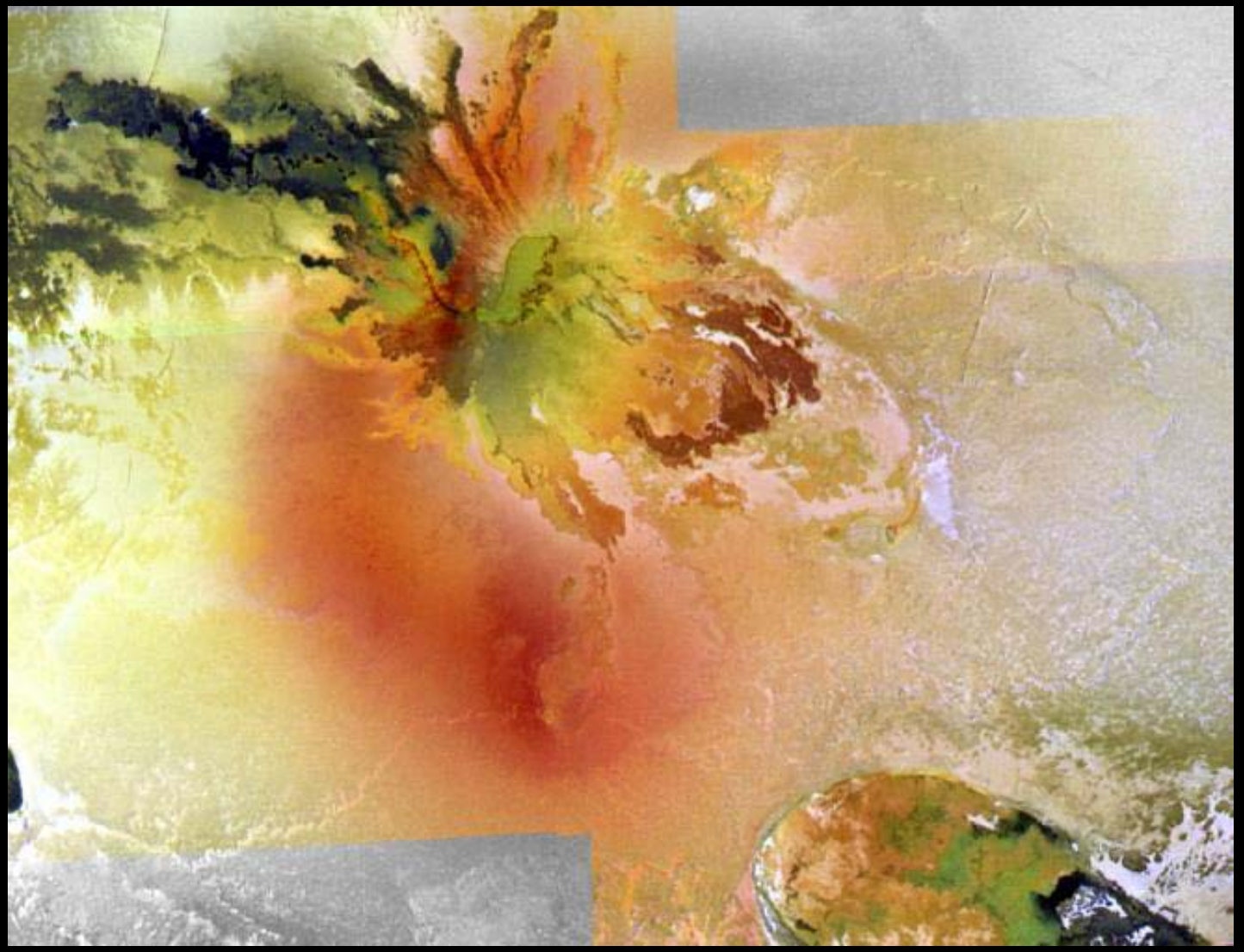
IO

Close…



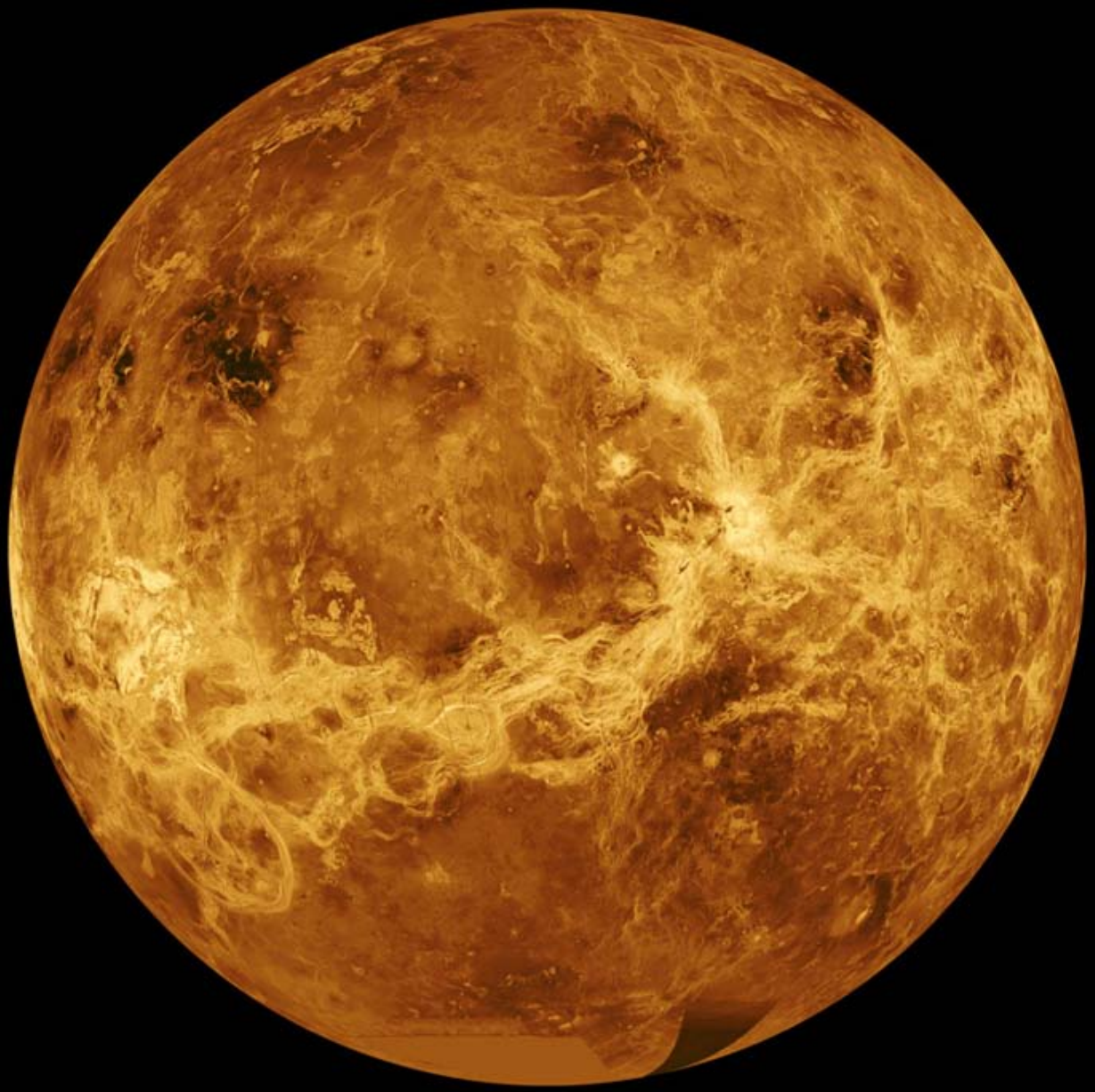
CREDIT: NASA/JPL/USGS

Closer…
CULANN PATERA



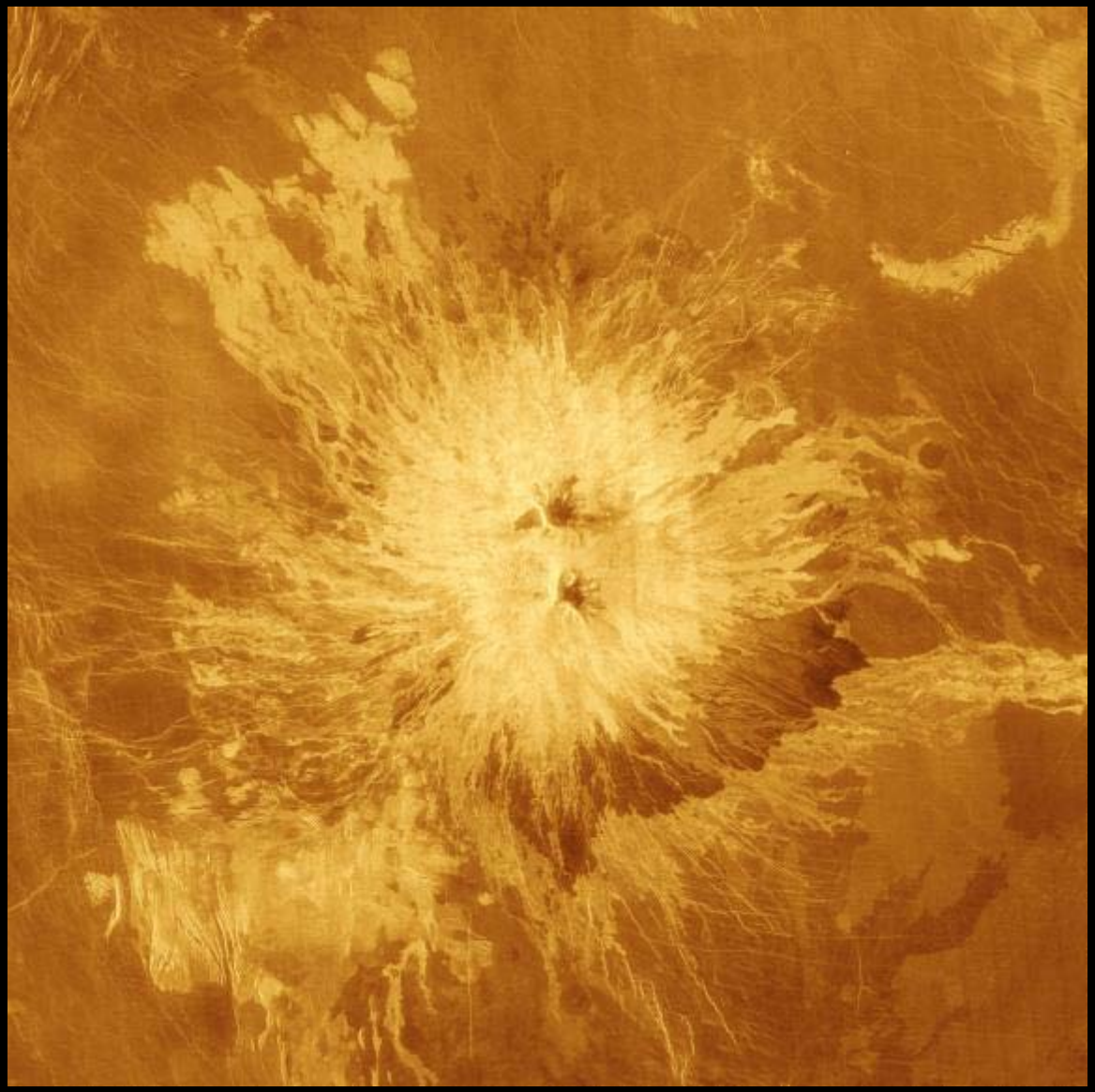
CREDIT: NASA/JPL/University of Arizona

VENUS



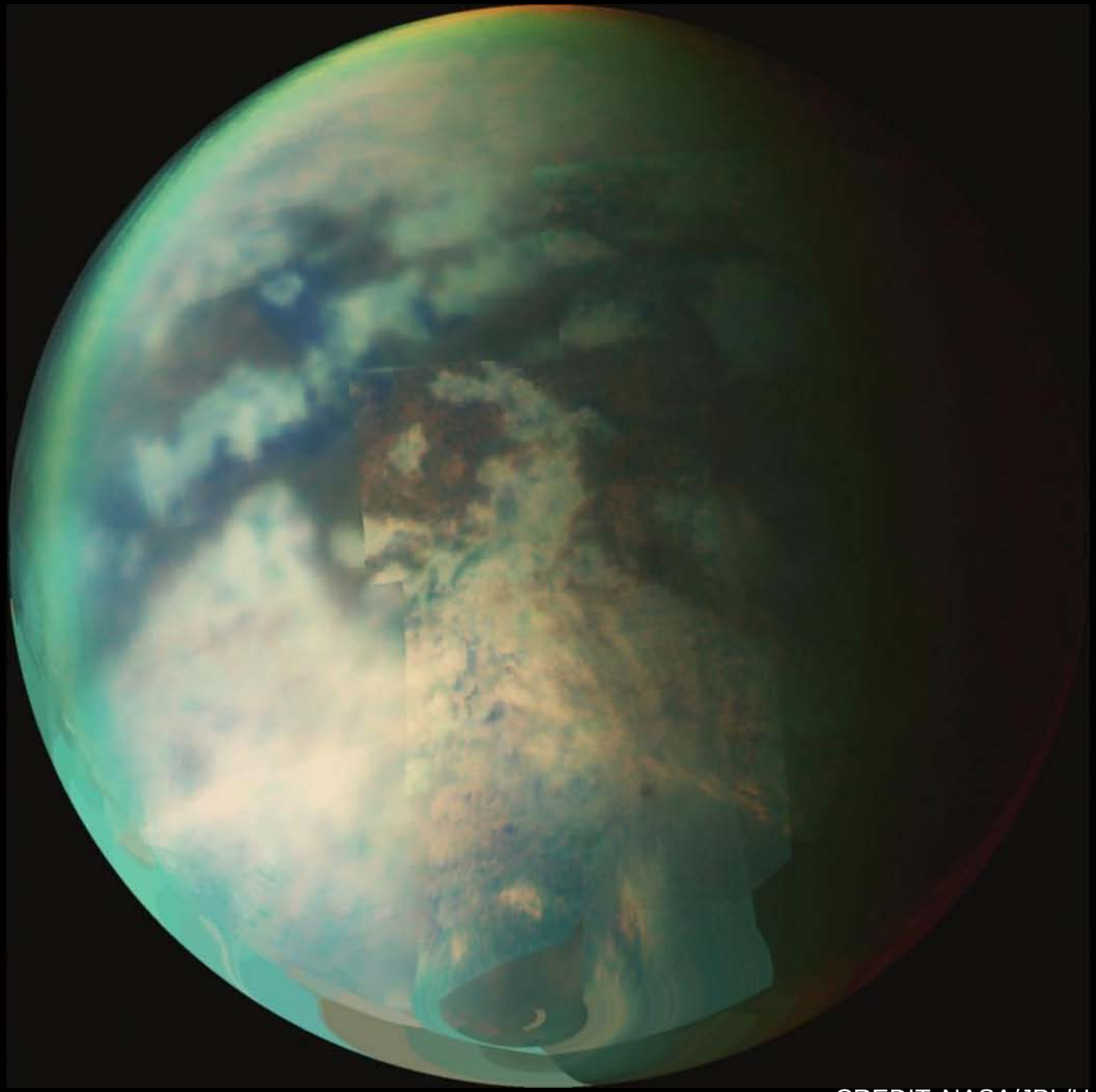
CREDIT: NASA/JPL

SAPAS MONS



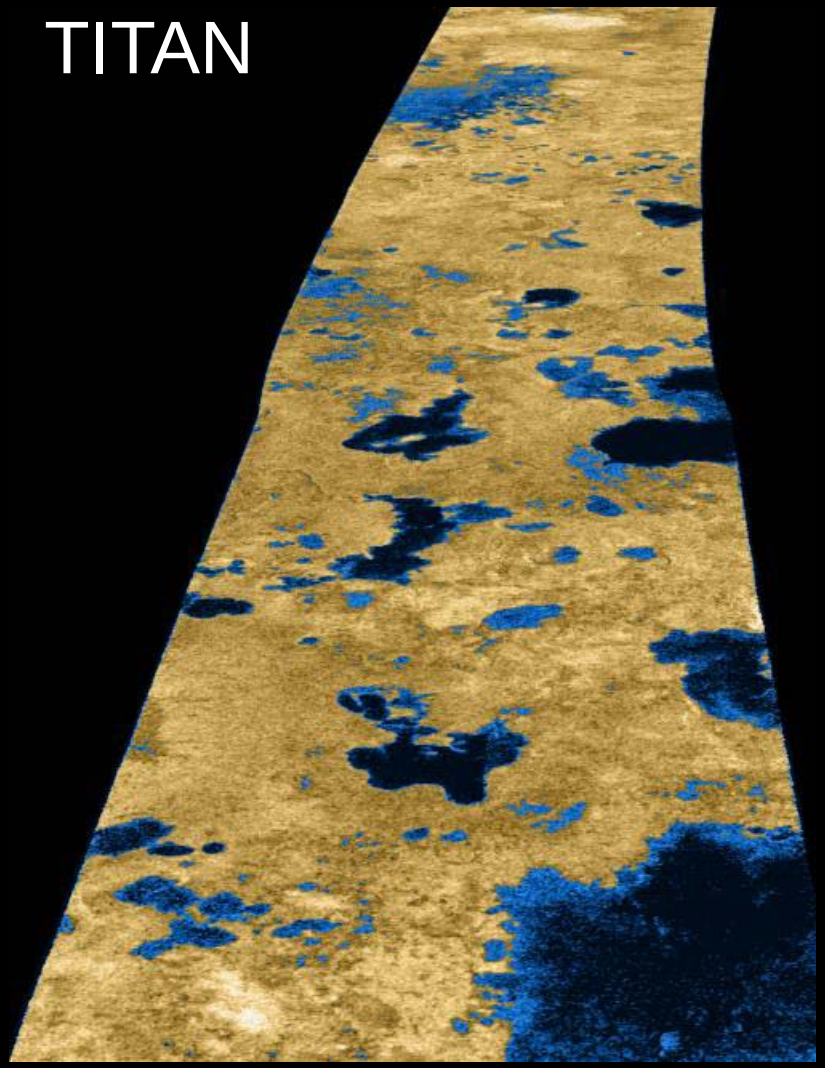
CREDIT: NASA/JPL

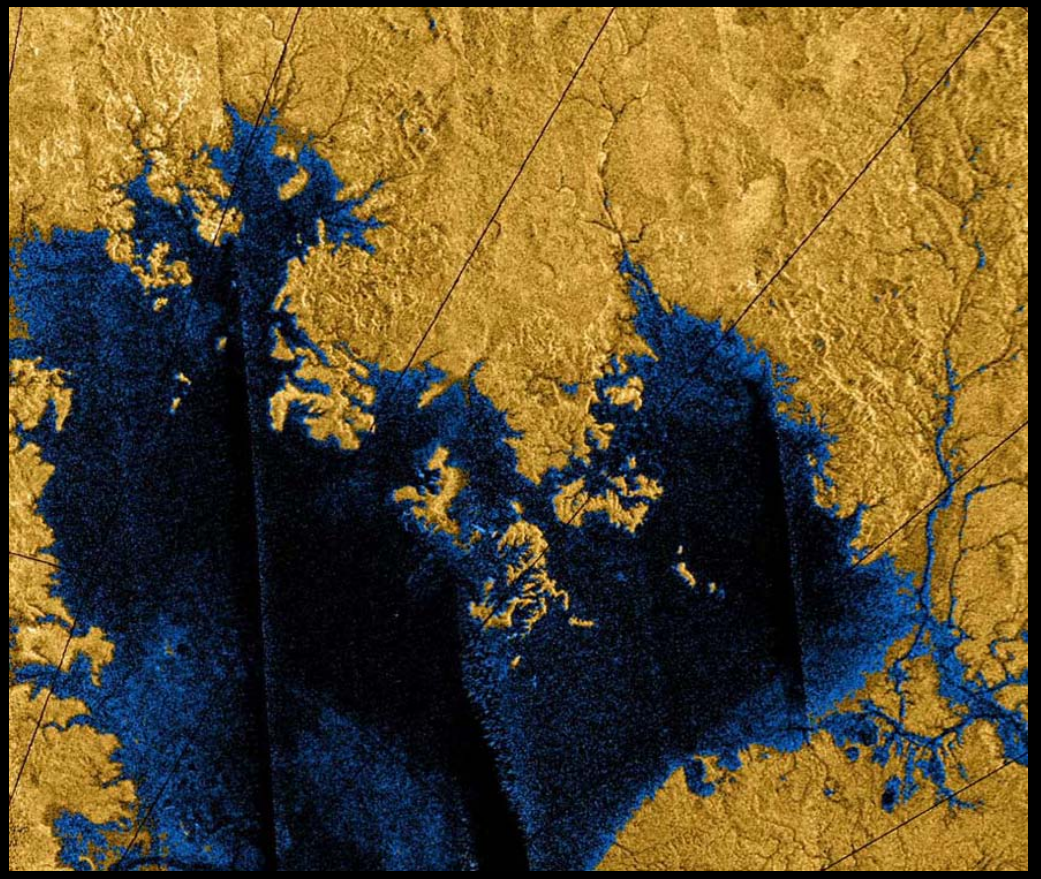
TITAN



CREDIT: NASA/JPL/University of Arizona

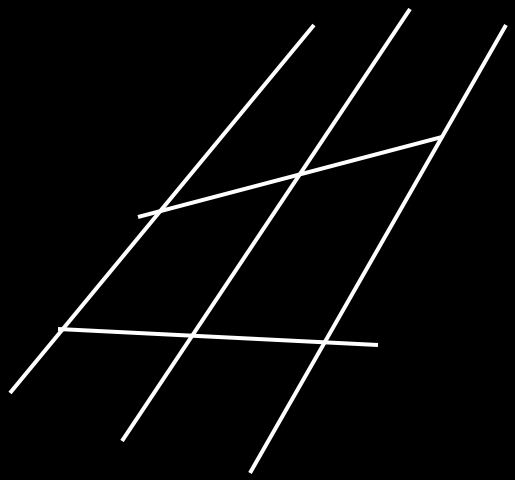
TITAN





CREDIT: NASA/JPL-Caltech/USGS

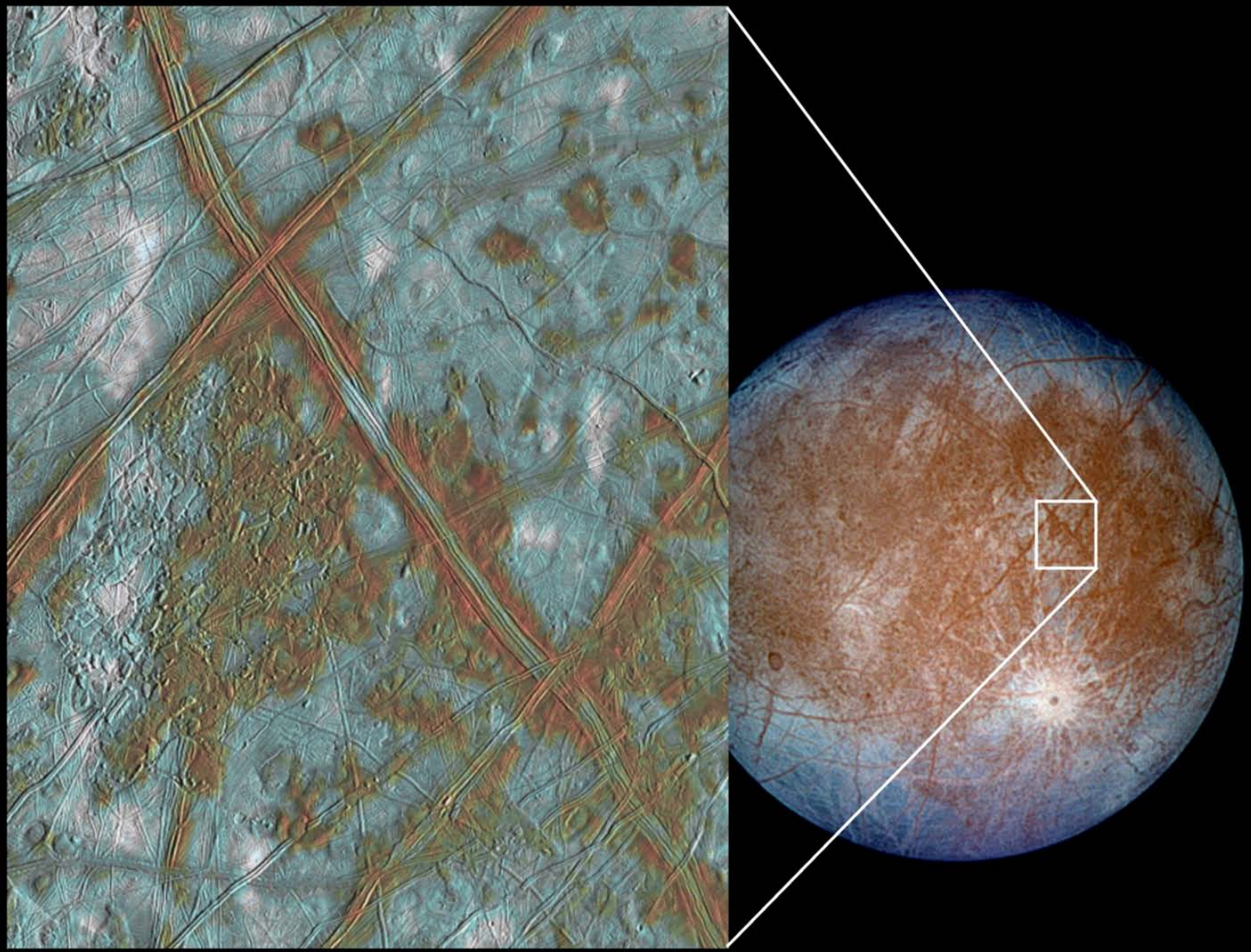
LINE



Straight lines - tectonic activity

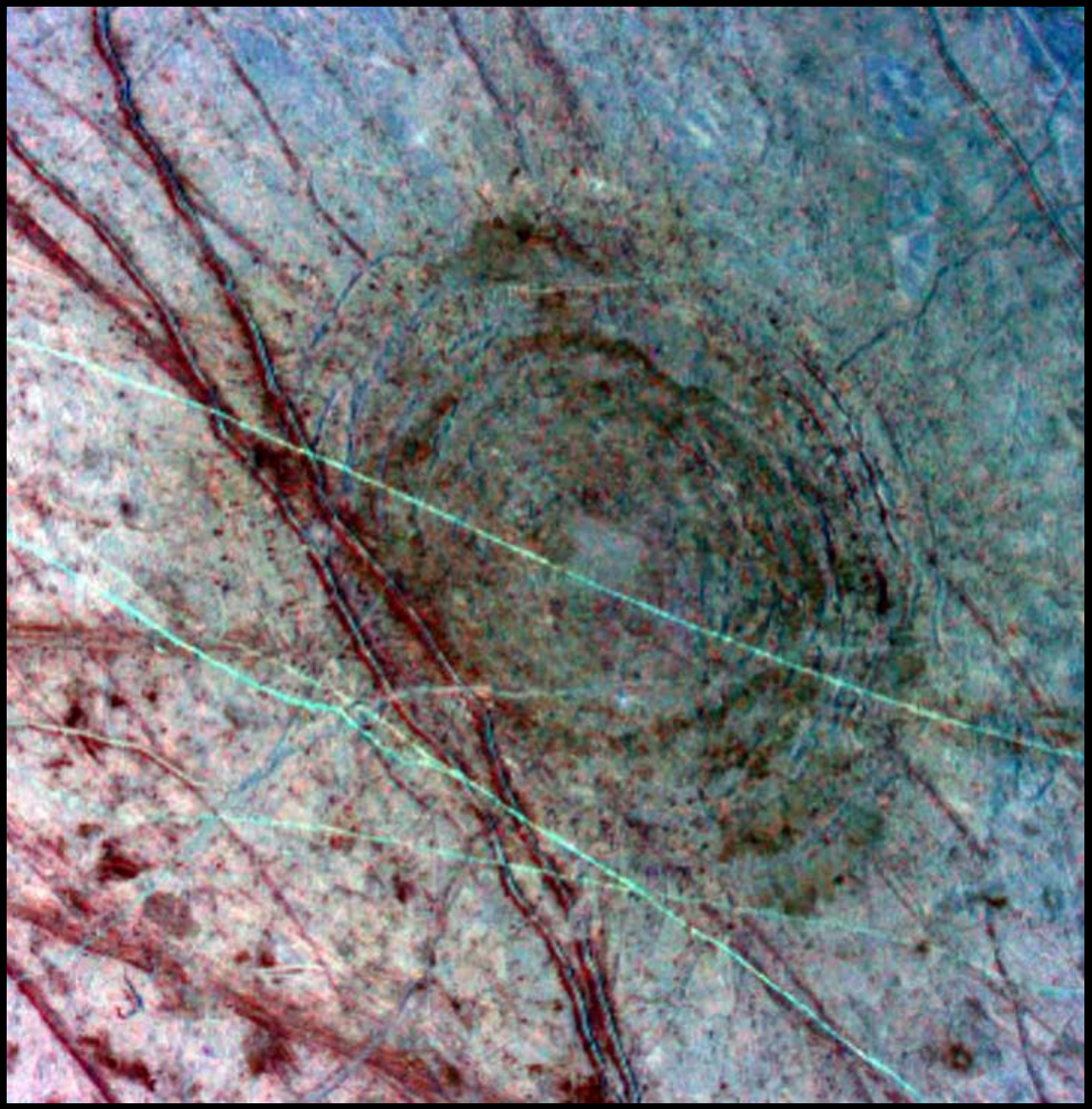
JUPITER'S MOON, EUROPA CREDIT: NASA/JPL

EUROPA



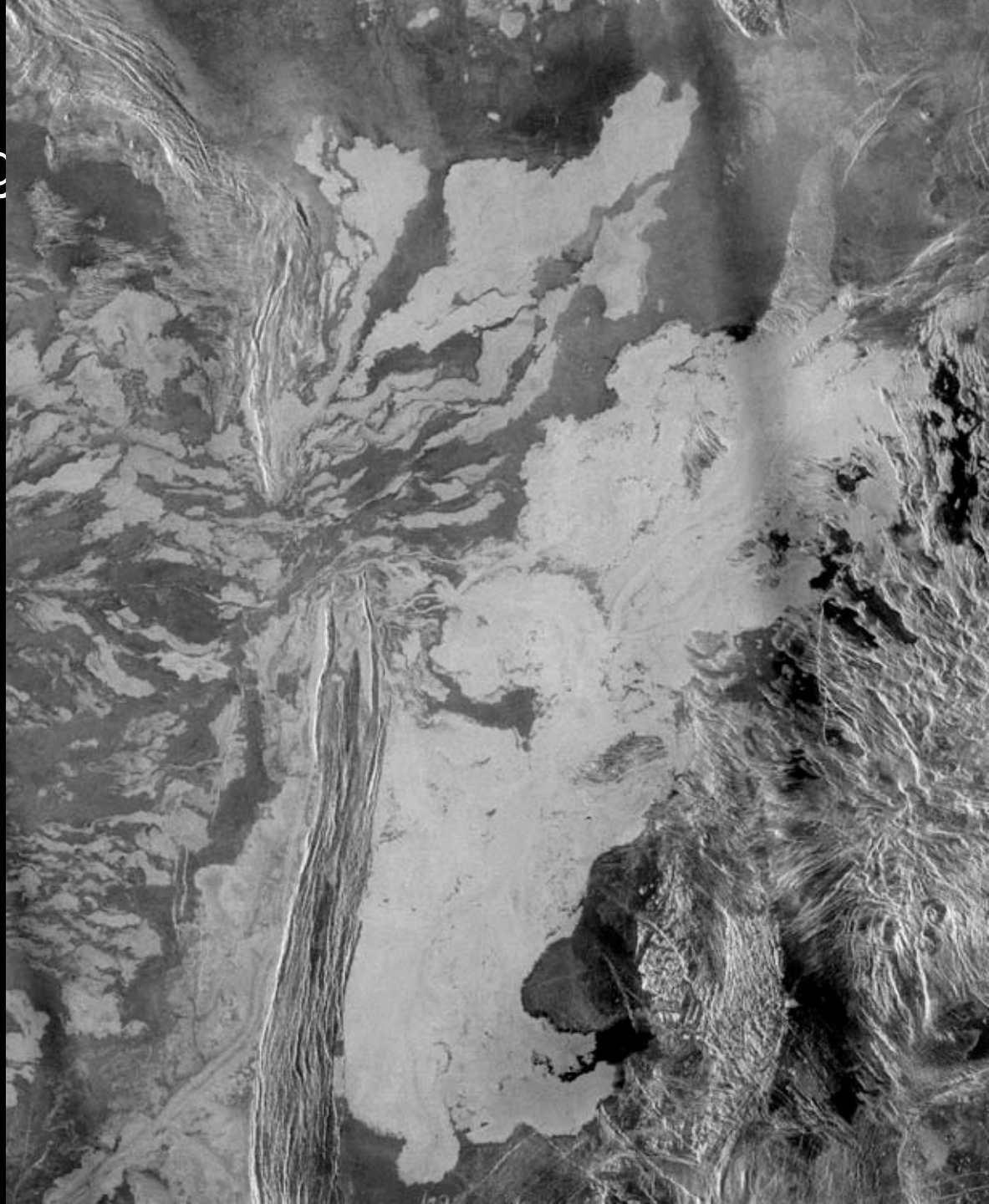
CREDIT: NASA/JPL/University of Arizona

EUROPA: Geology & Storytelling



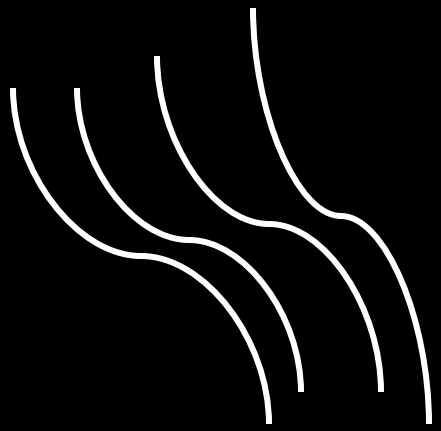
CREDIT: NASA/JPL/University of Arizona

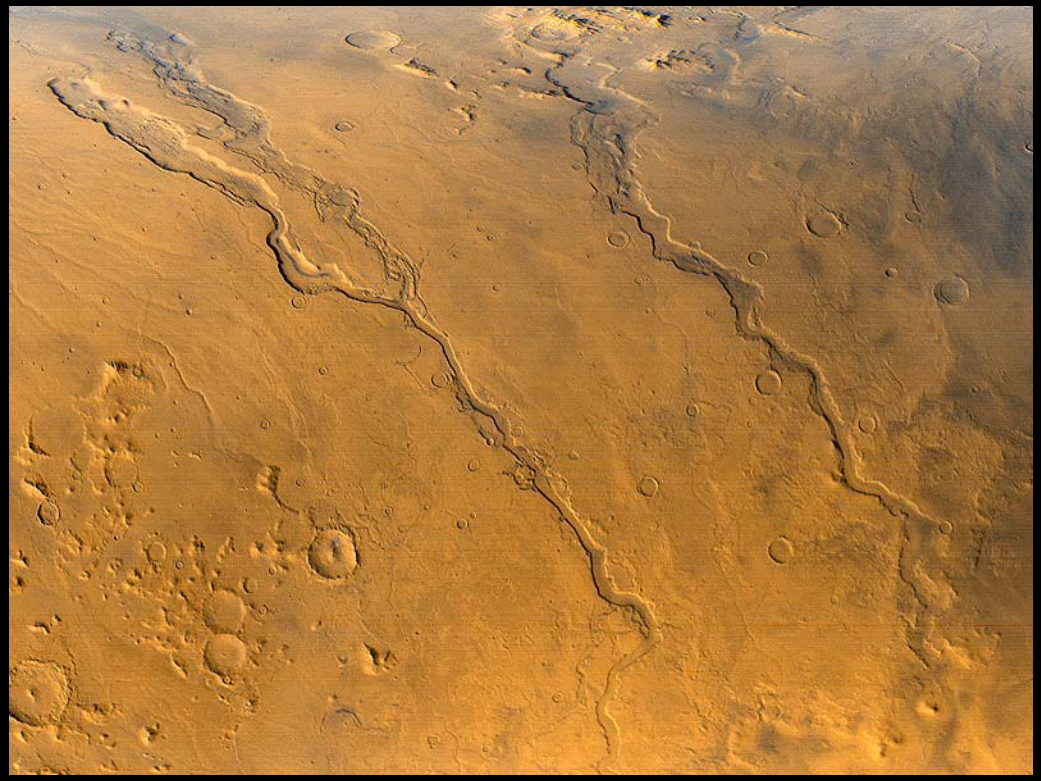
VENUS:
Geology & Storytelling



CREDIT: NASA/JPL

LINE

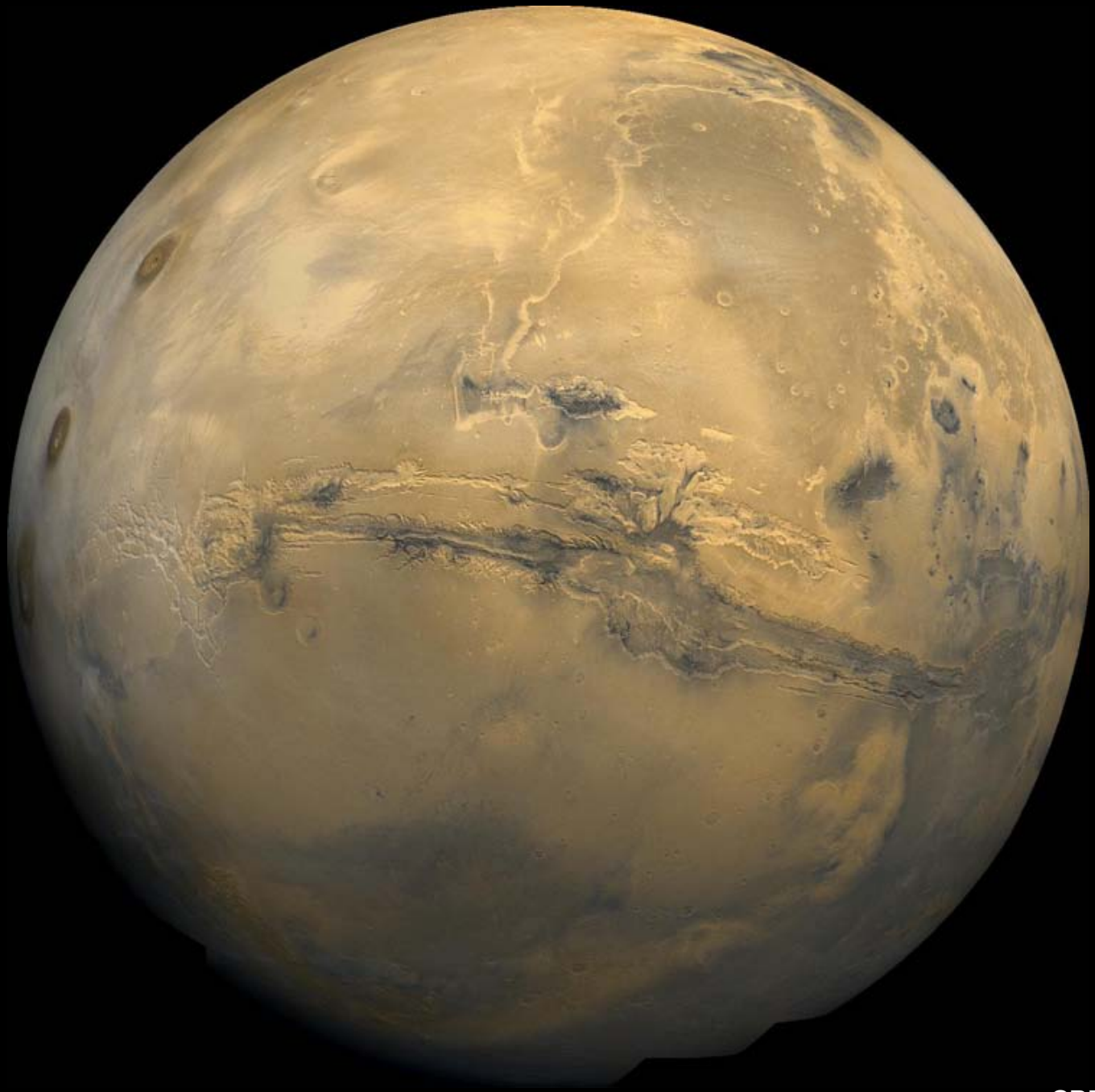




Squiggly lines - erosion (liquid & wind)

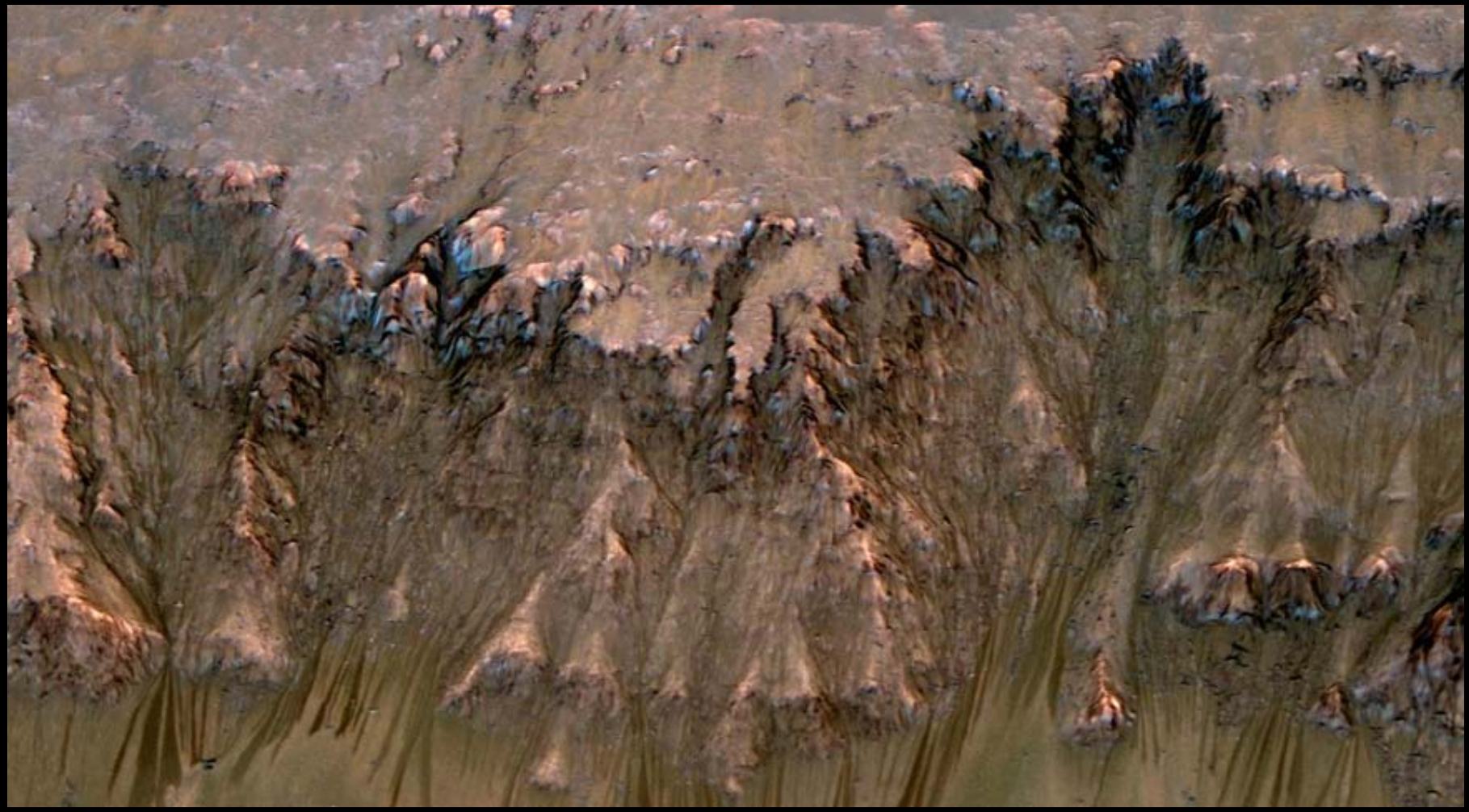
CREDIT: NASA/JPL

MARS



CREDIT: NASA/JPL

MARS



CREDIT: NASA/JPL-Caltech/Univ. of Arizona

FOLLOW THE WATER: Mars

CREDIT: NASA/JPL/UNIVERSITY OF ARIZONA

MARS

CREDIT: NASA/JPL/Univ. of Arizona

MARS

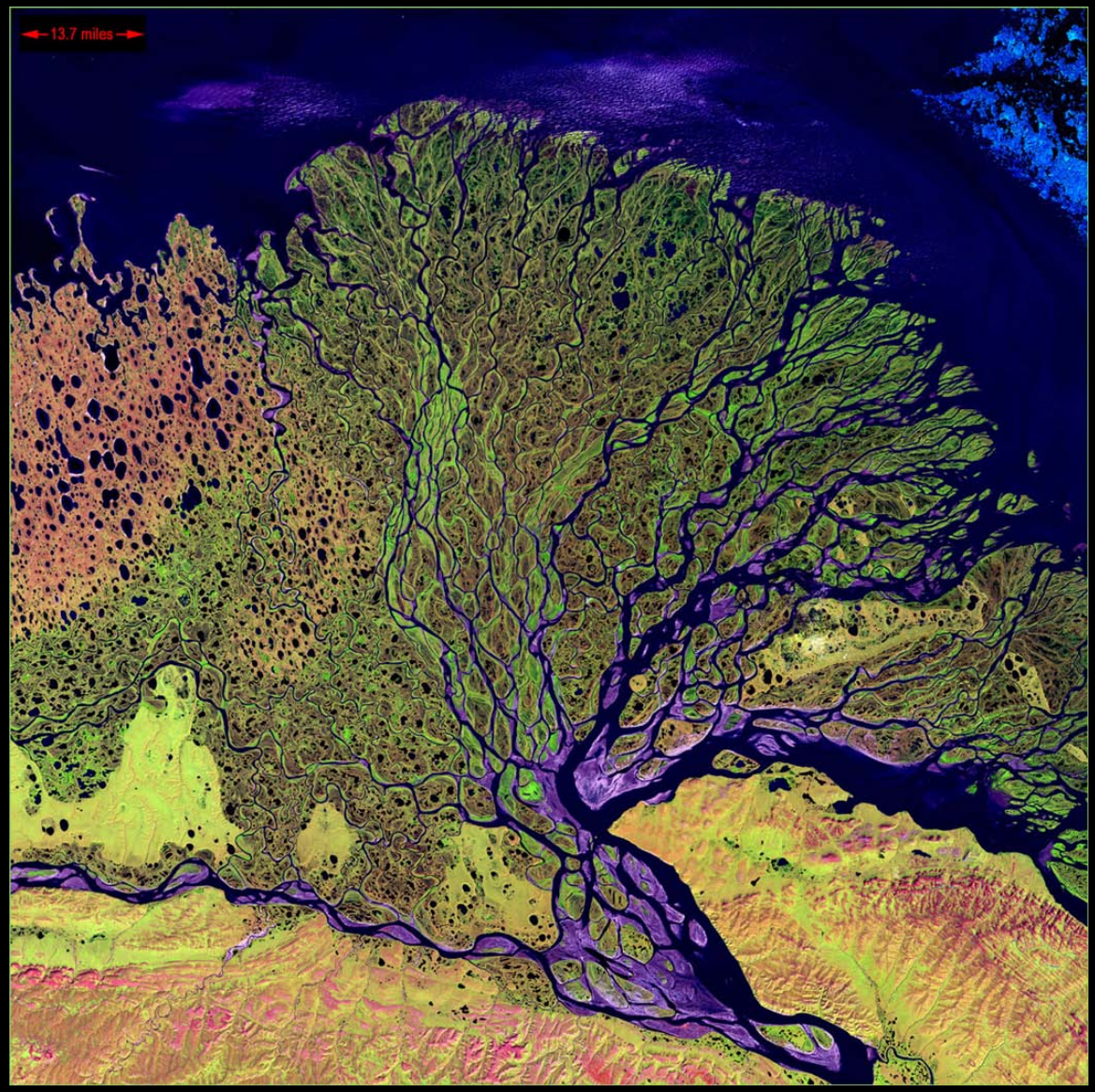
CREDIT: NASA/JPL-Caltech/University of Arizona

What’s the Story?

Mars’ Victoria Crater

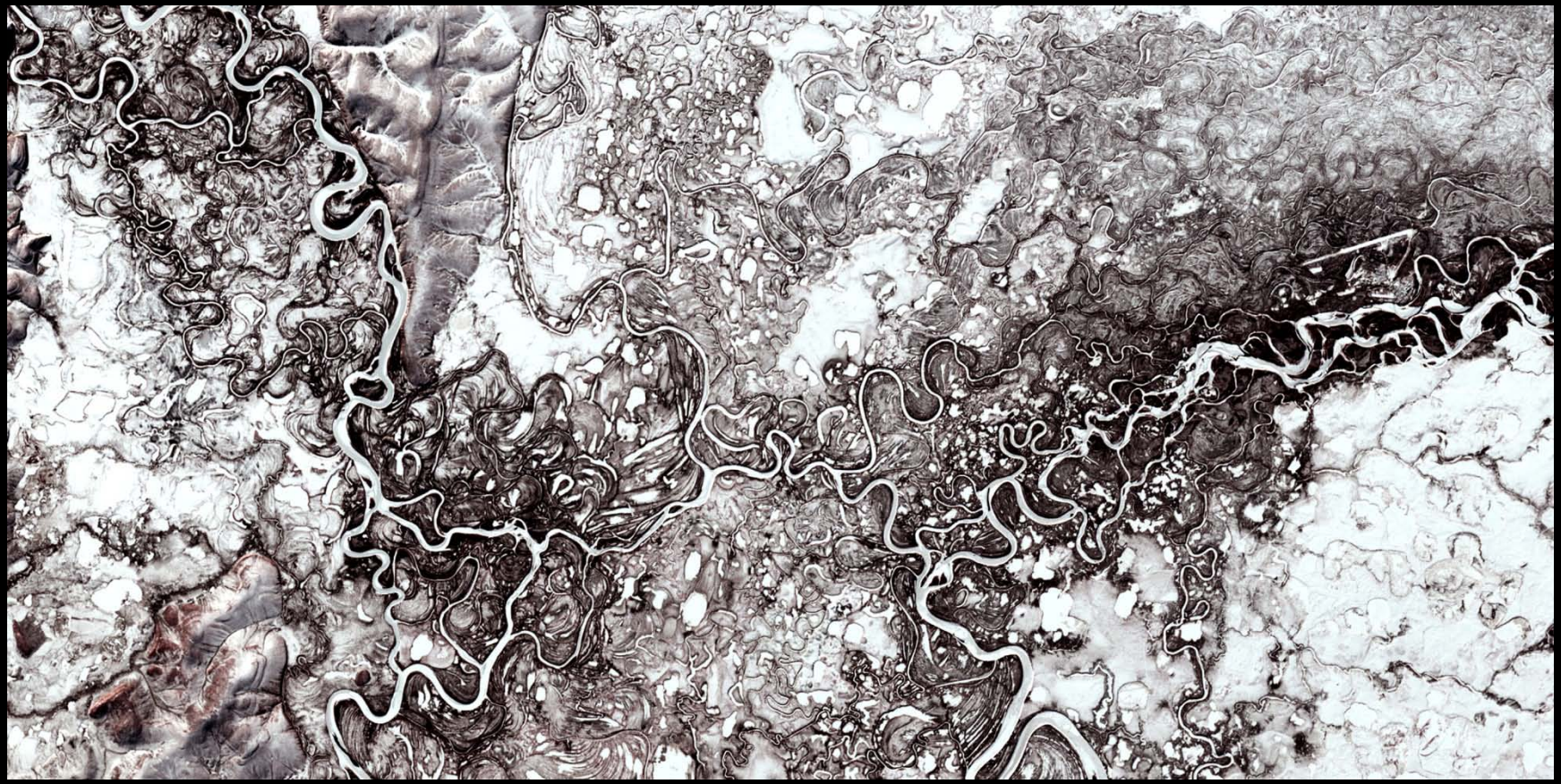
CREDIT: NASA/JPL-Caltech/University of Arizona/Cornell/Ohio State University

EARTH



CREDIT: NASA Earth Observatory

EARTH



CREDIT: NASA Earth Observatory

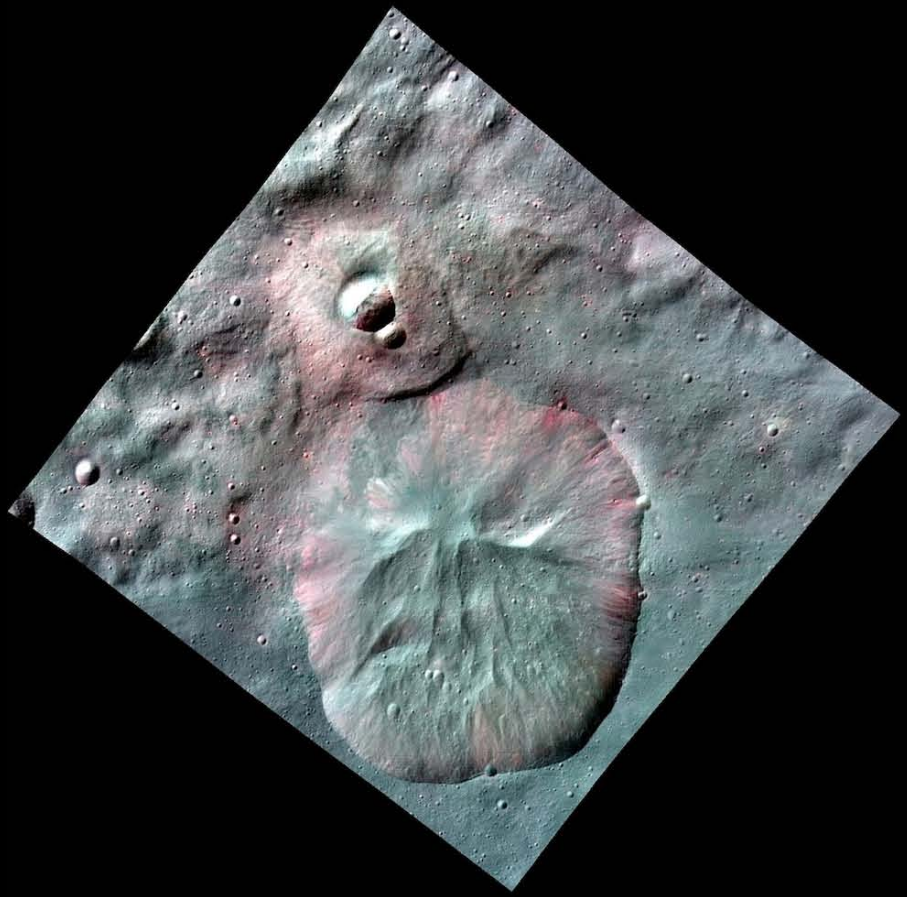
COLOR

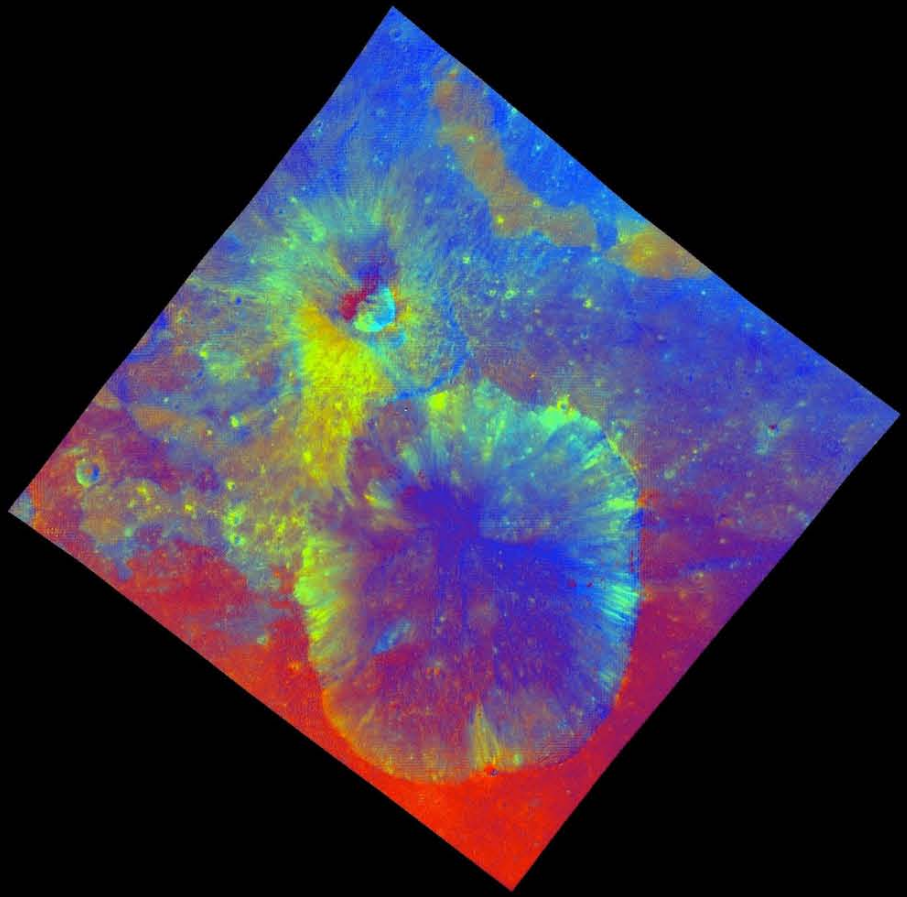
MOON

Color – true and added

CREDIT: NASA/JPL

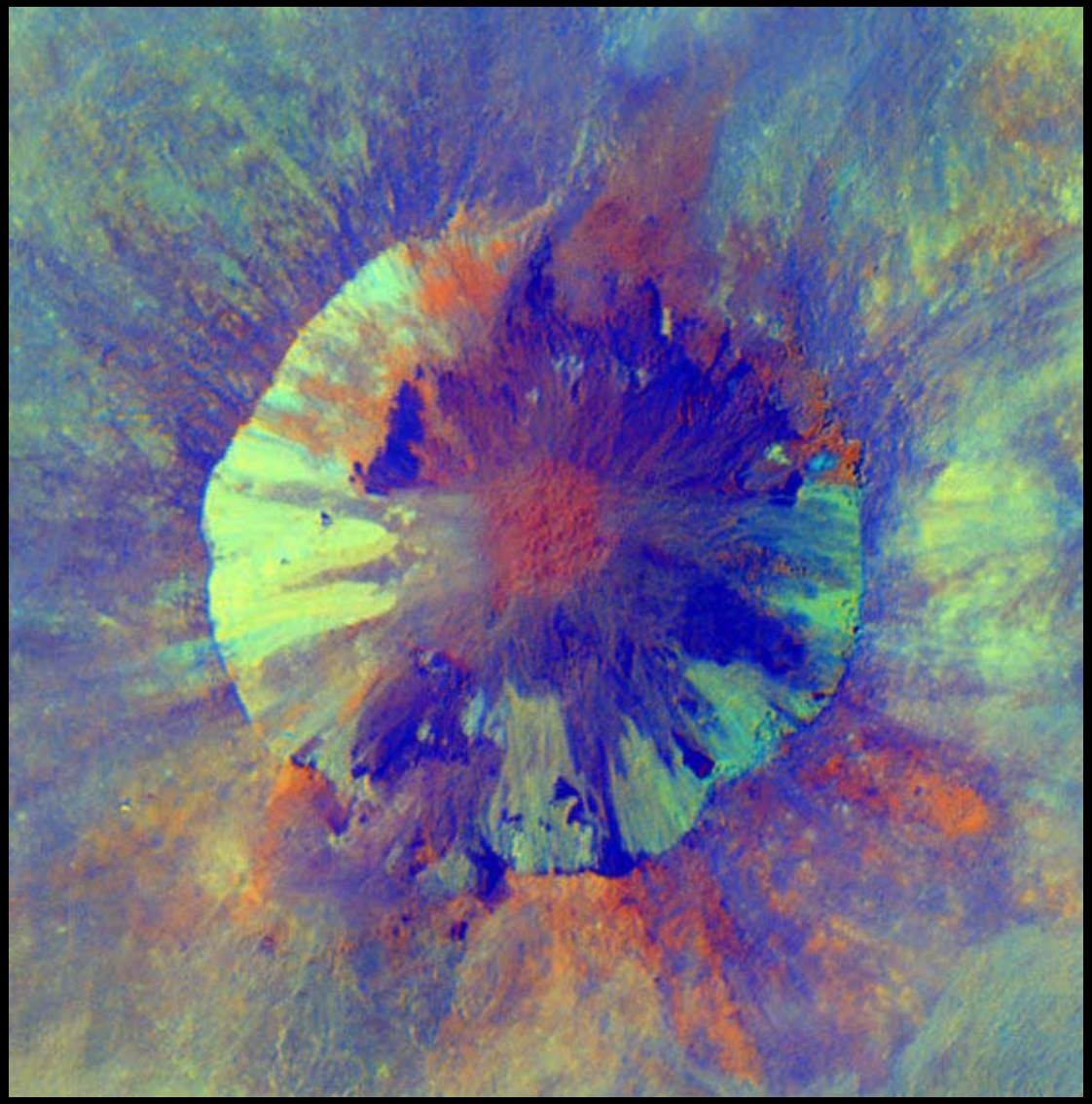
VESTA





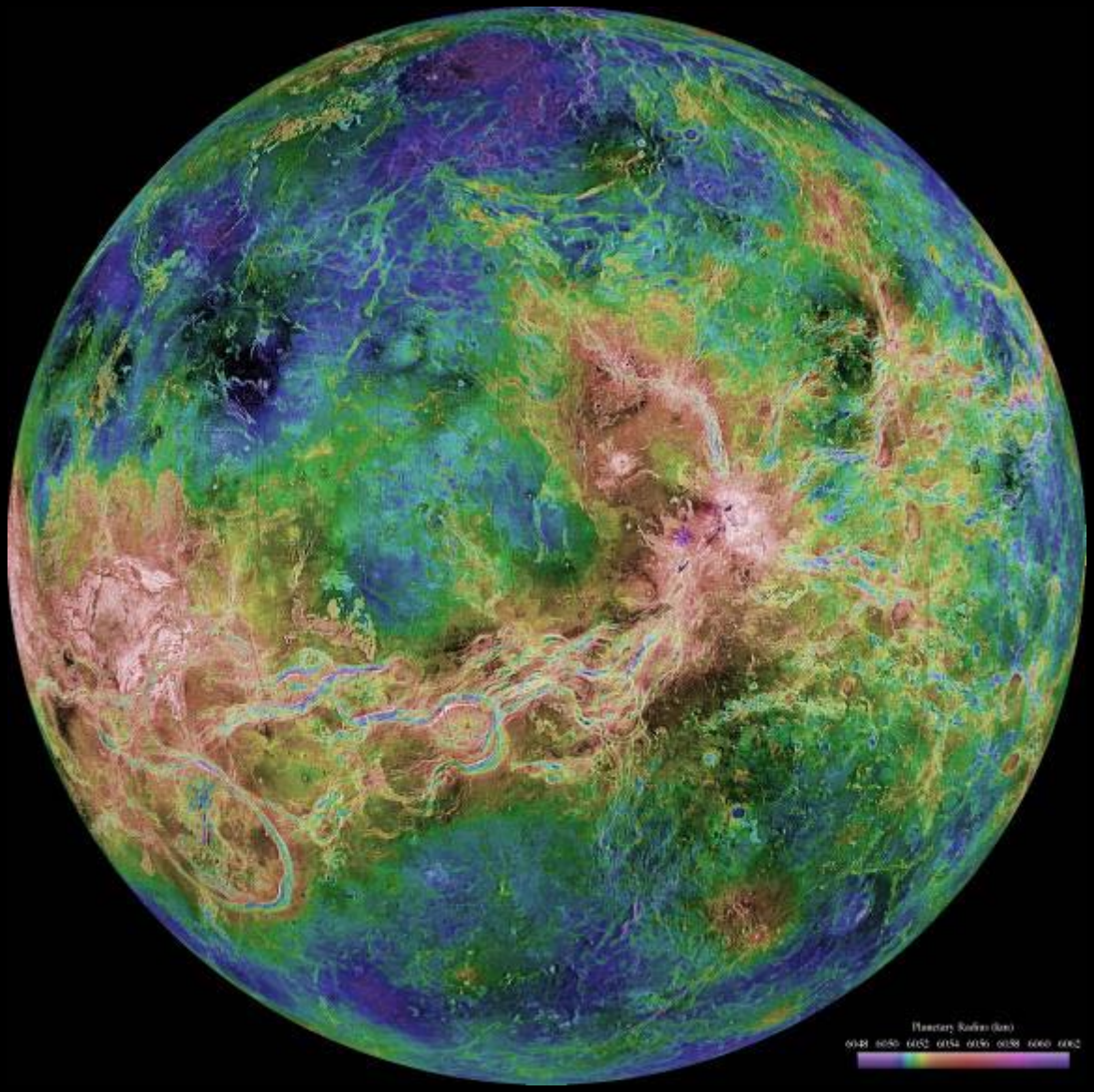
CREDIT: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

VESTA: Cornelia Crater



CREDIT: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

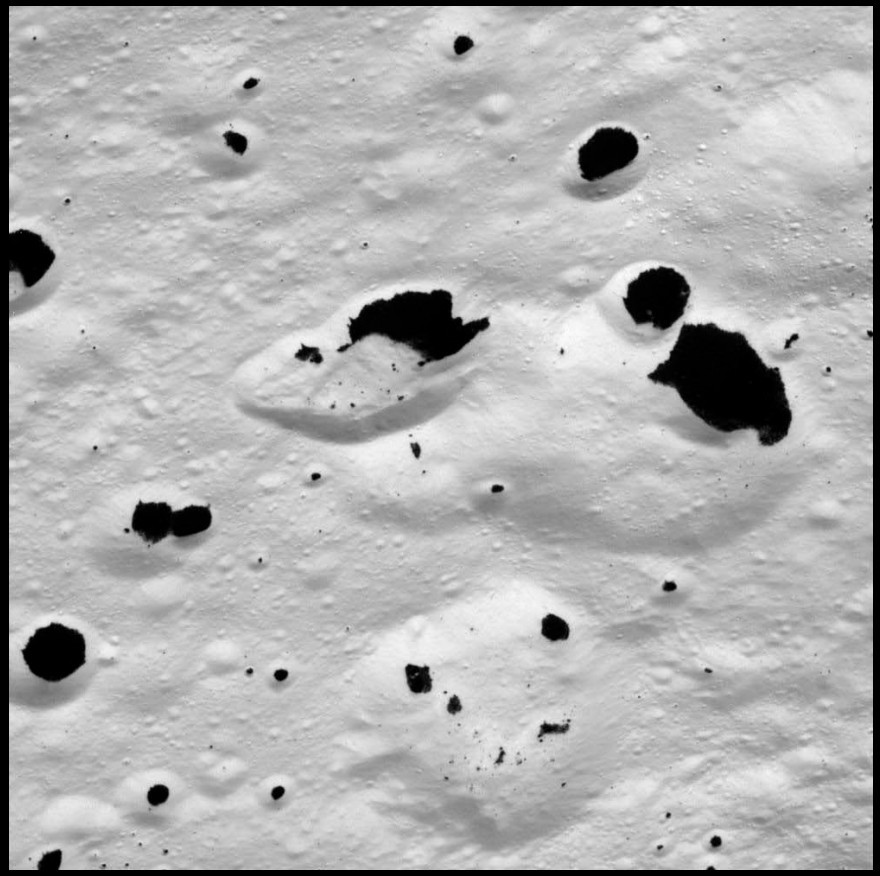
VENUS

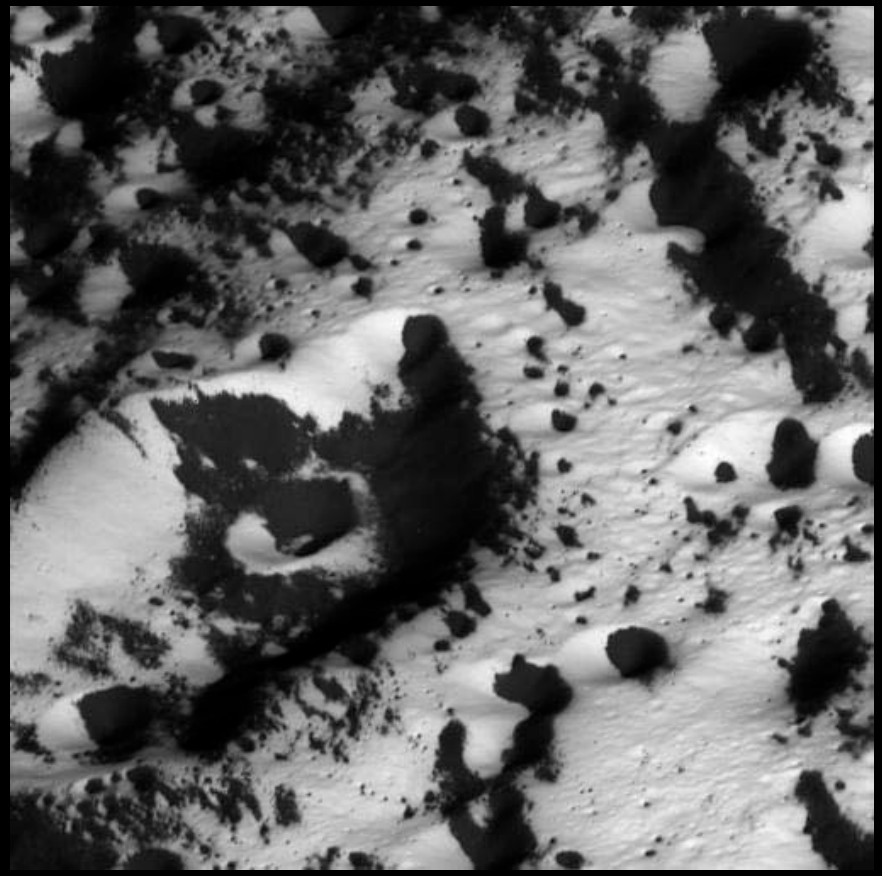


CREDIT: NASA/JPL/USGS

VALUE / ALBEDO

Saturn's moon, IAPETUS

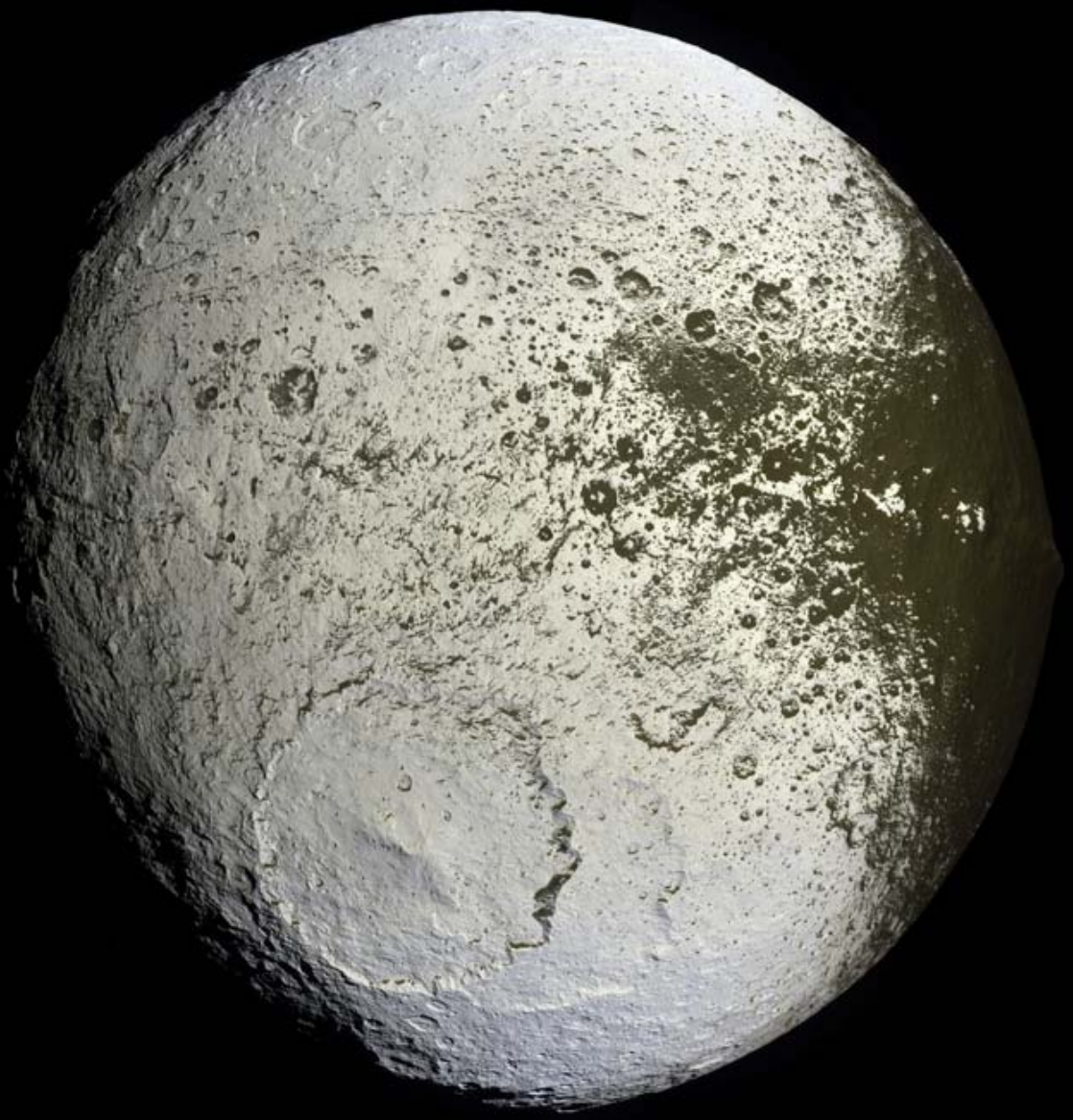




Value – light and dark, shade and highlight

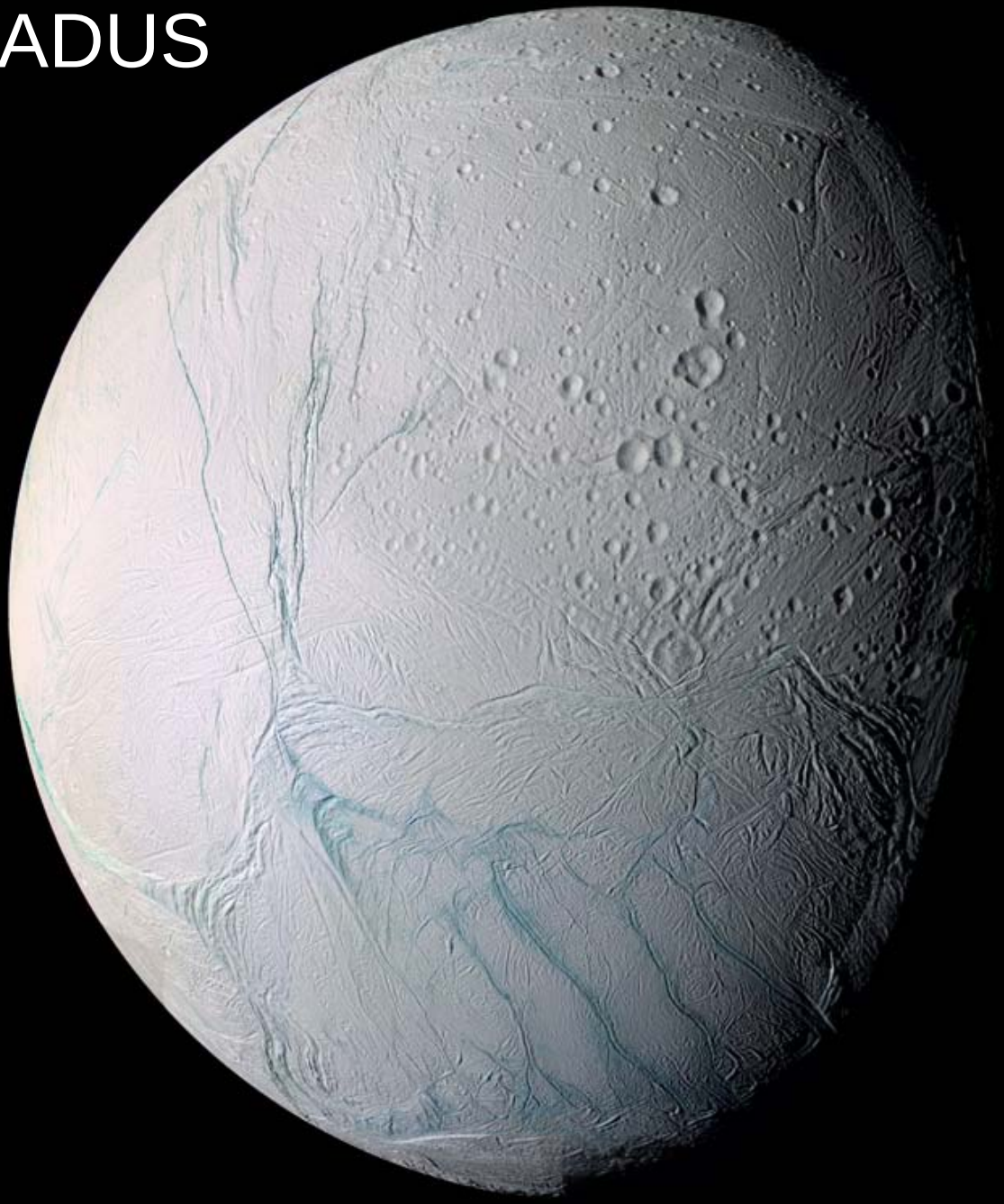
CREDIT: NASA/JPL/Space Science Institute

IAPETUS: The Yin-Yang Moon



CREDIT: NASA/JPL/Space Science Institute

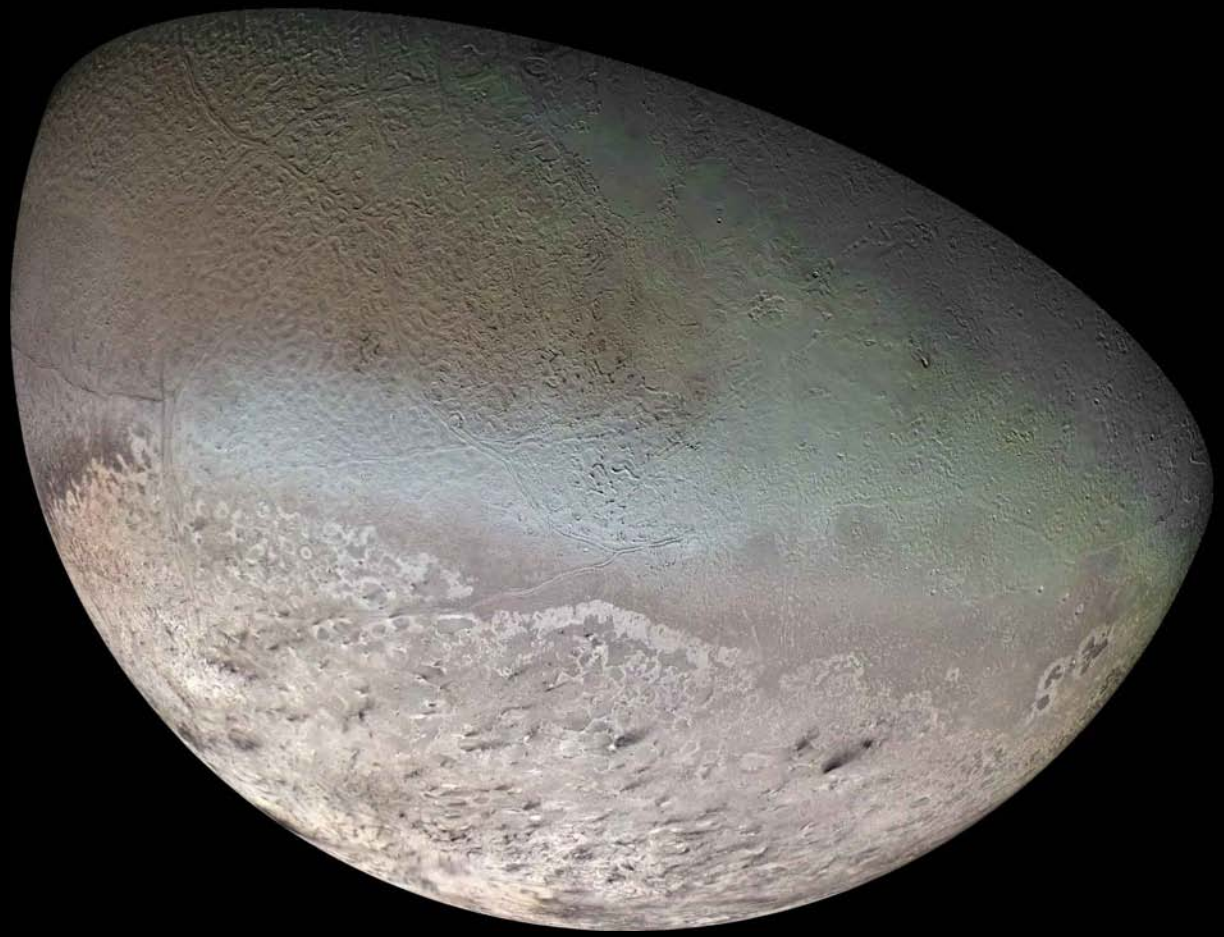
ENCELADUS



CREDIT: NASA/JPL/Space Science Institute

TEXTURE

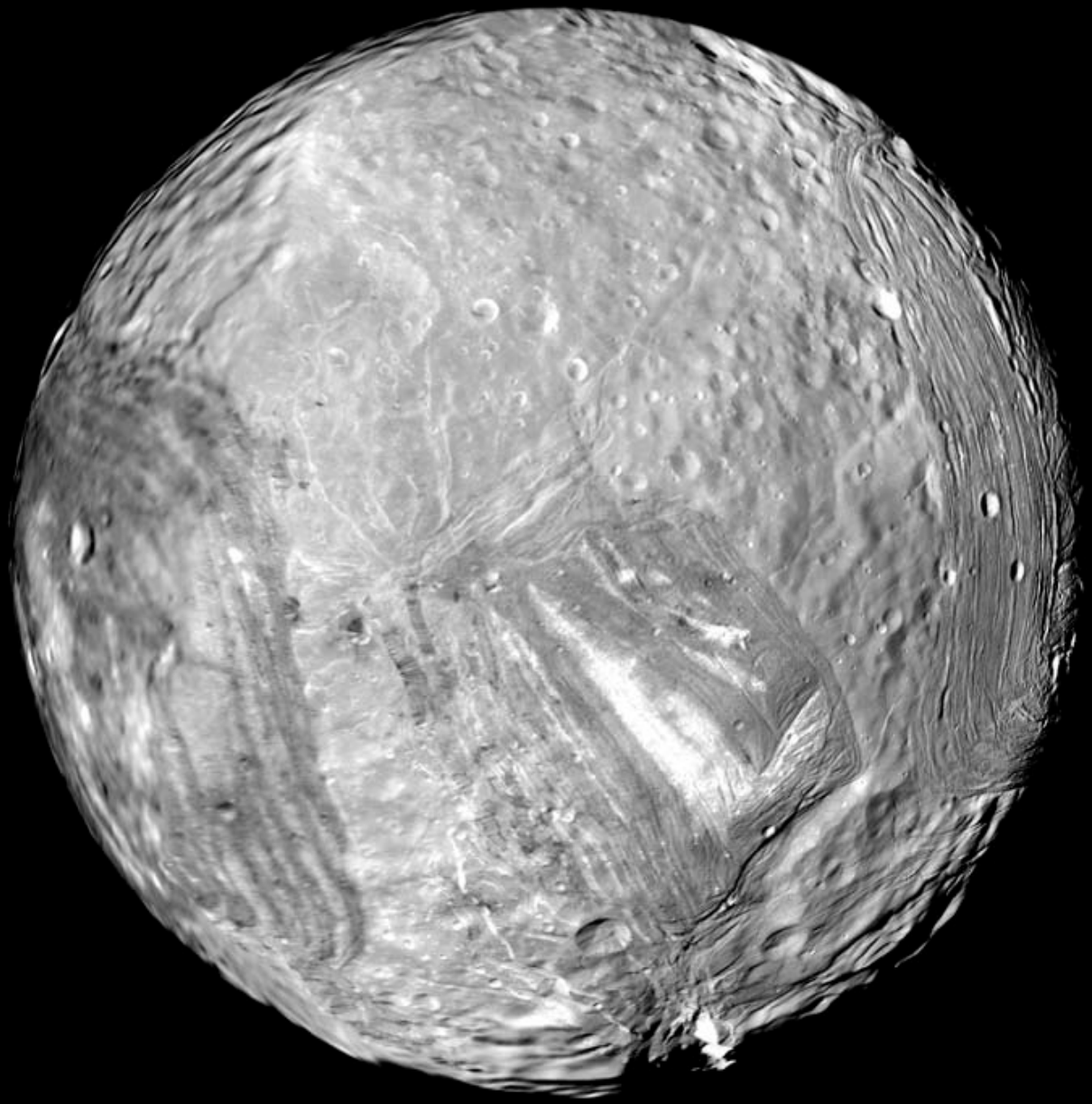
TRITON



Texture – the quality of the surface

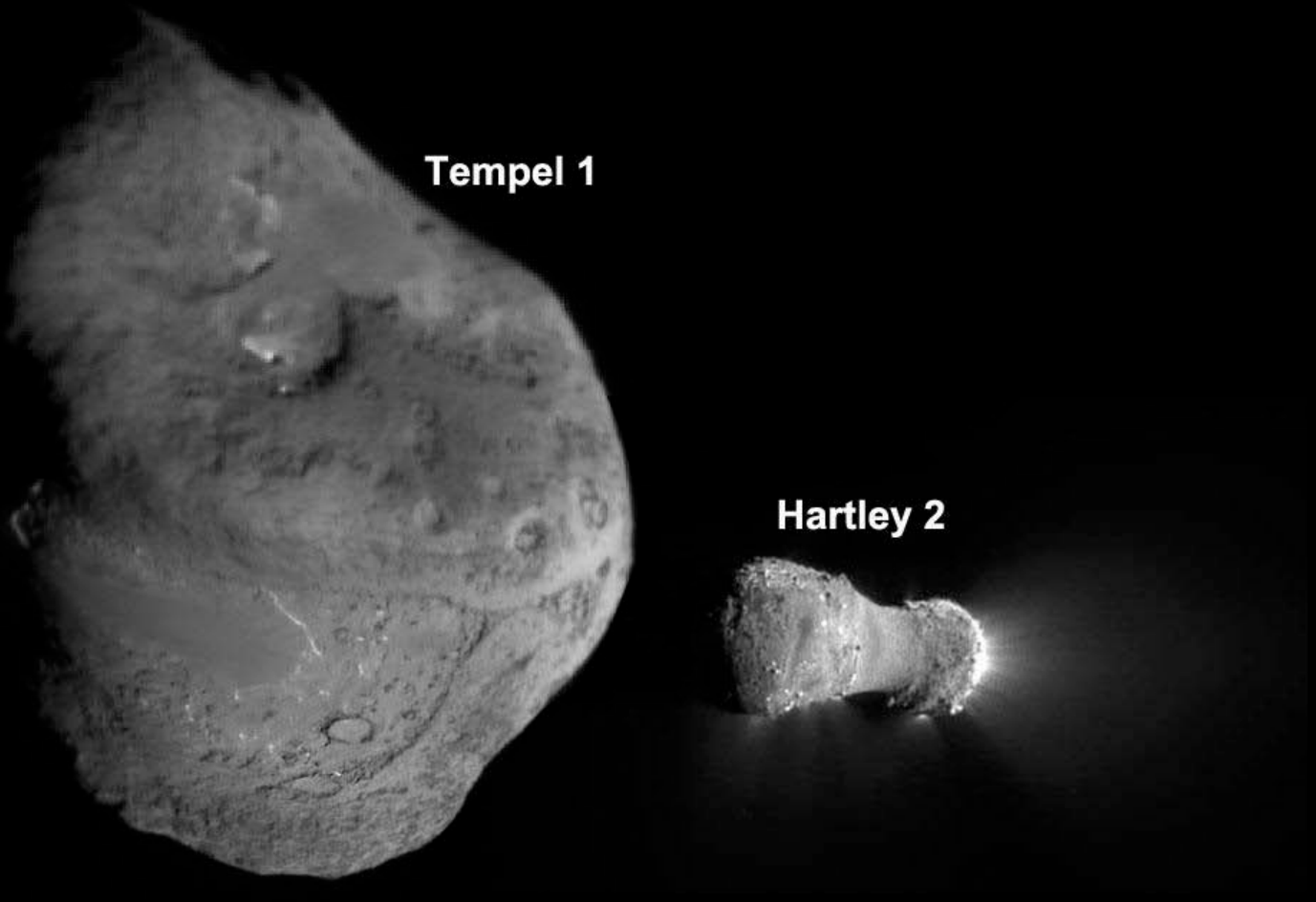
CREDIT: NASA/JPL/USGS

MIRANDA
Uranus Moon



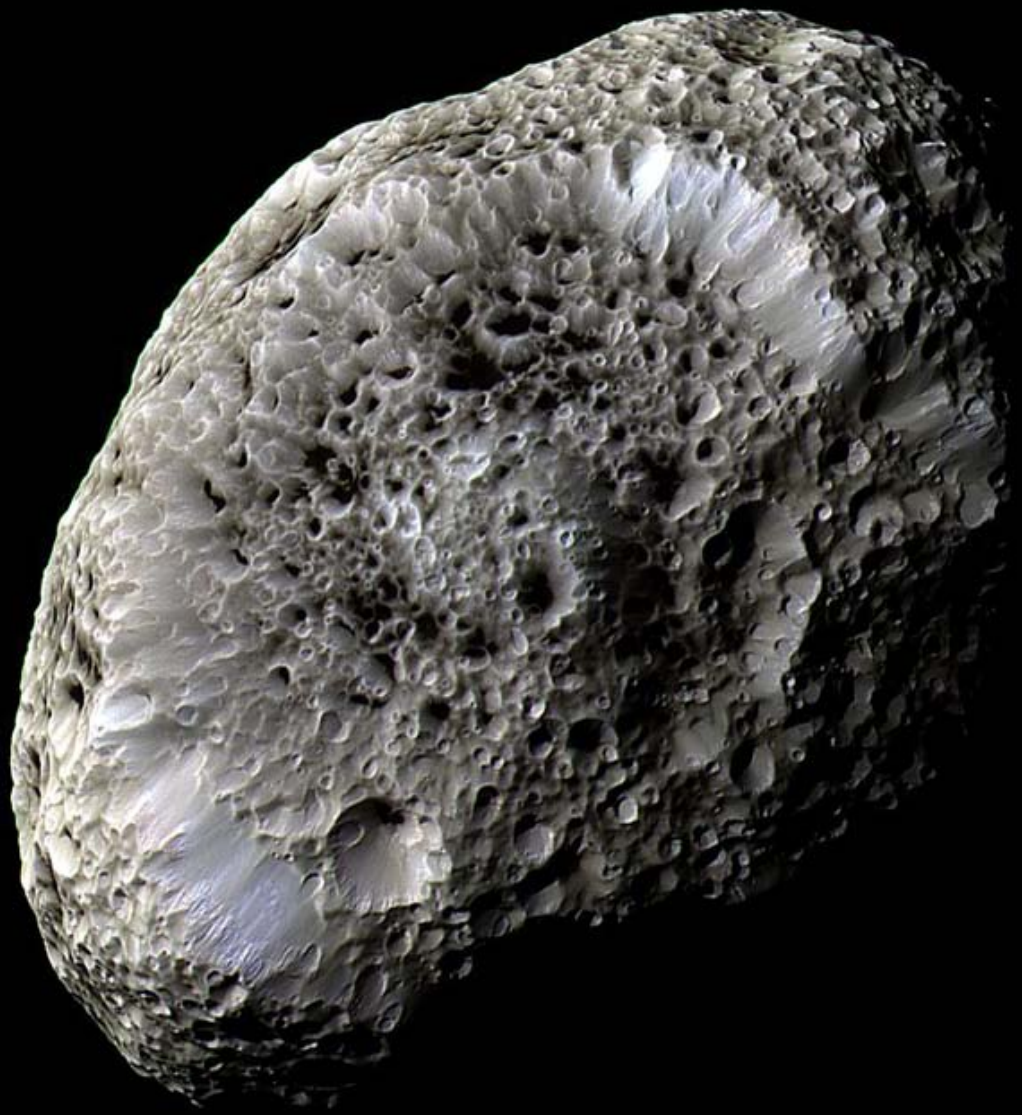
NASA/JPL-Caltech/University of Arizona

COMET NUCLEI



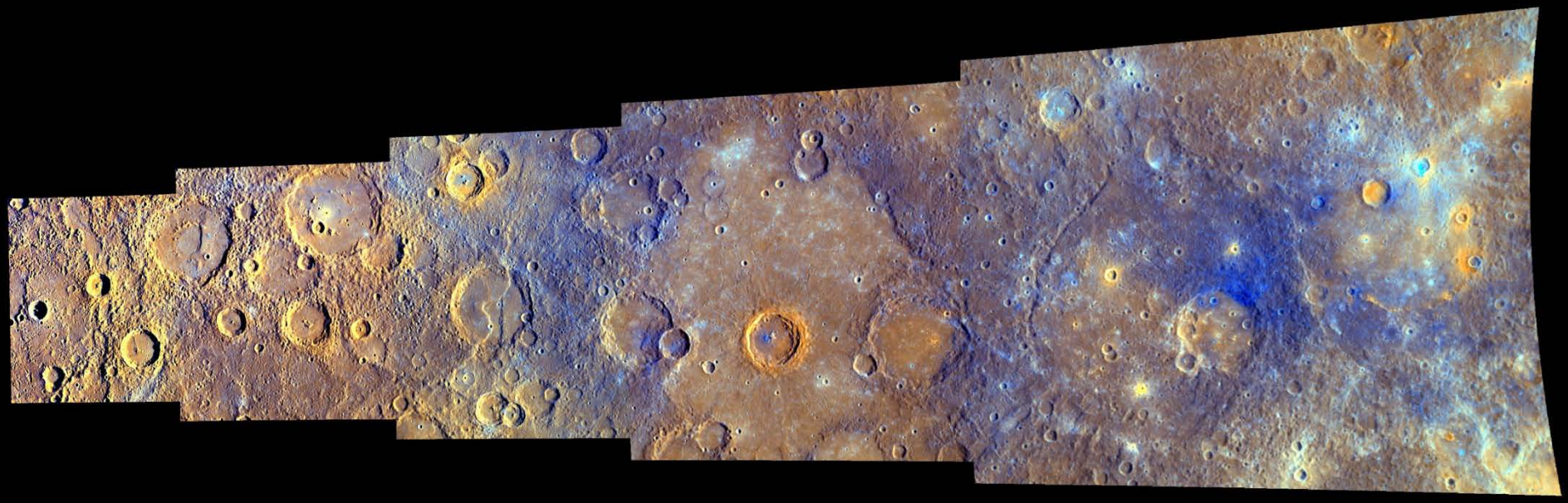
CREDIT: NASA/JPL-Caltech/UMD

HYPERION



SATURNS MOON HYPERION: CREDIT: NASA/JPL/Space Science Institute

DECIPHERING GEOLOGIC STORIES: Circles, Lines & Blobs



CREDIT: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

MYSTERIOUS LANDSCAPE: What happened here…?

ONE CRATER CHAIN…

TWO CRATER CHAINS…

MESSENGER: CREDIT: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of

Learn more

NASA's Discovery Program

http://discovery.nasa.gov

Shari Asplund

shari.e.asplund@jpl.nasa.go

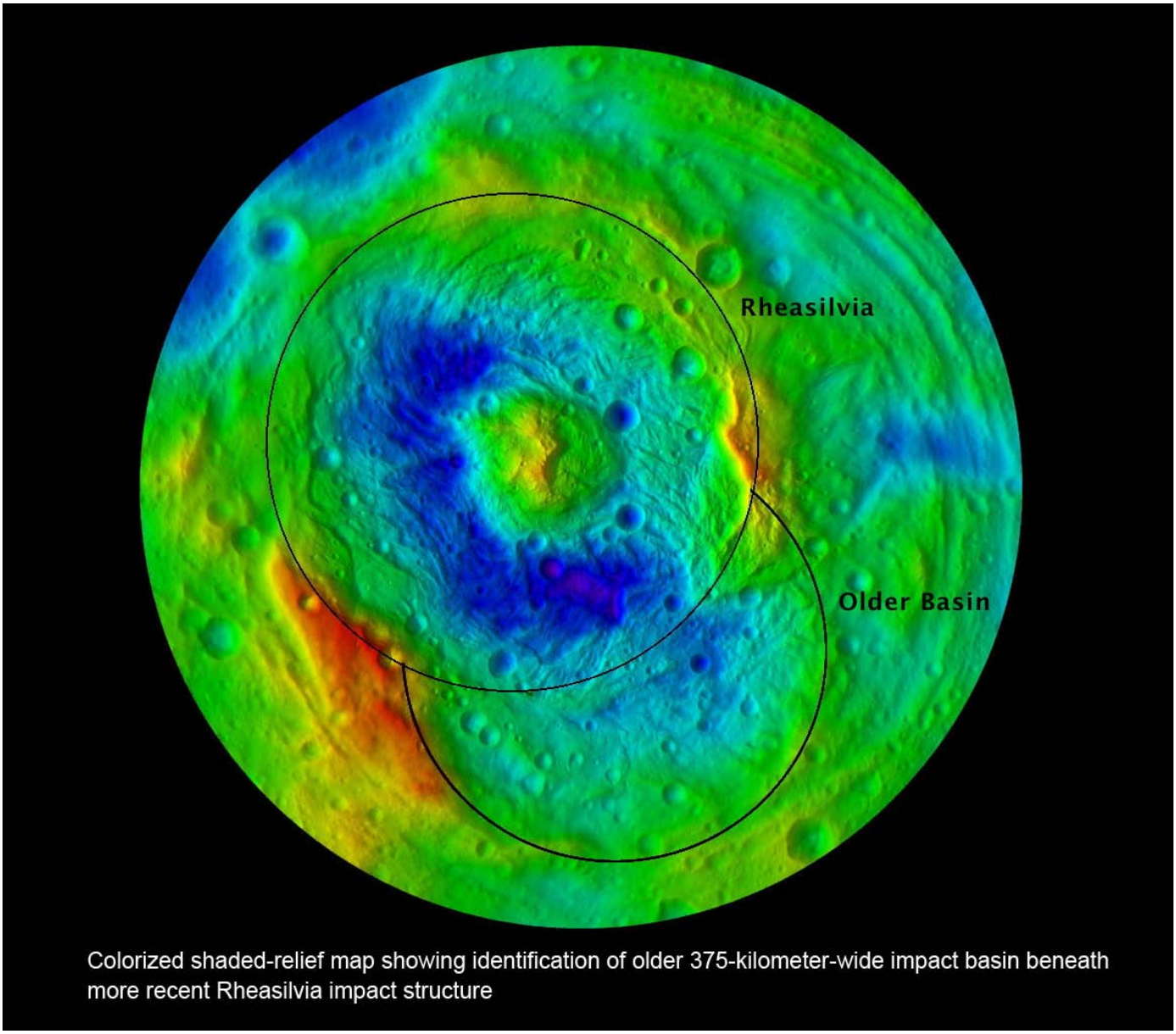
South American Andes Mountains: Strata Volcano

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…

Image Credit: NASA

Barringer Crater, Arizona

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…

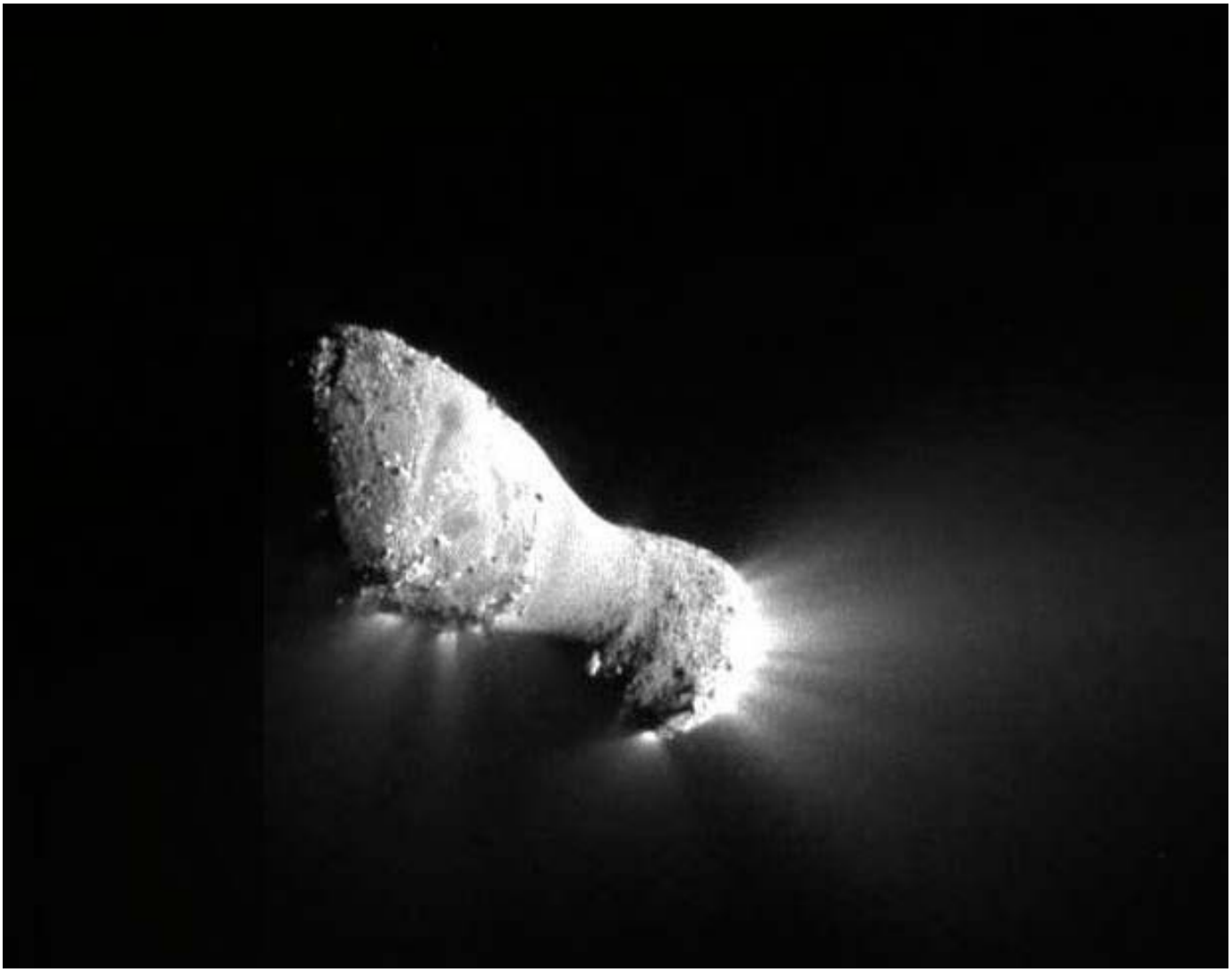


Colorized shaded-relief map showing identification of older 375-kilometer-wide impact basin beneath more recent Rheasilvia impact structure

Colorized Image of Vesta's South Pole

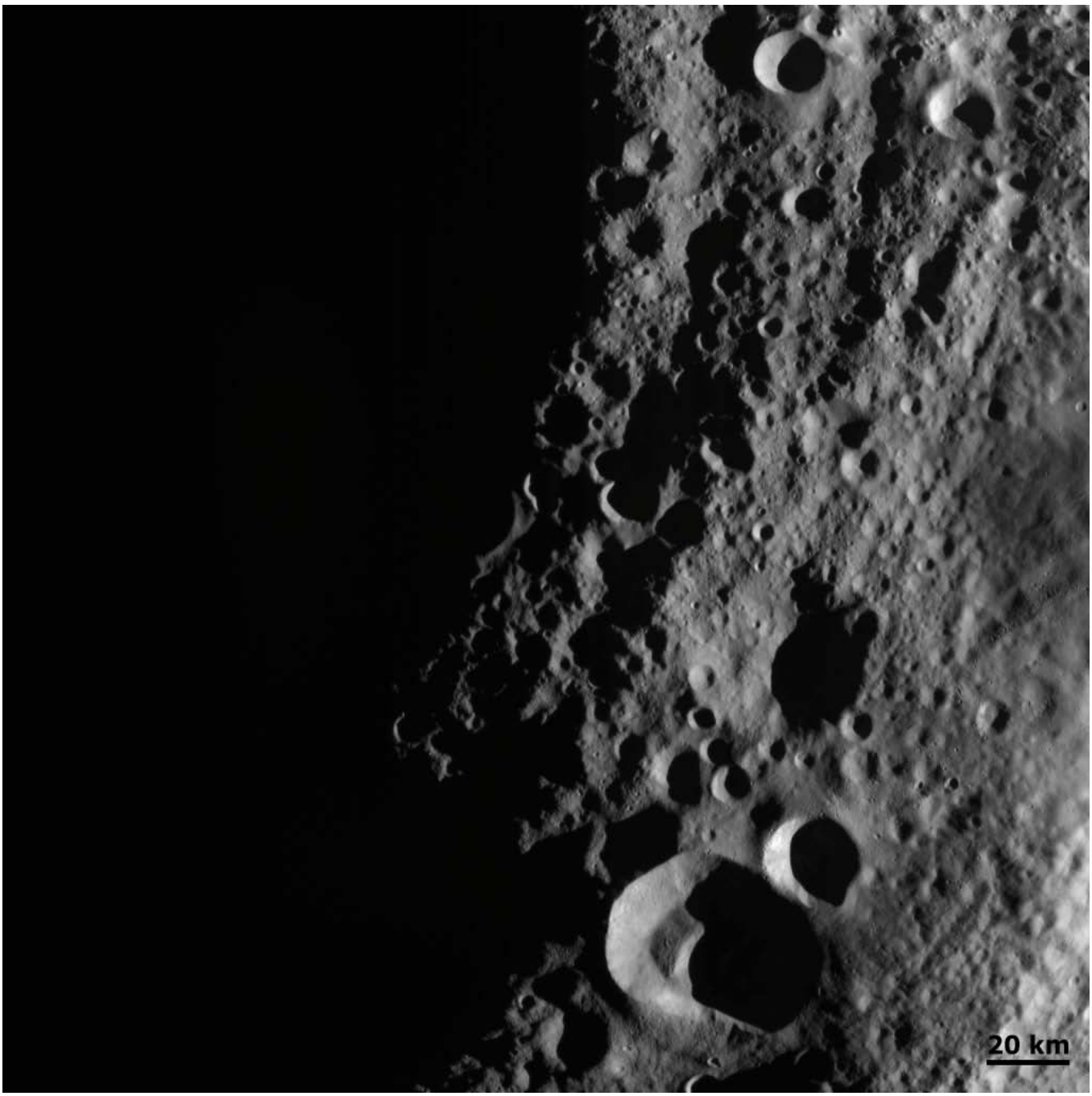
Scientists use color to emphasize variations such as mineral composition, temperature variation, and topography.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA



Comet Hartley 2: taken by the EPOXI Mission, with its outgassing jets (which create the coma and tail)

Image Credit: NASA

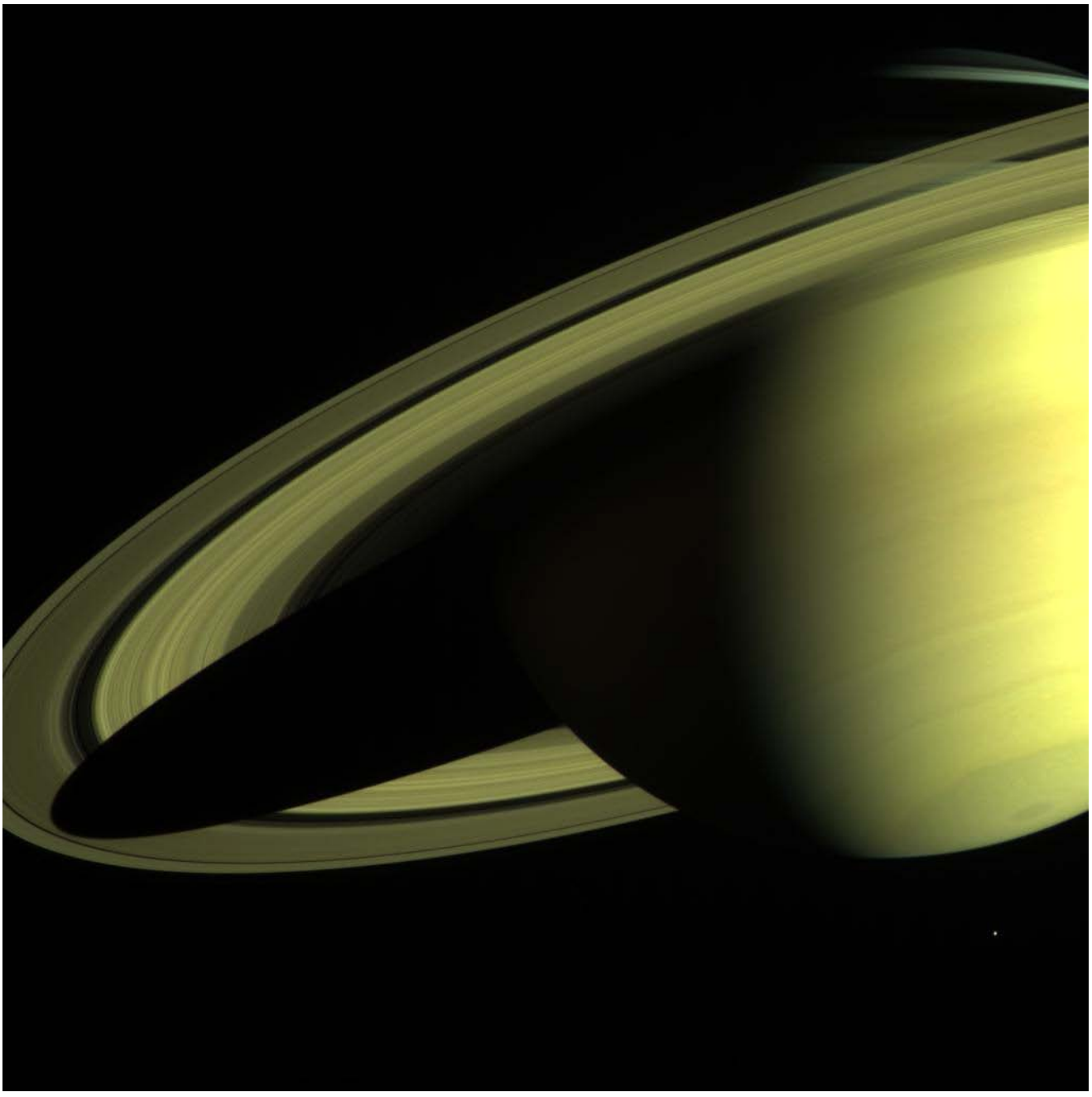


Day into night on Asteroid Vesta

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

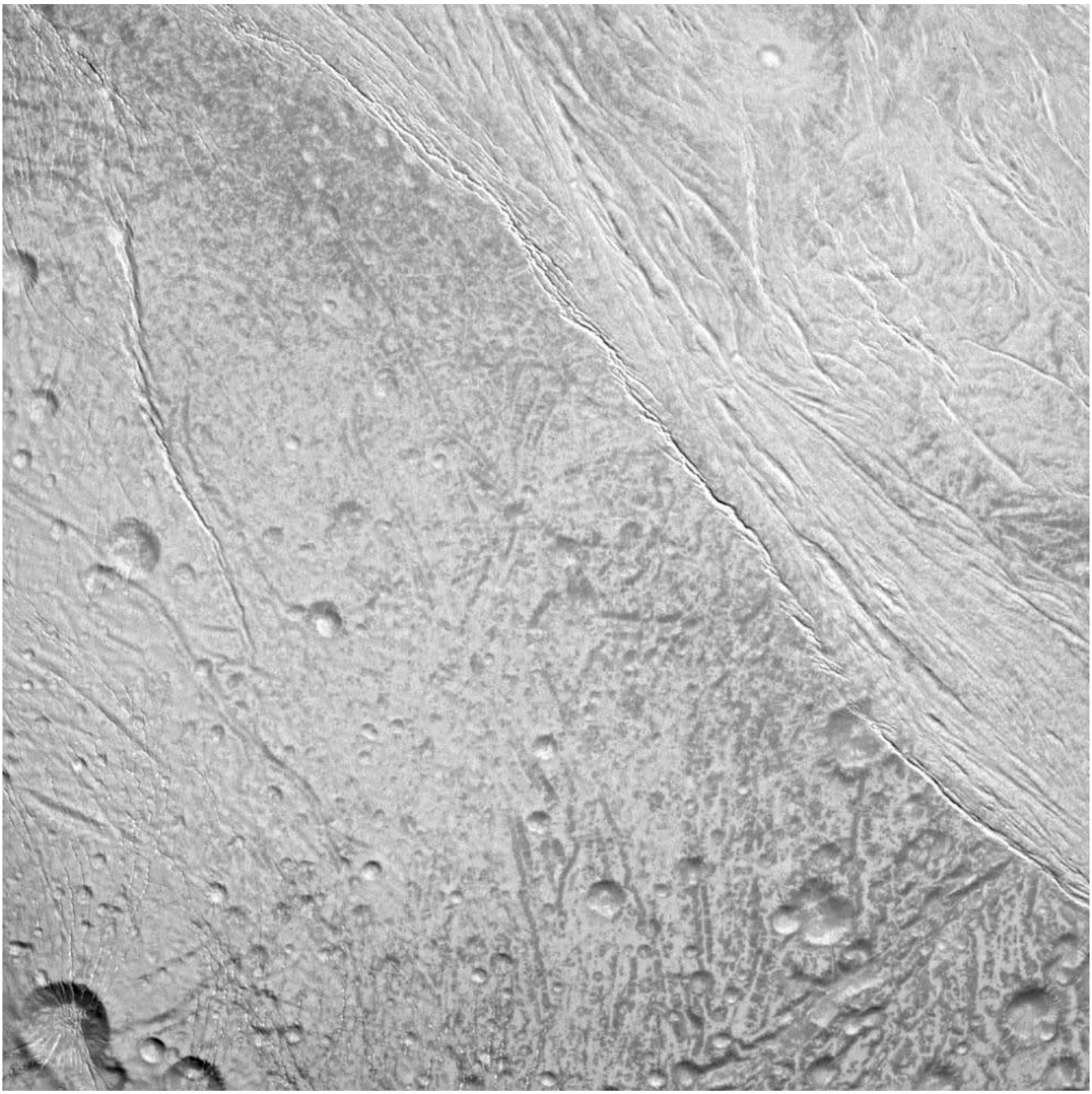
Day and Night, Saturn

Scientists use color to emphasize variations such as mineral composition, temperature variation, and topography.



Deep Impact Mission: Comet Tempel 1

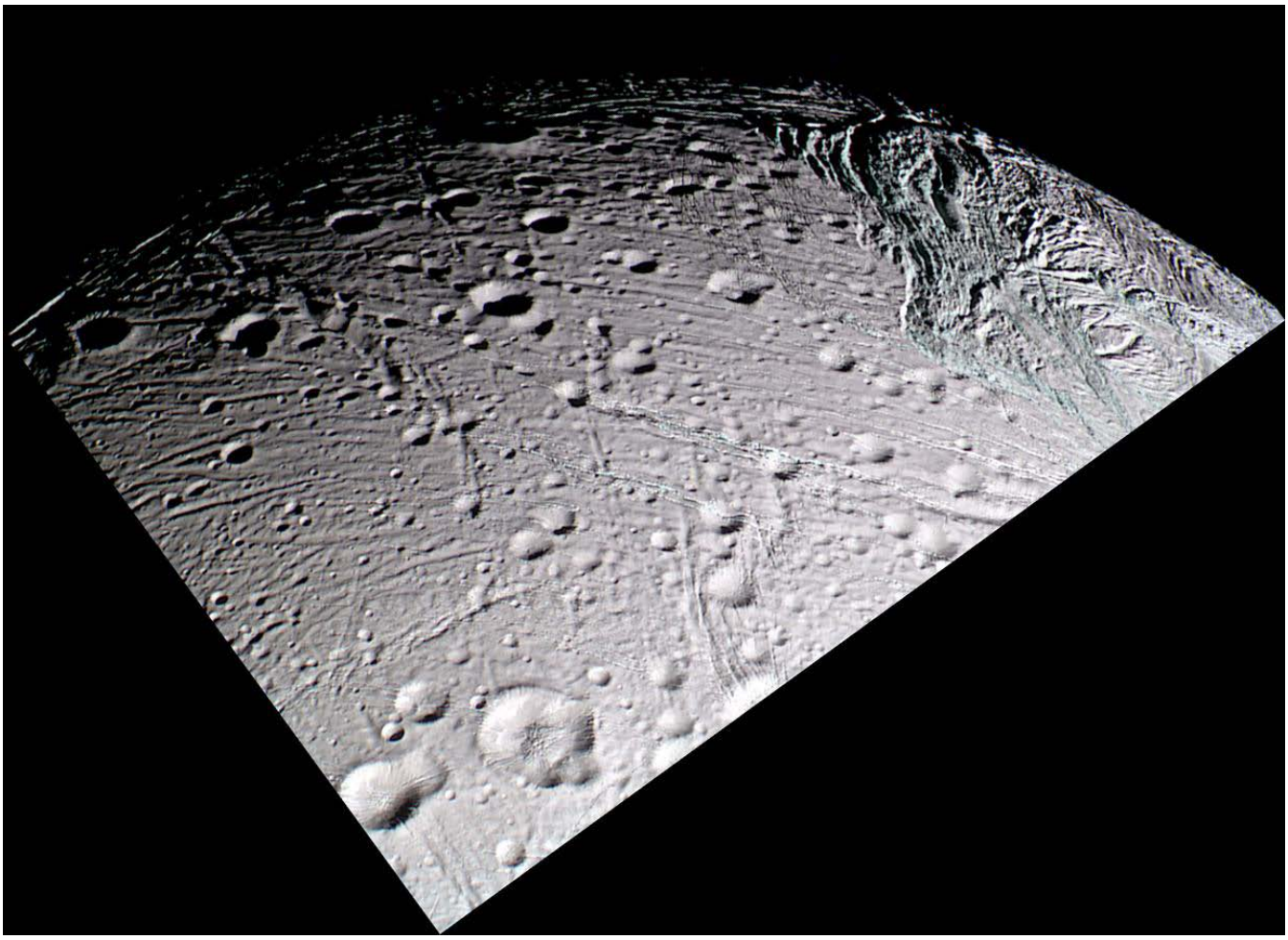
Impactor spacecraft hitting comet Tempel 1's nucleus as the main spacecraft flys by and takes image.



Enceladus' Icy Surface

This moon of Saturn's cryovolcanoes

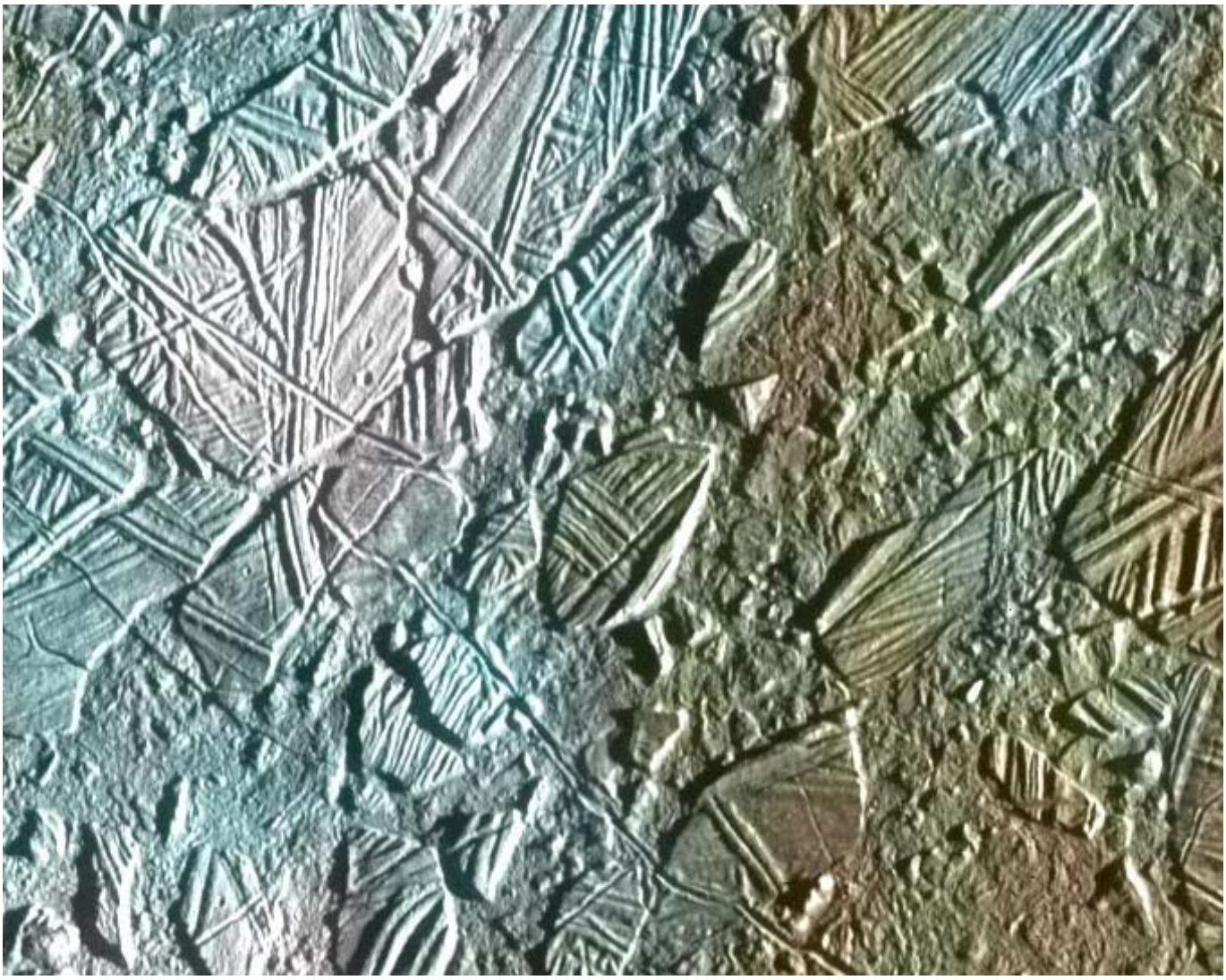
(jetting ices) is responsible for the largest of Saturn's rings!



Enceladus Old and Young

Folding on far right indicates tectonic activity and a more youthful surface; craters on the bottom and left an older surface

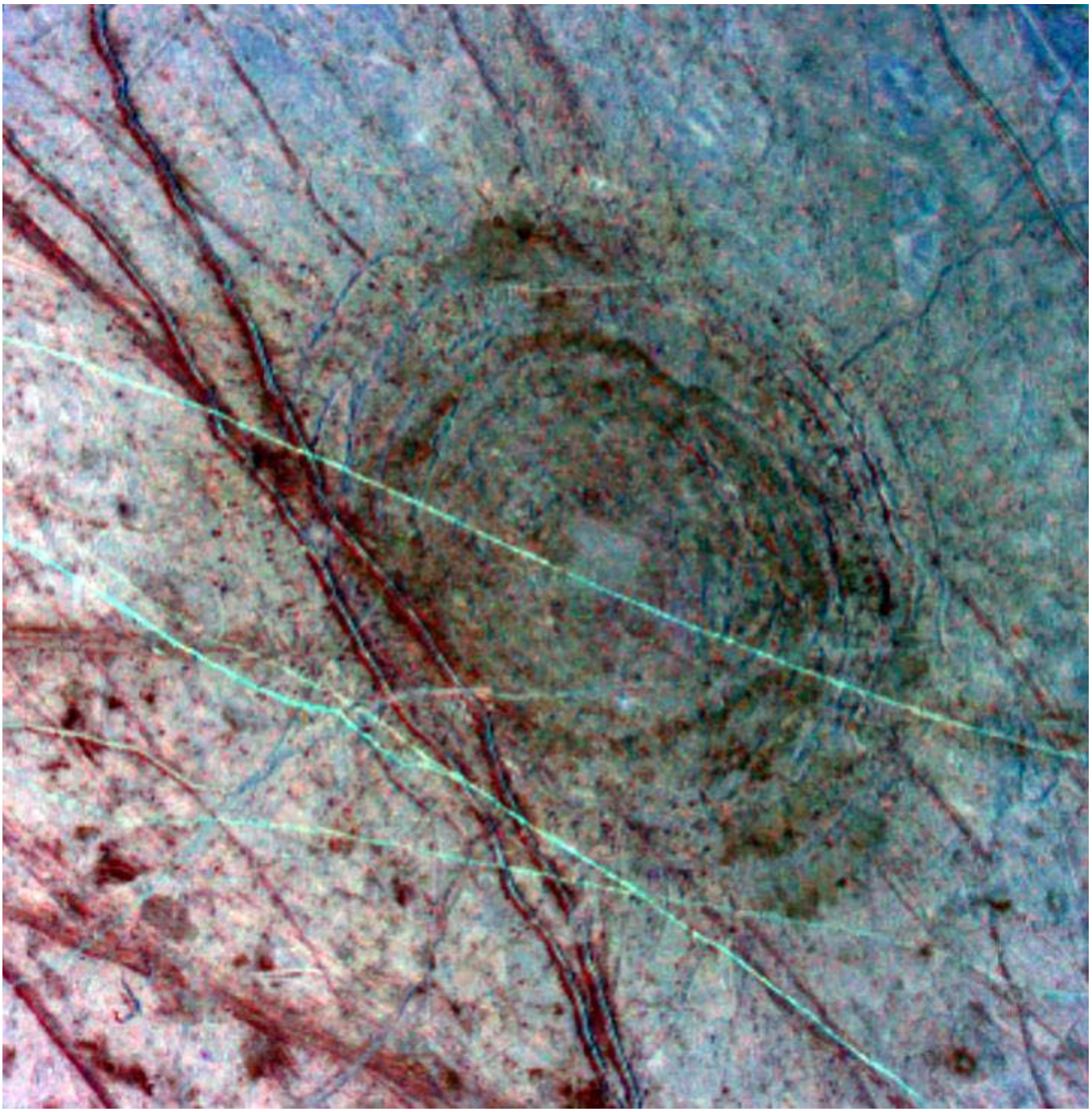
Image Credit: NASA



Jupiter's Moon Europa: Chaos

The cracks and fault lines and fissures of Europa resemble activity we observe on our own North and South poles!

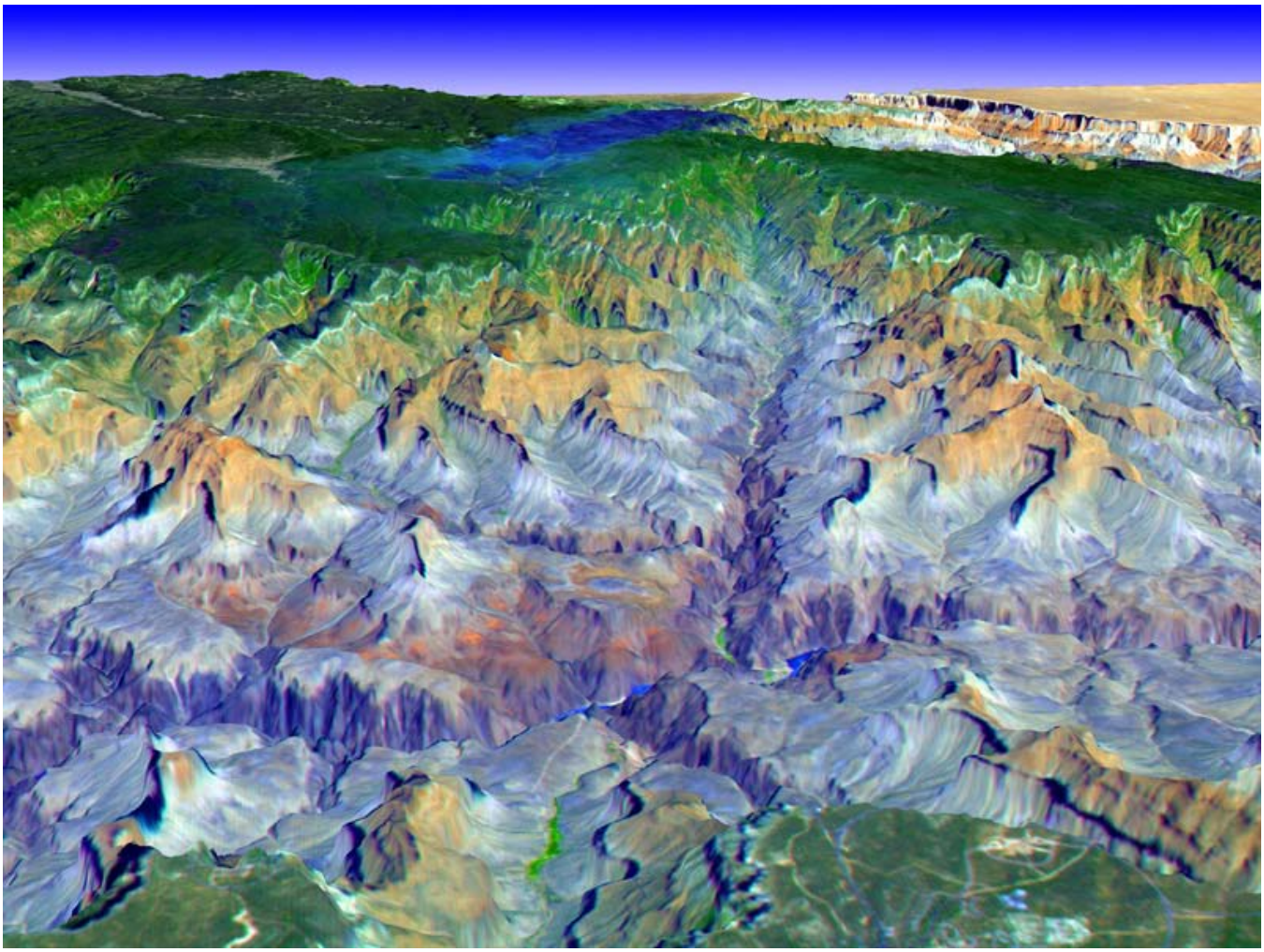
Image Credit: NASA



An impact on Jupiter's icy moon Europa

The Elements of Art and the Cosmic Connection
NASA's Discovery and New Frontiers Programs

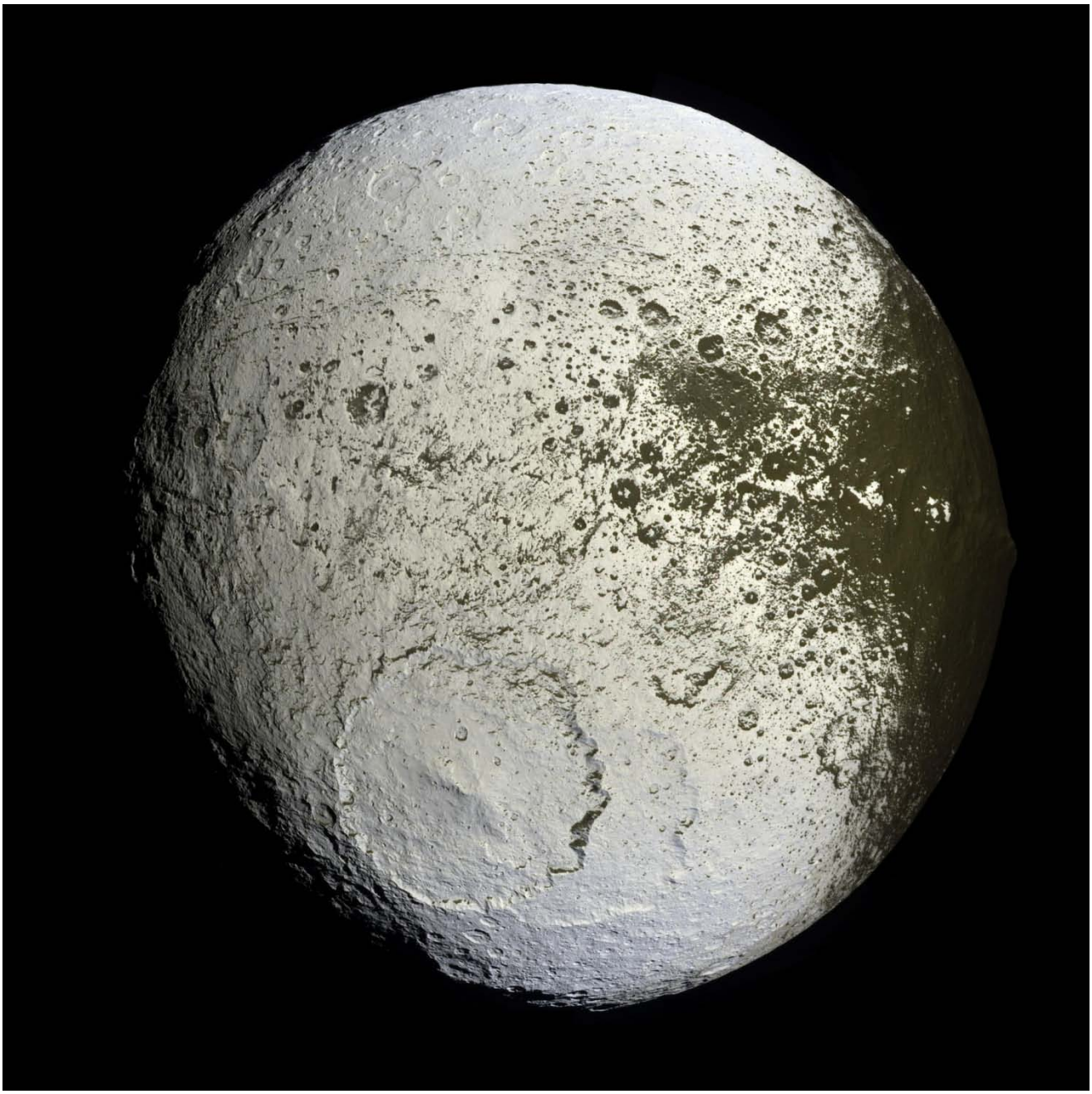
Image Credit: NASA



Grand Canyon

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids… Visible and near infrared data were combined to form an image that simulates the natural colors of water and vegetation.

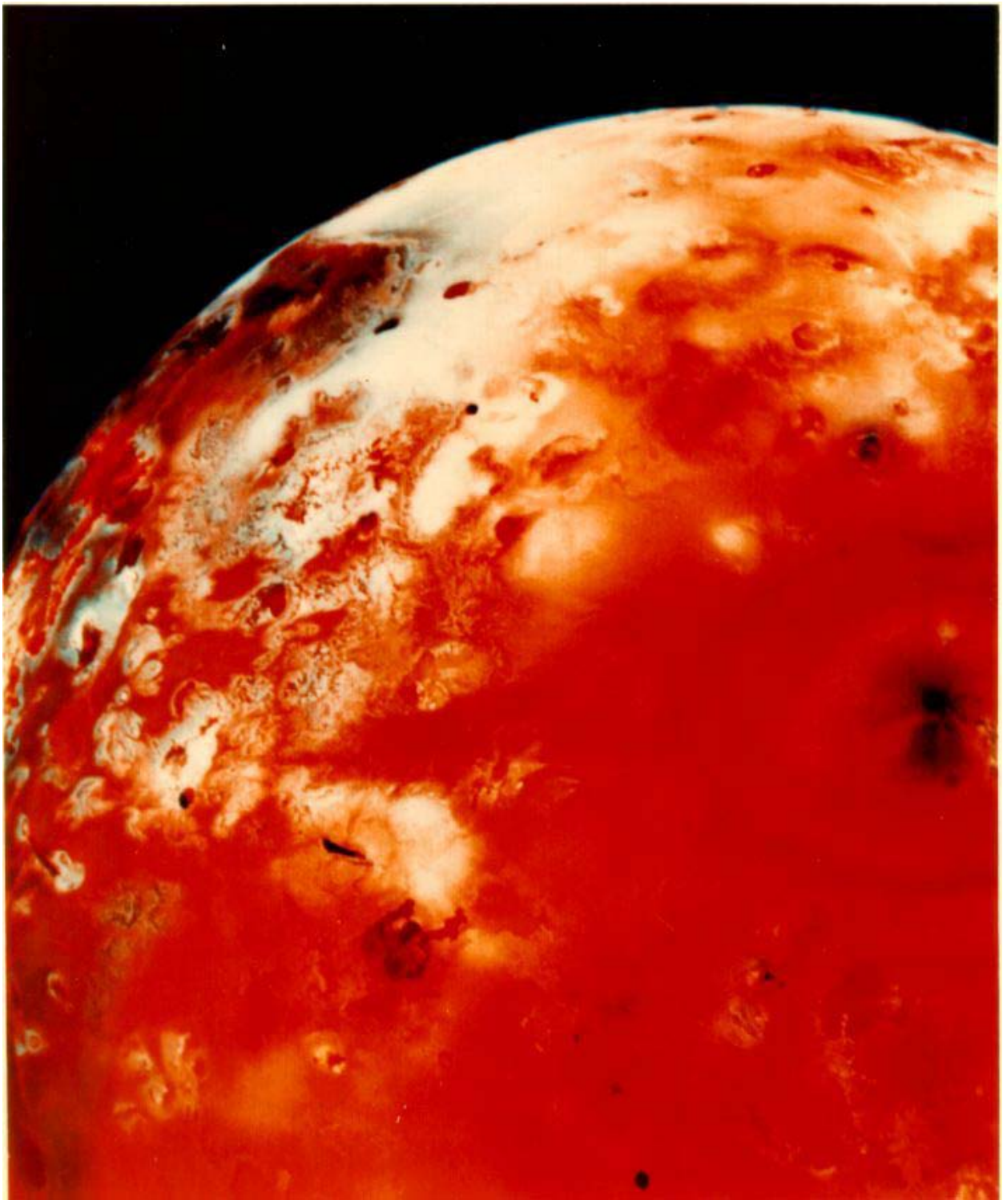
Image credit: NASA/GSFC/MITI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team



Saturn's moon, Iapetus

The black areas are in shadow, the brown is the actual color of the surface of the moon.

Image credit: NASA/JPL/Space Science Institute



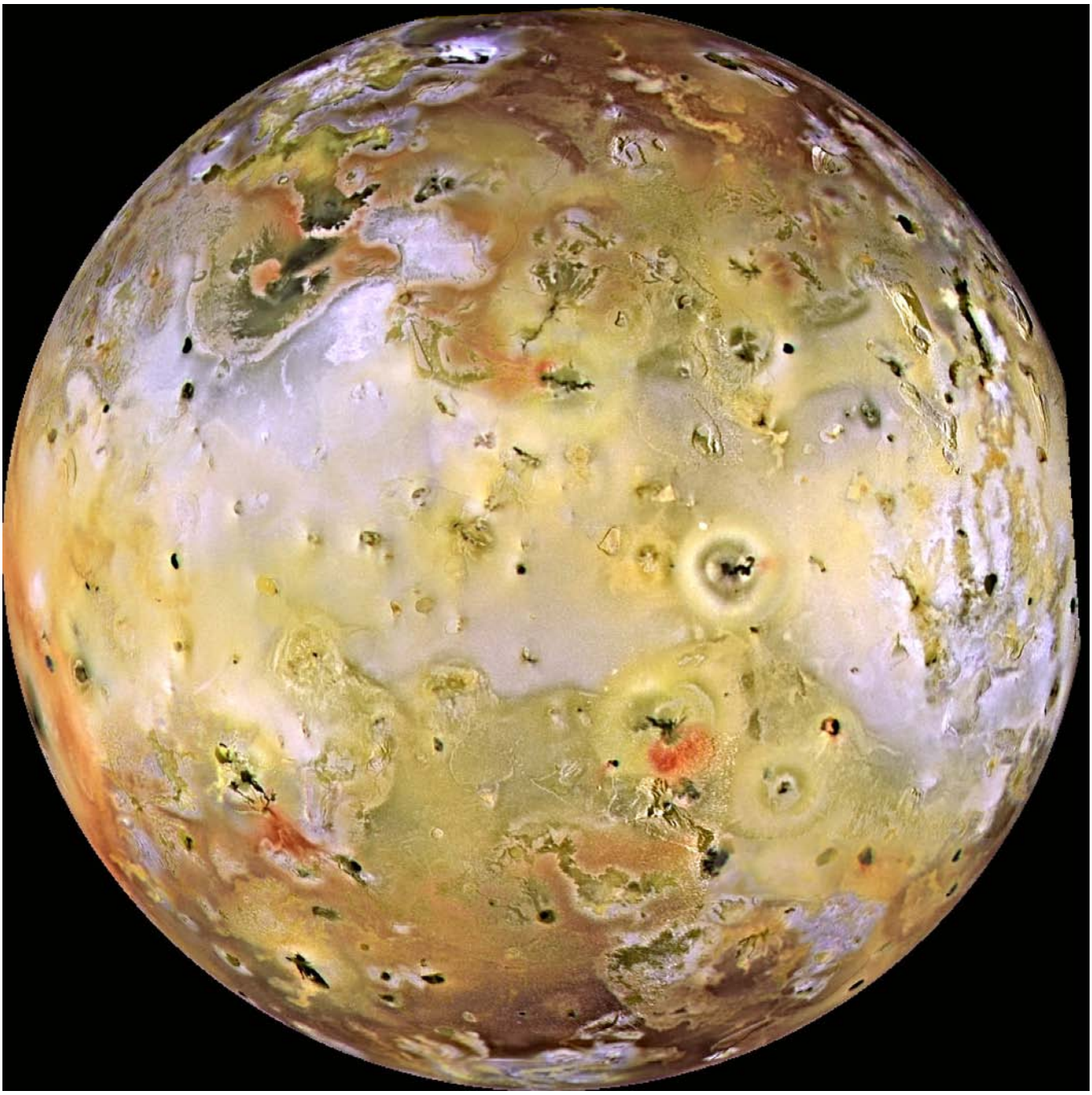
Jupiter's moon, Io's, Volcanoes…

…the most volcanic solar system body, Io is so close to Jupiter that the *land* is pulled 15 meters daily, like land tides!

Jupiter Eye on Io

The gas giant in contrast to its moon, Io

Image credit: NASA/JPL/Space Science Institute



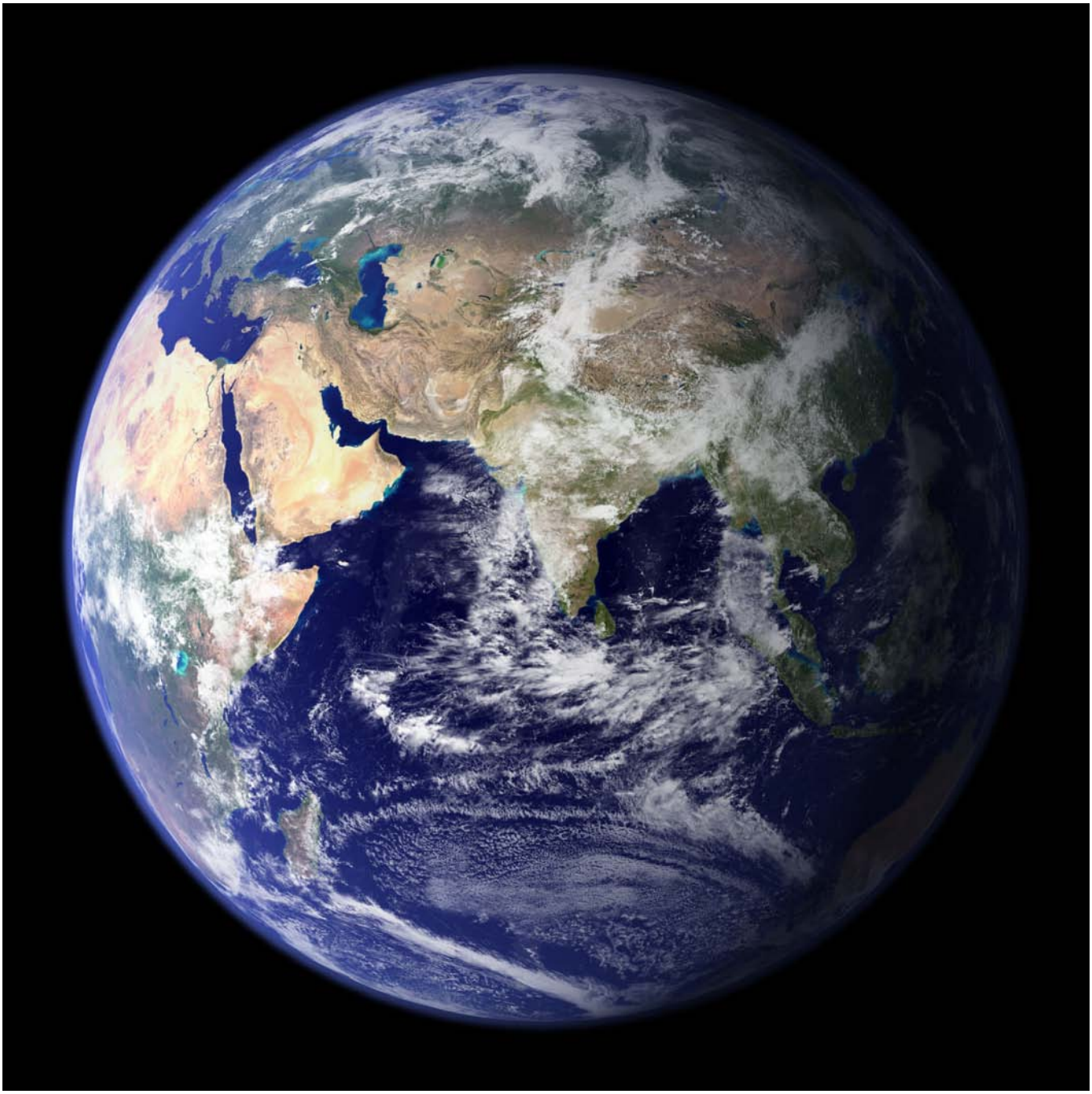
Jupiter Moon Io

…the most volcanic solar system body, Io is so close to Jupiter that the *land* is pulled 15 meters daily, like land tides! This is a true color image.

Mercury's vast crater, Kalidasa

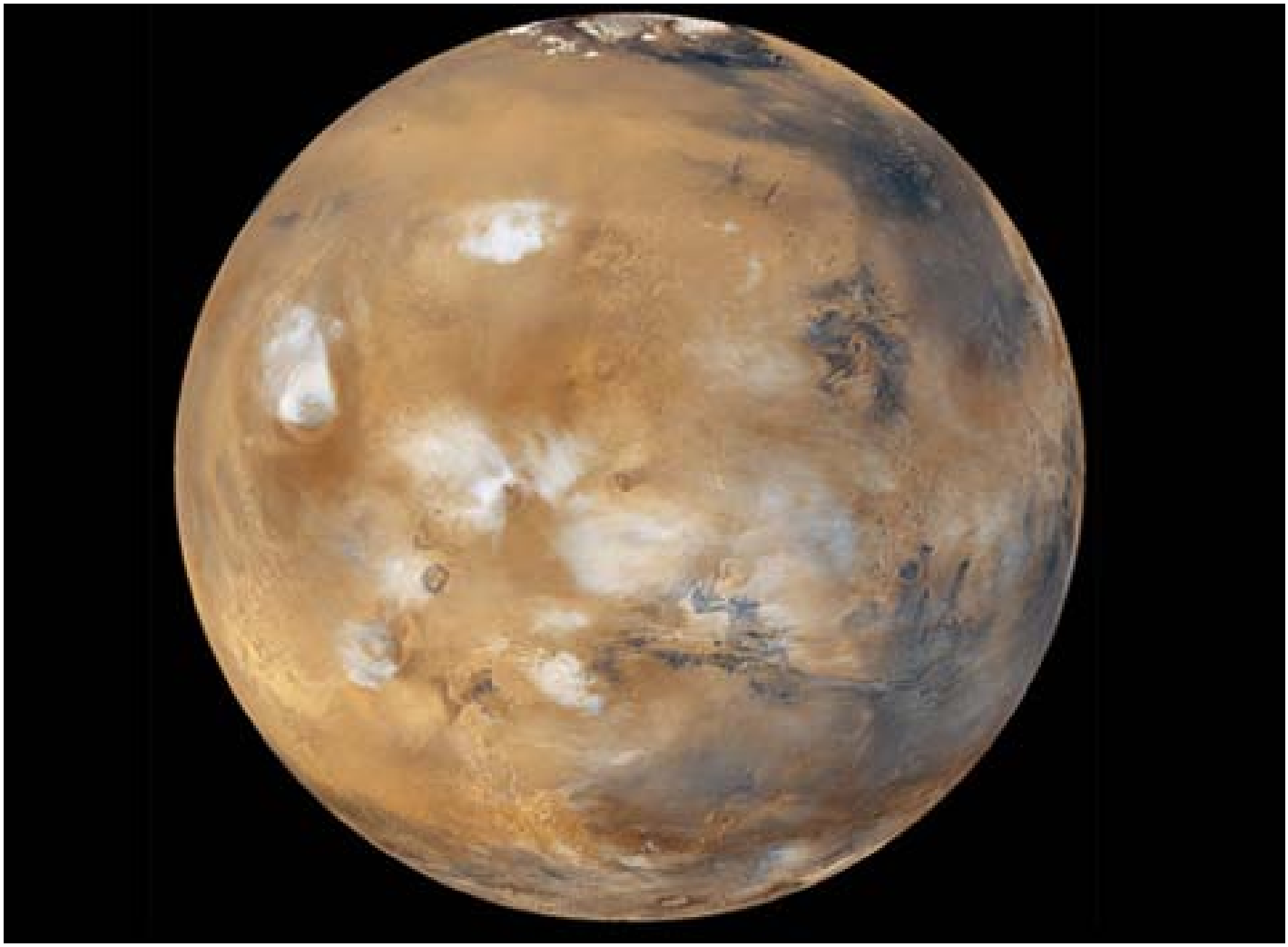
Taken by the MESSENGER spacecraft… check out the crater in the crater!

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington



Earth from space: Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…

Image Credit: NASA

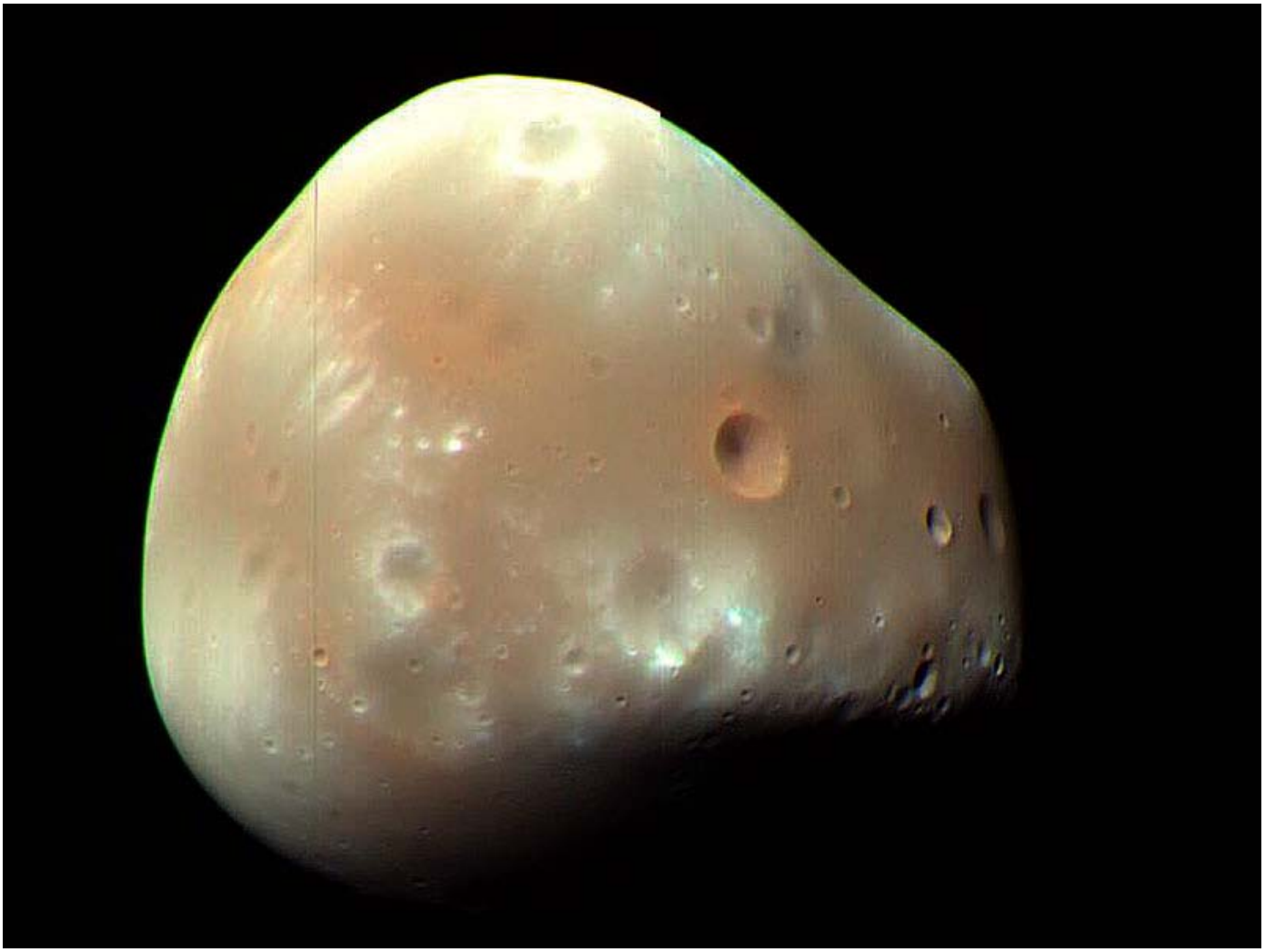


Mars

Image Credit: NASA

Mars: Merged Color Image

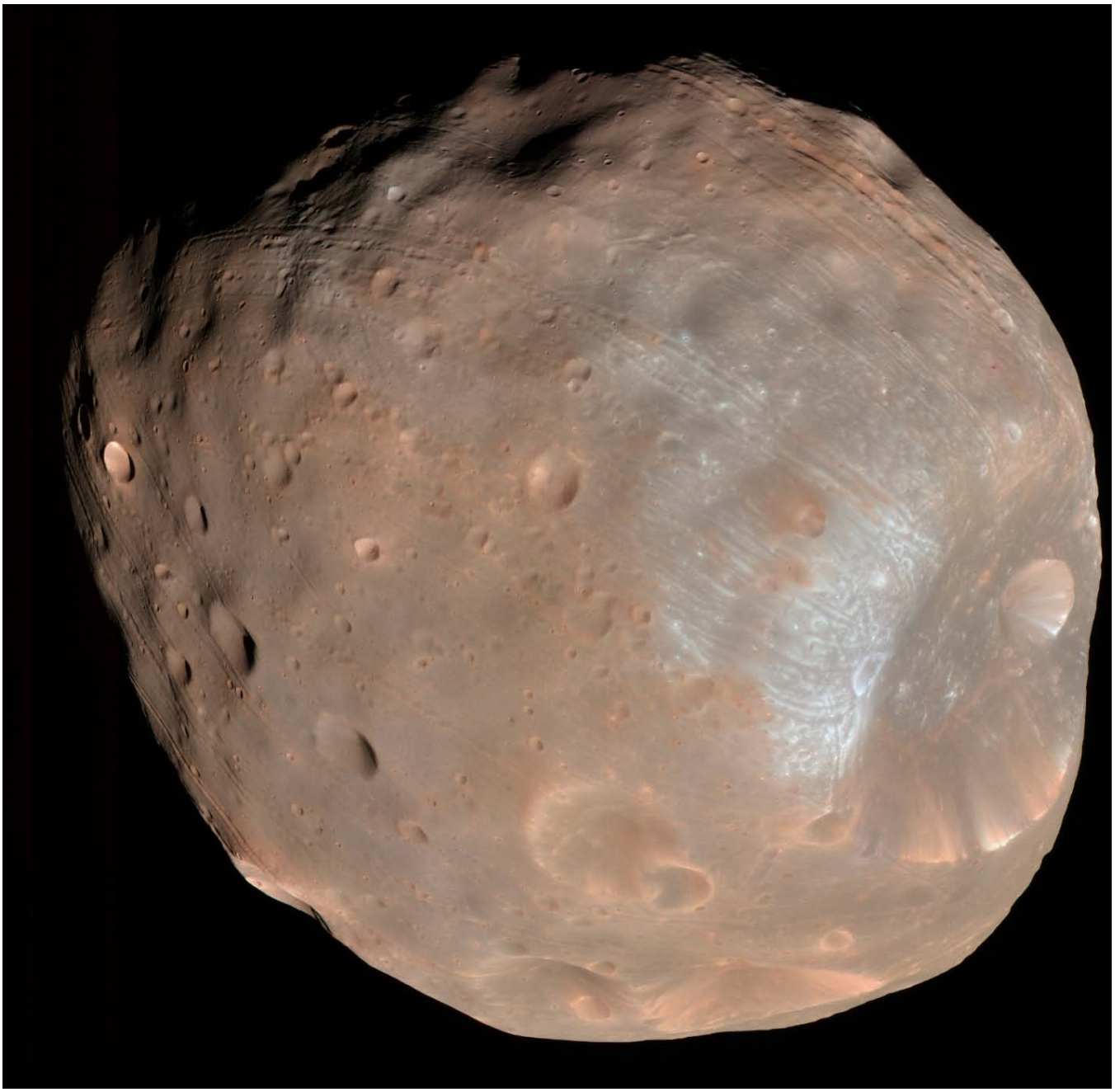
Using different color filters on black and white images helps scientists analyze topography, composition, etc.



Mars' Moon Deimos

Did Mars' gravity capture it from the main asteroid belt??

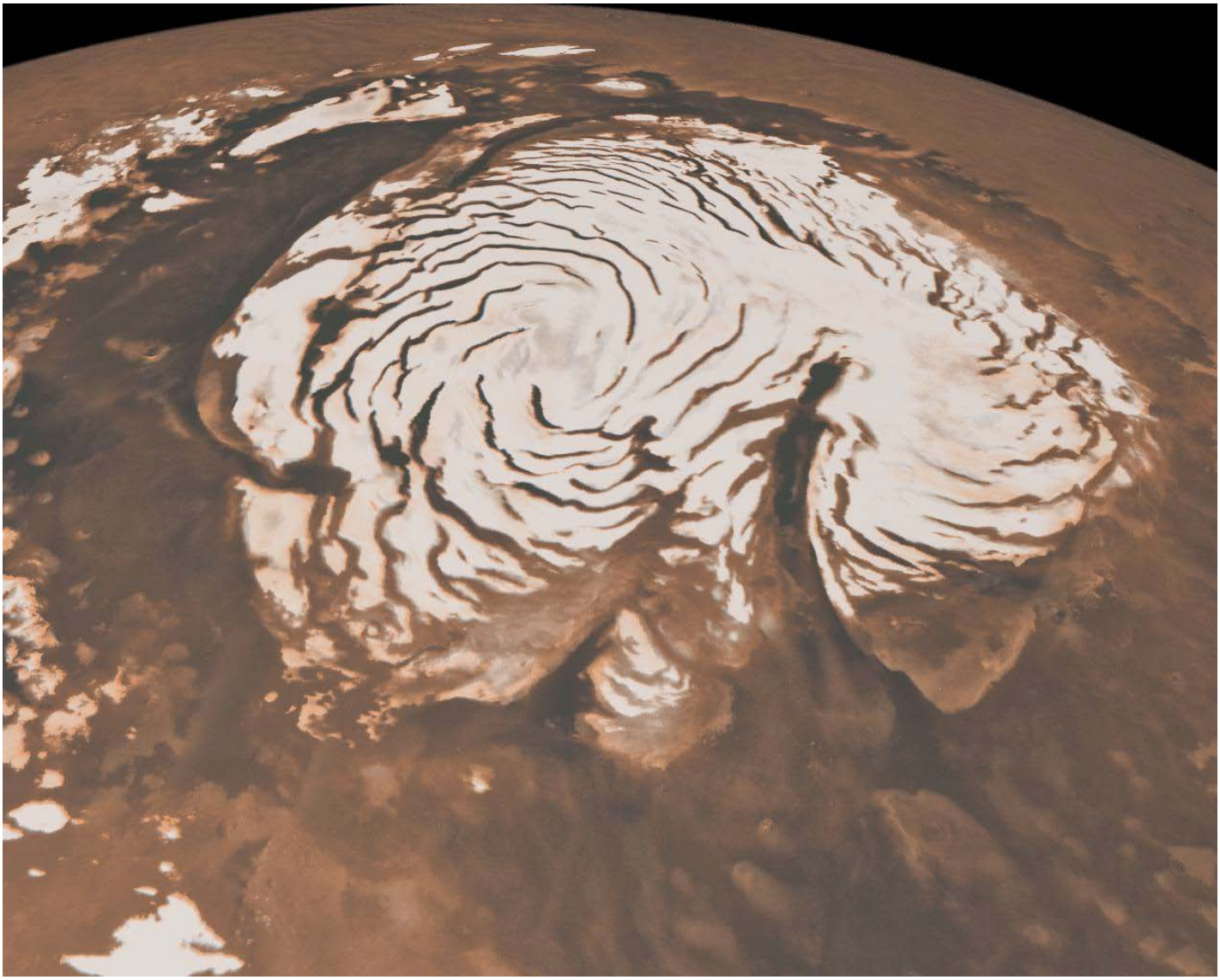
Image Credit: NASA



Mars' Moon Phobos

Did Mars' gravity capture it from the main asteroid belt??

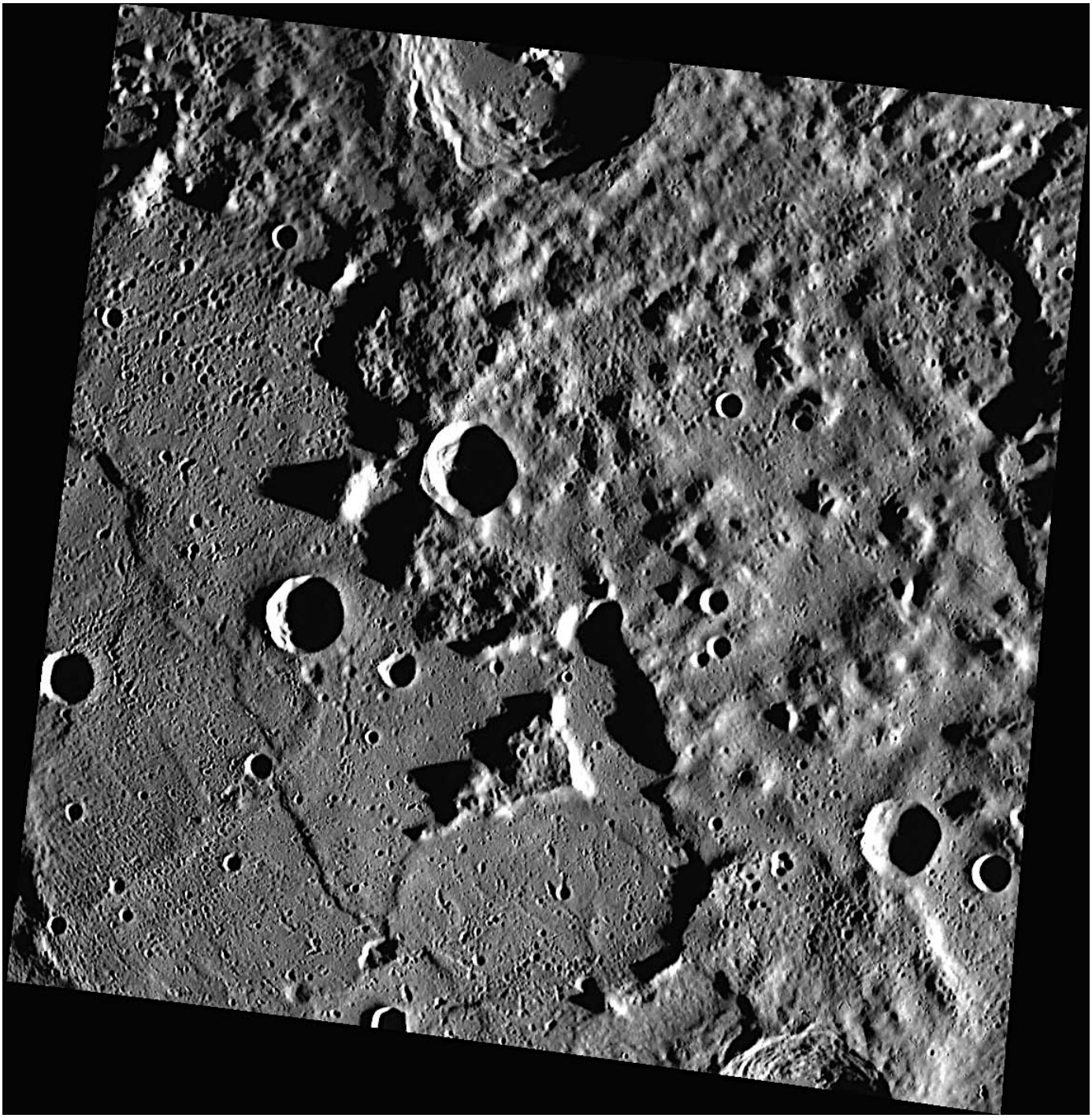
Image Credit: NASA



Mars' Pole

Image Credit: NASA

Mars' Victoria Crater: 730 m wide, navigated by Mars Rover



Mercury Up Close

Taken by MESSENGER

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington

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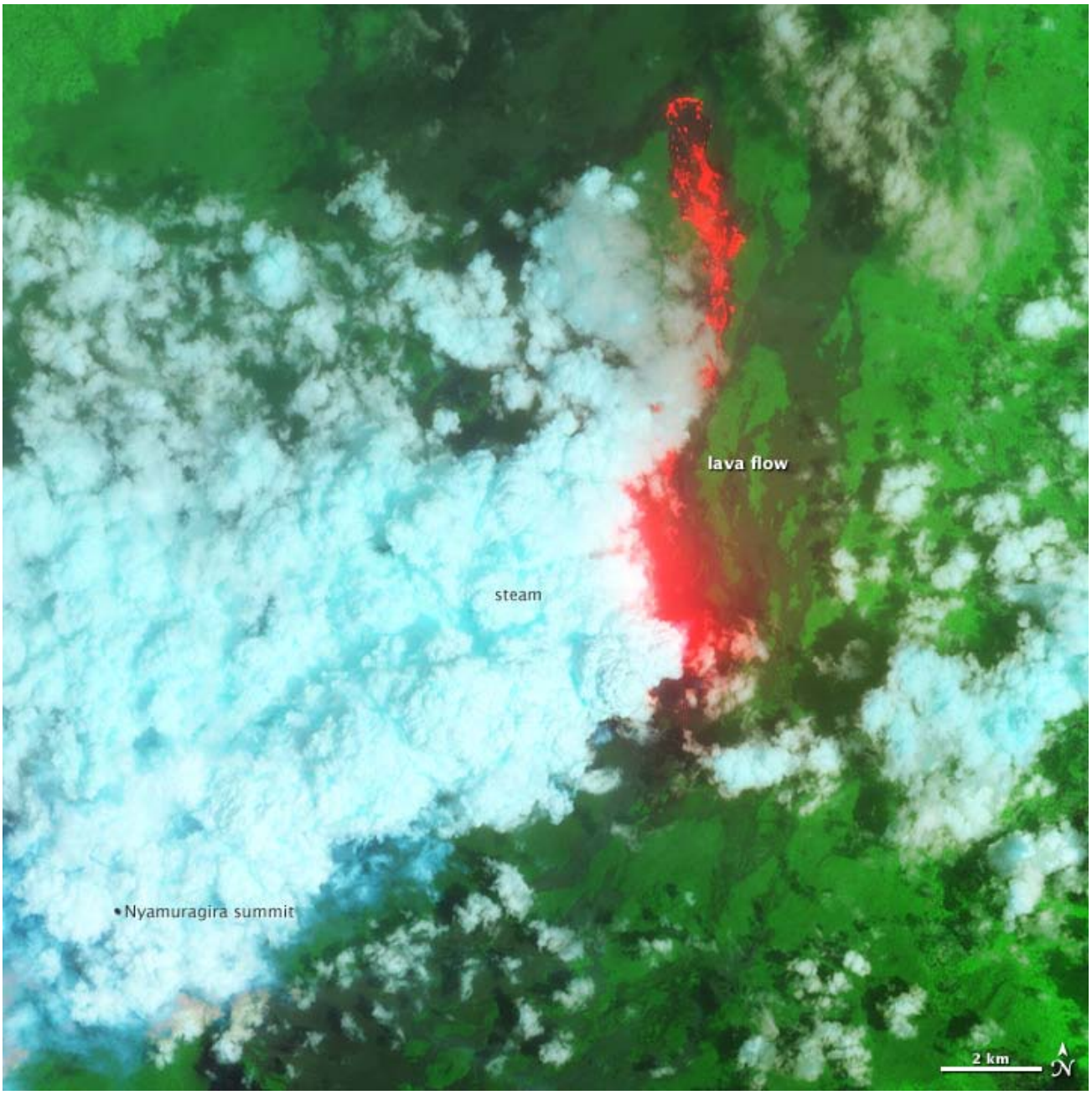
NASA's Discovery and New Frontiers Programs

Image Credit: NASA

MESSENGER's Mercury Crater Trails

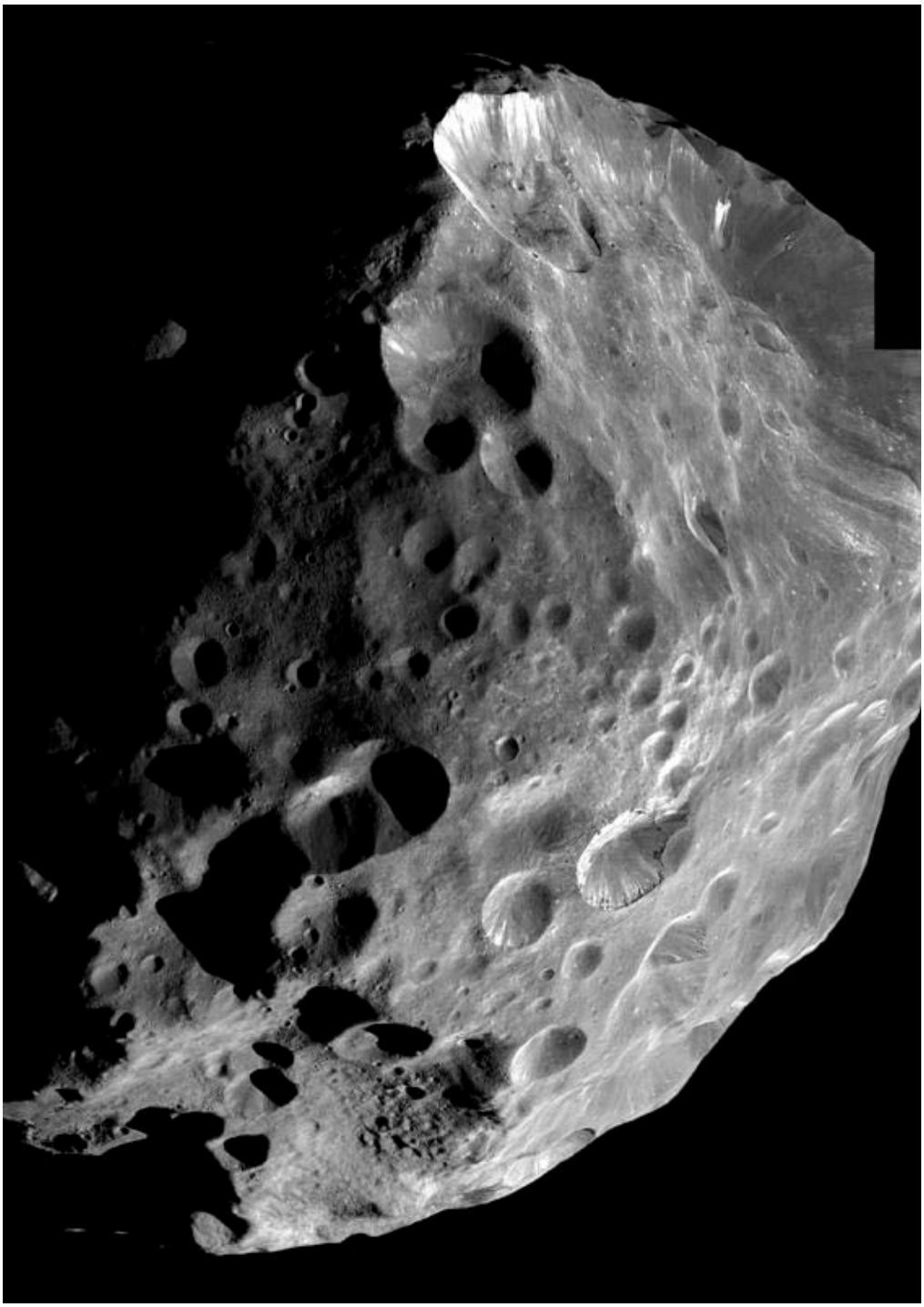
What could cause them? Think@ skipping a rock on a pond.

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington



Nyamuragira Eruption, Africa

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…



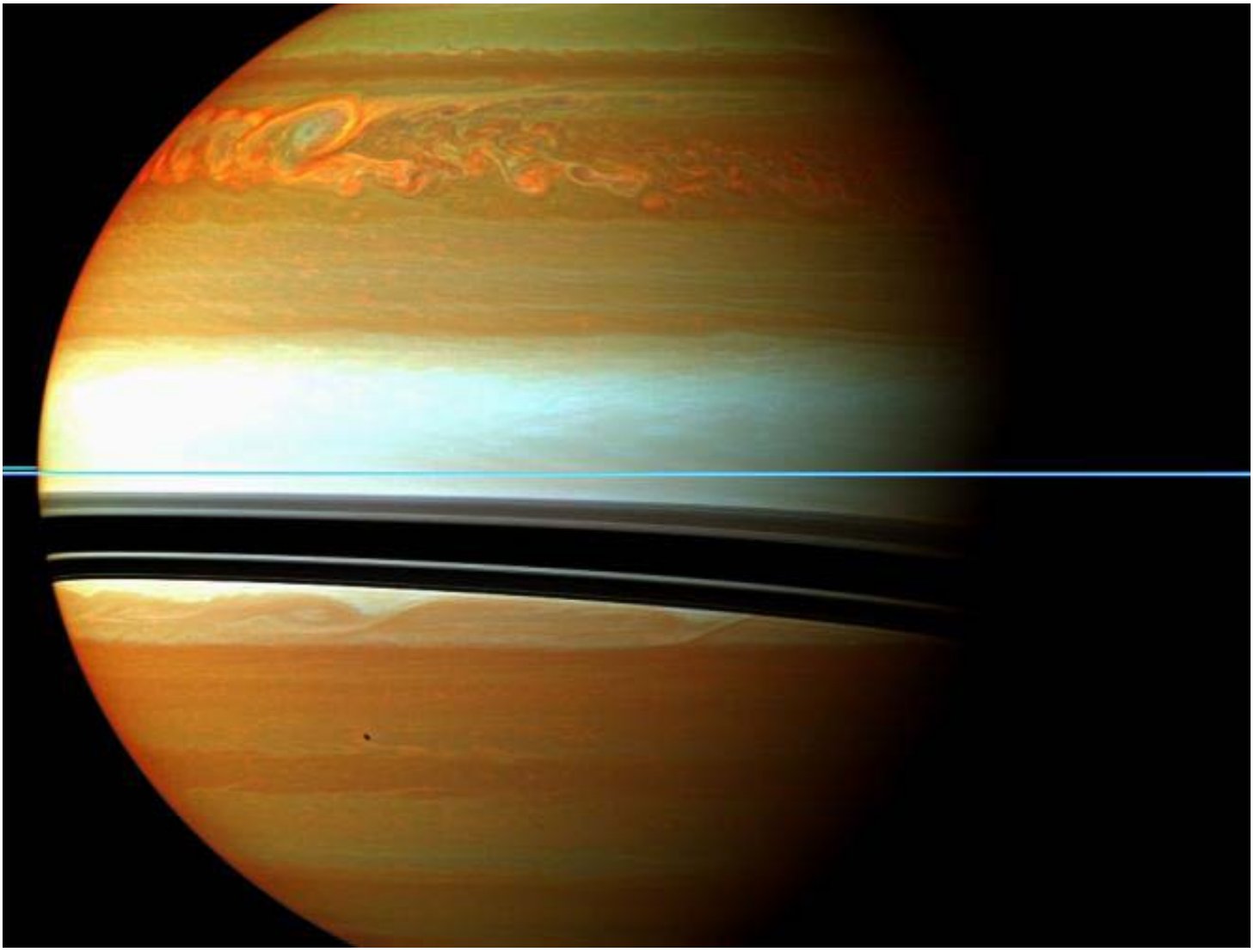
Phobos

Mars moon taken by Cassini spacecraft on its way to Saturn

Pine Island Glacier:
huge ice stream flowing into Hudson Bay in northern Canada

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…

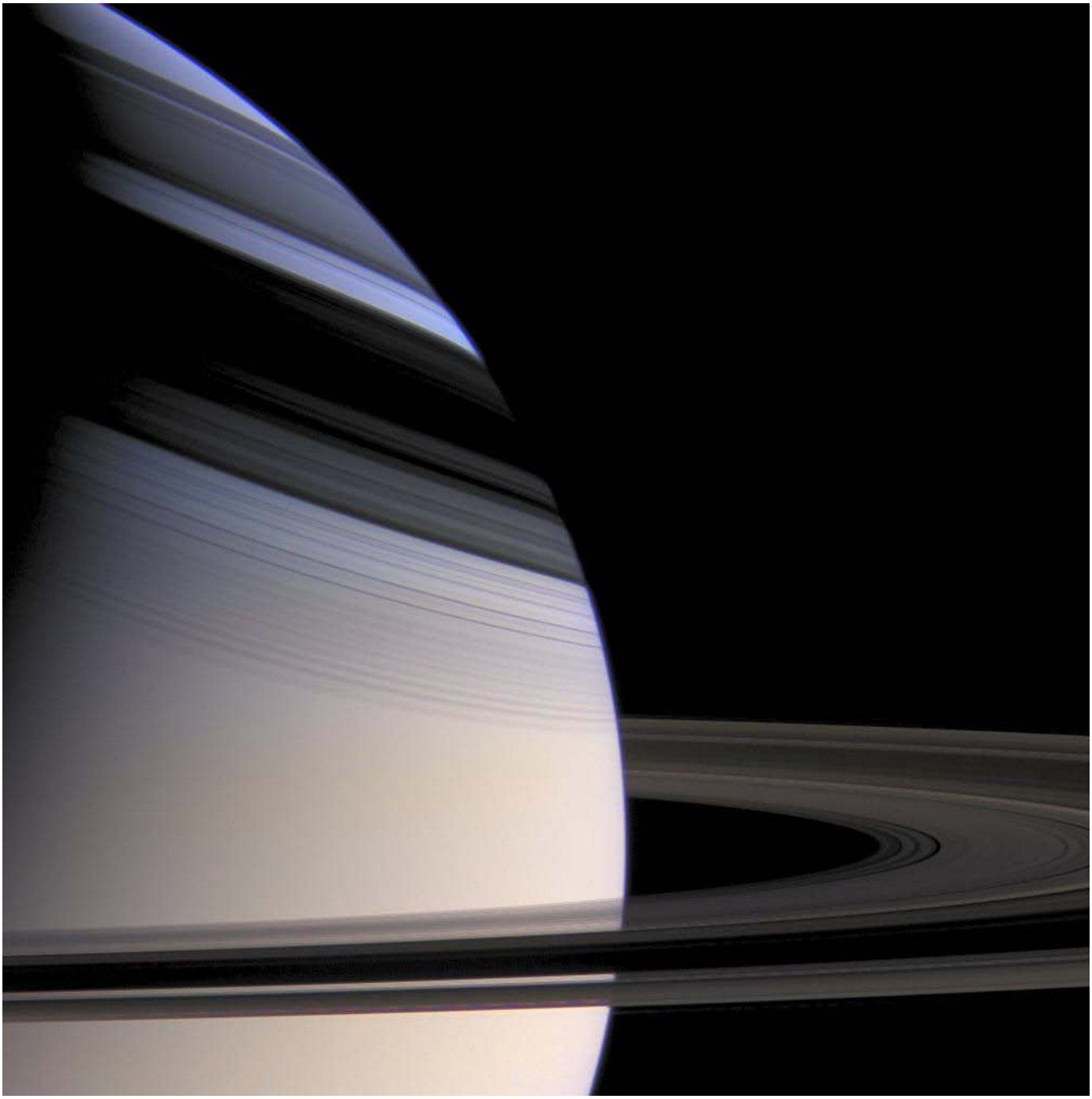
Image Credit: NASA



Saturn from Cassini

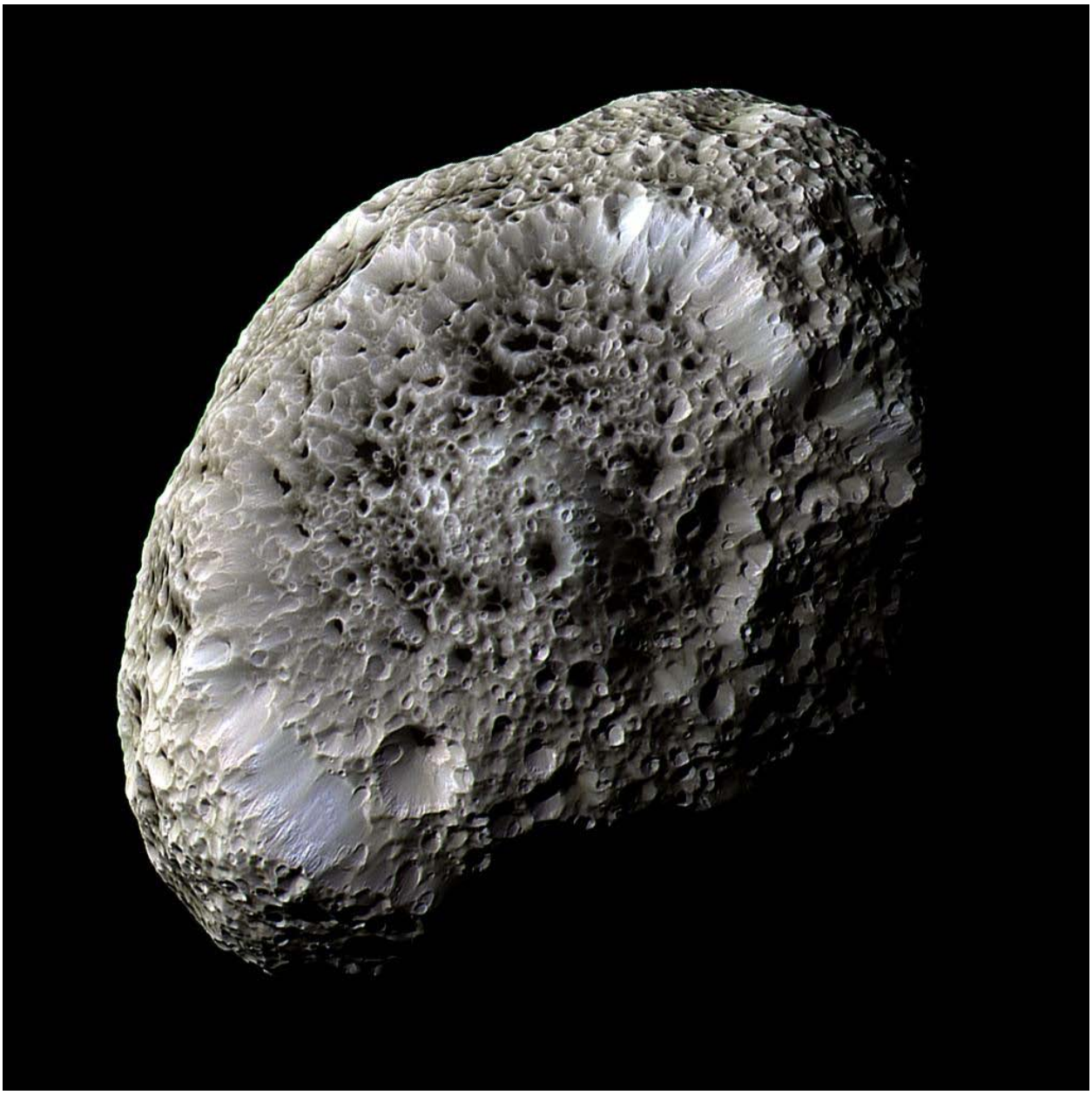
See the shadow of the rings?

Image credit: NASA/JPL/Space Science Institute



Saturn Rings

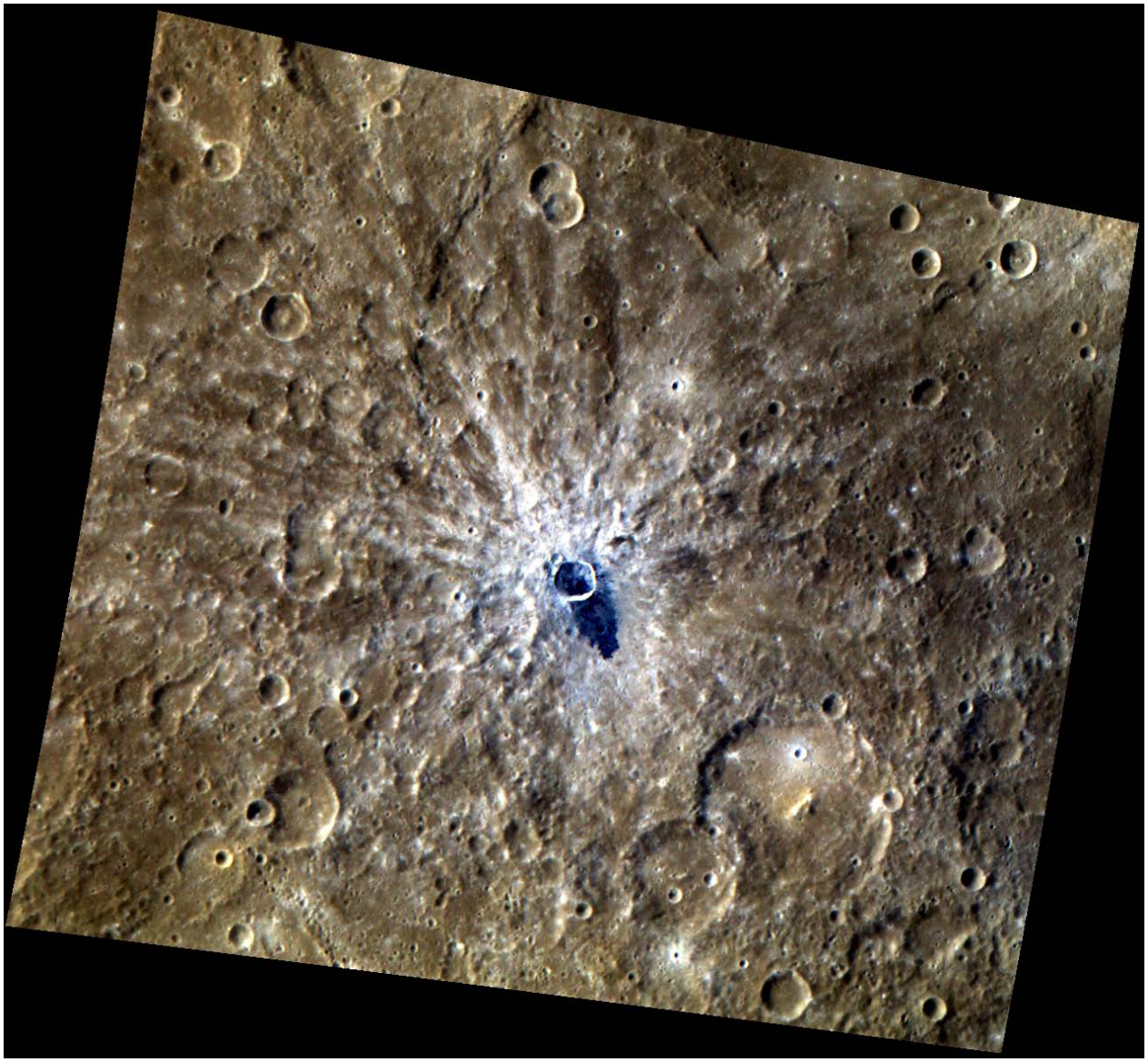
Image credit: NASA/JPL/Space Science Institute



Saturn's Odd Moon, Hyperion

Check out the unusual surface topography of Hyperion. Can you think of something that looks like that on Earth? Why might its craters look like that?

Image credit: NASA/JPL/Space Science Institute



Mercury by MESSENGER

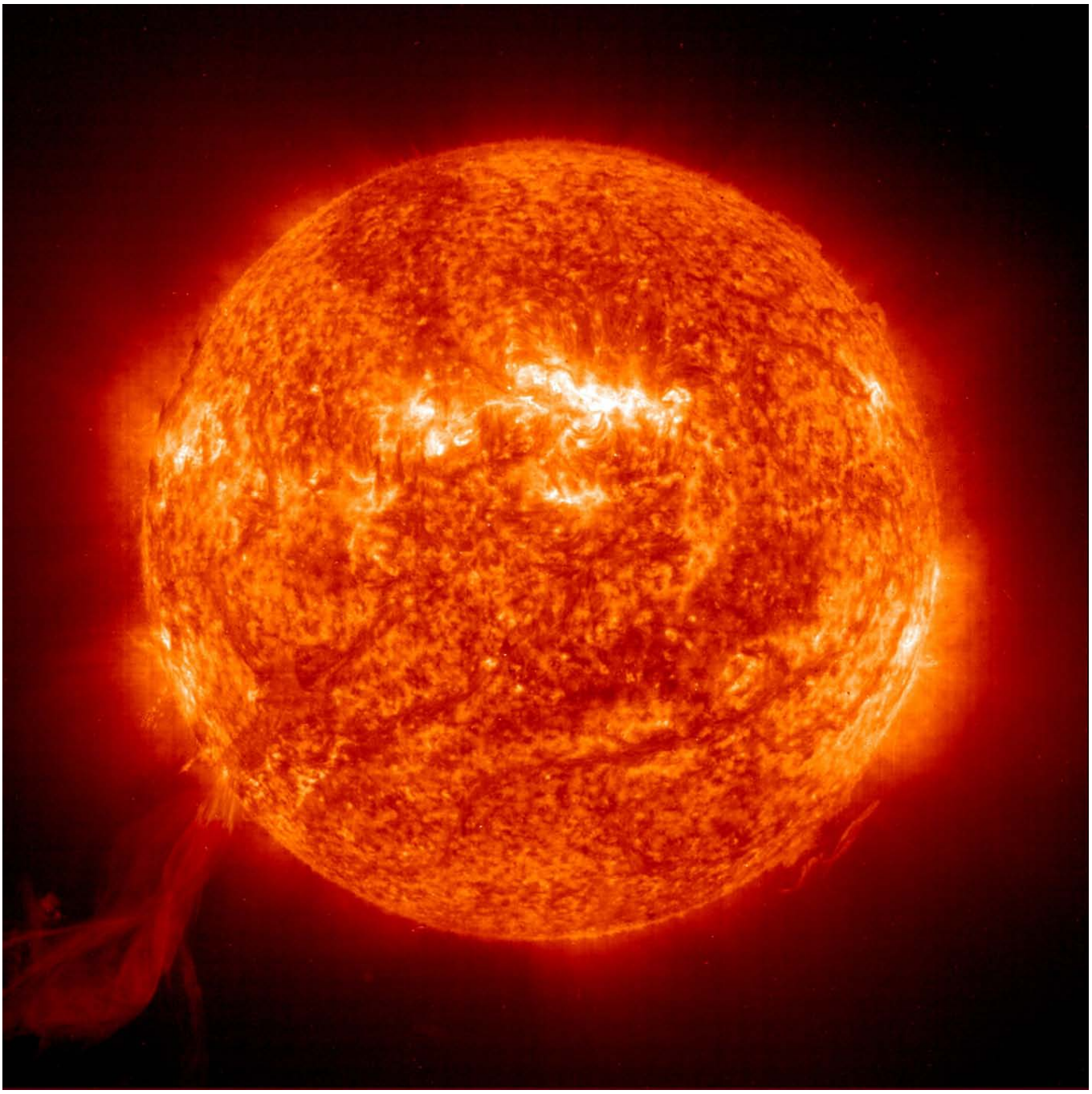
This image shows a 14-kilometer diameter crater that is relatively young, as indicated by the bright rays that cross the neighboring features. A dark "tongue" of impact melt, which has a bluer color than the nearby surface, appears to have flowed out of the crater.

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington

Storms over the Gulf of Mexico and the Atlantic, 11/22/11

Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…

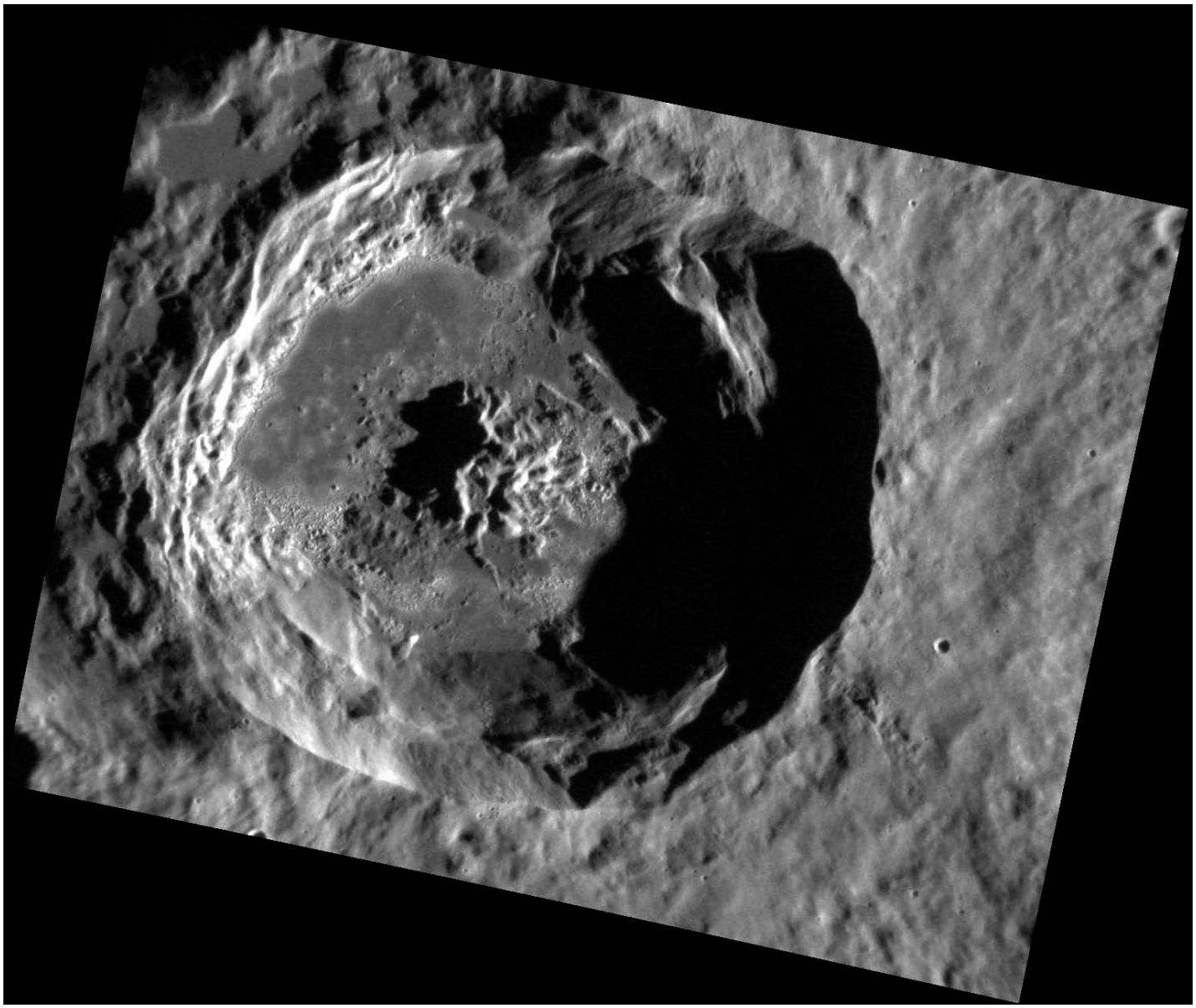
Image Credit: NASA



Our very own star, Sun

A sunflame image take by SoHo

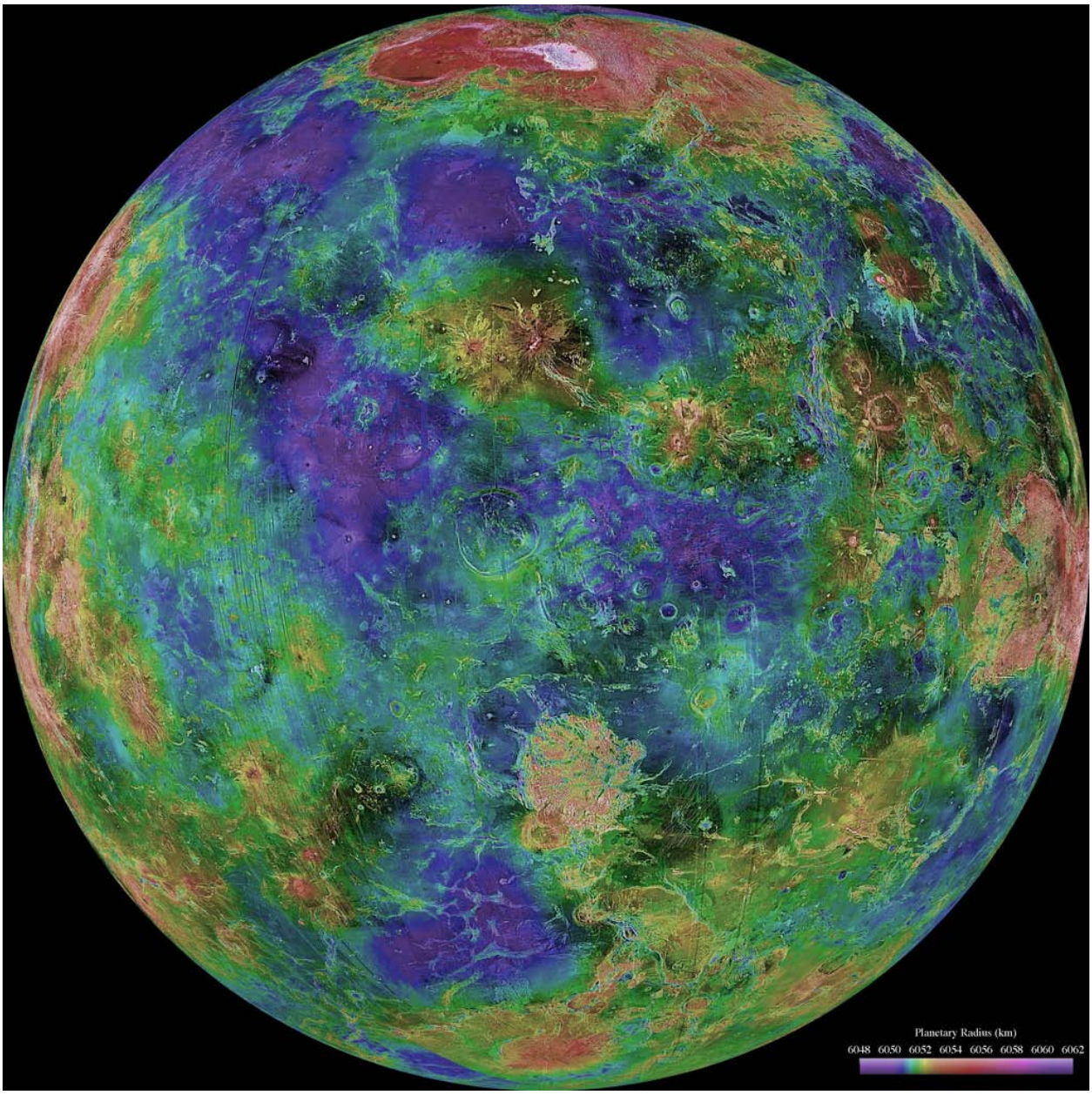
Image Credit: NASA



Mercury: Unnamed Hollows

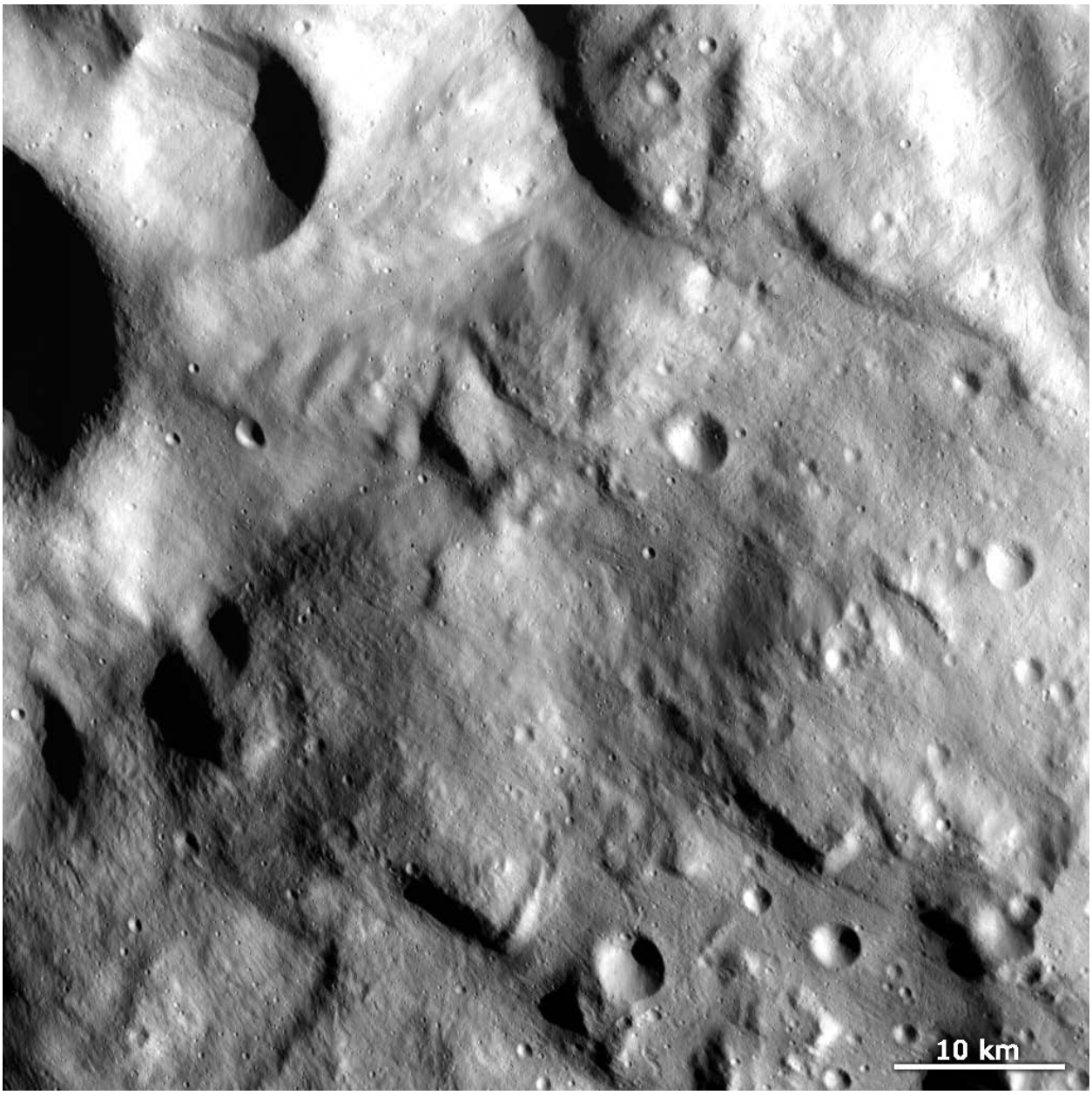
MESSENGER took this image… is it a depression or a dome? Don't let your eyes deceive you!

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington



Venus Colorized

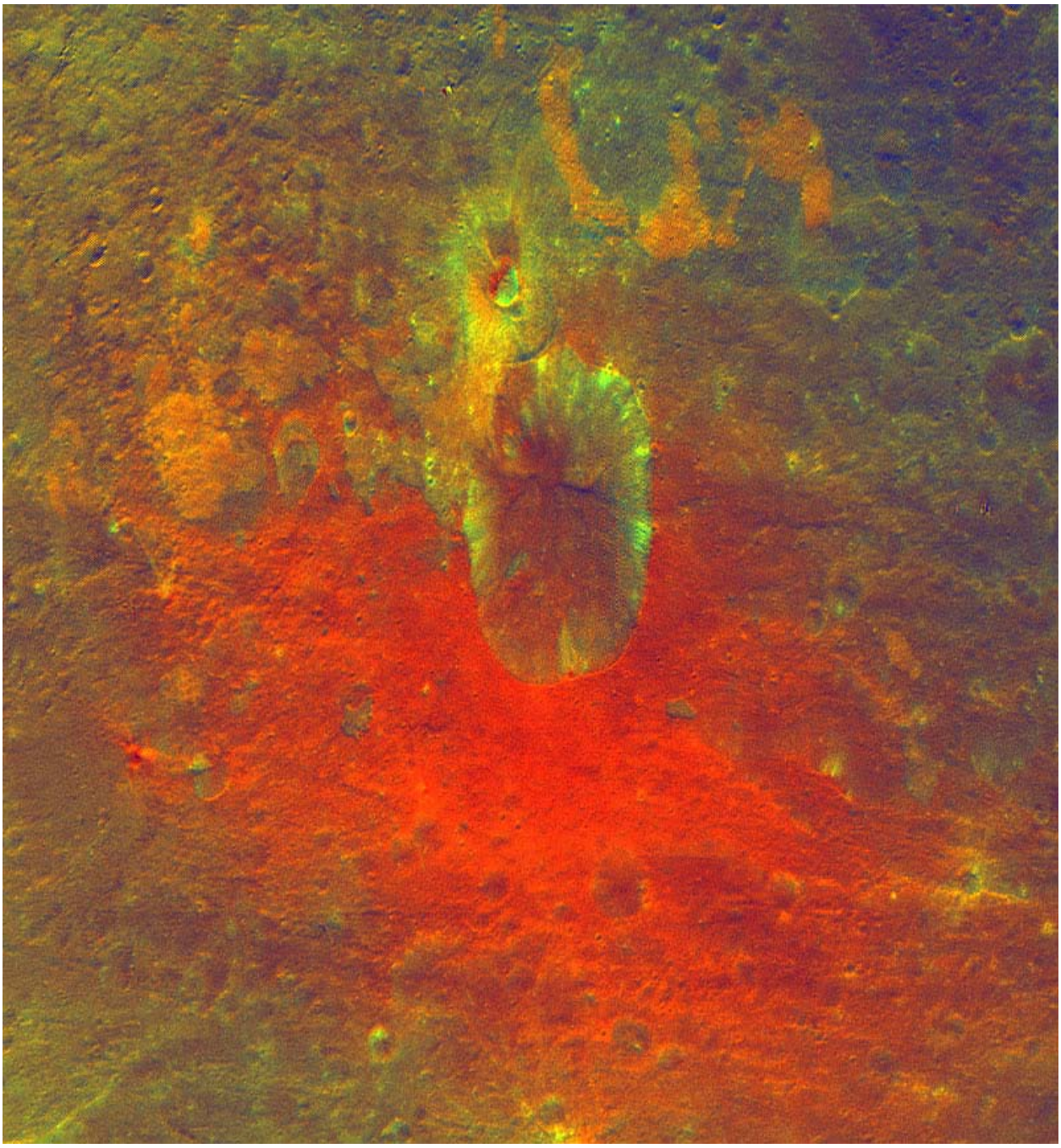
Scientists use color to emphasize variations such as mineral composition, temperature variation, and topography.



Vesta Close Up

Dawn spacecraft took this image with its framing camera…

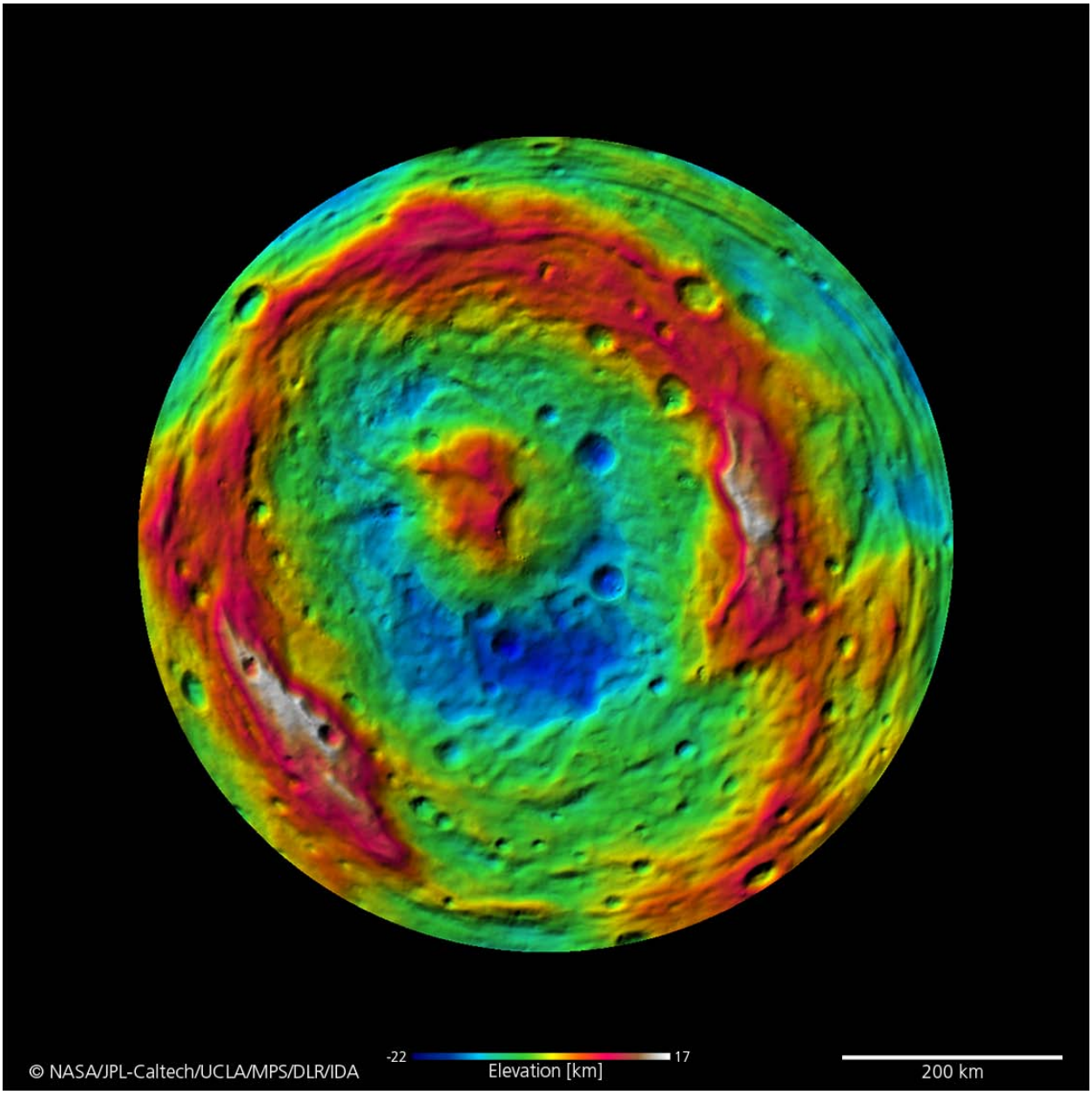
Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA



Vesta: False Color Crater

Scientists use color to emphasize variations such as mineral composition, temperature variation, and topography. This image highlights the ejecta left from the impact of the crater.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA



Vesta in 3-D Color

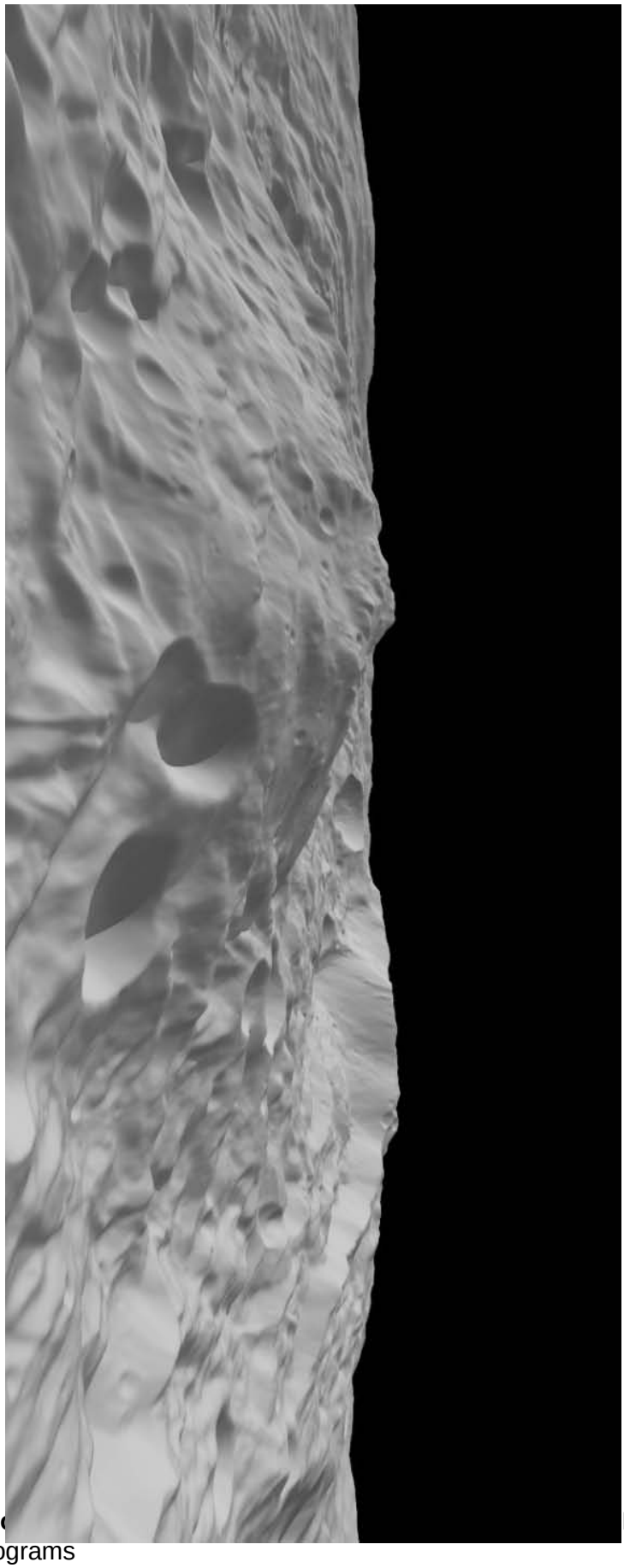
Scientists use color to emphasize variations such as mineral composition, temperature variation, and topography.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

Giant Asteroid

Vesta Landscape

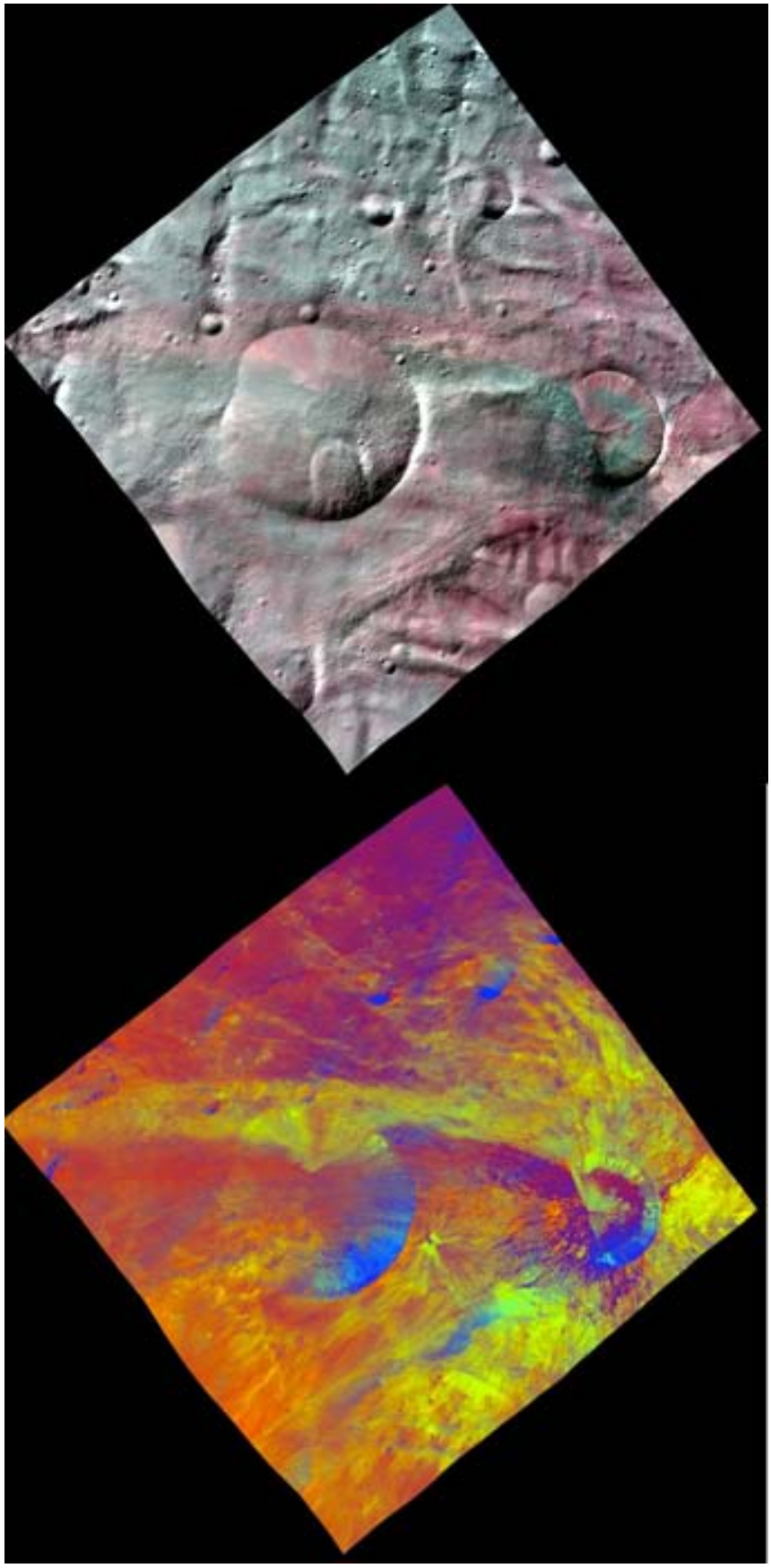
Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

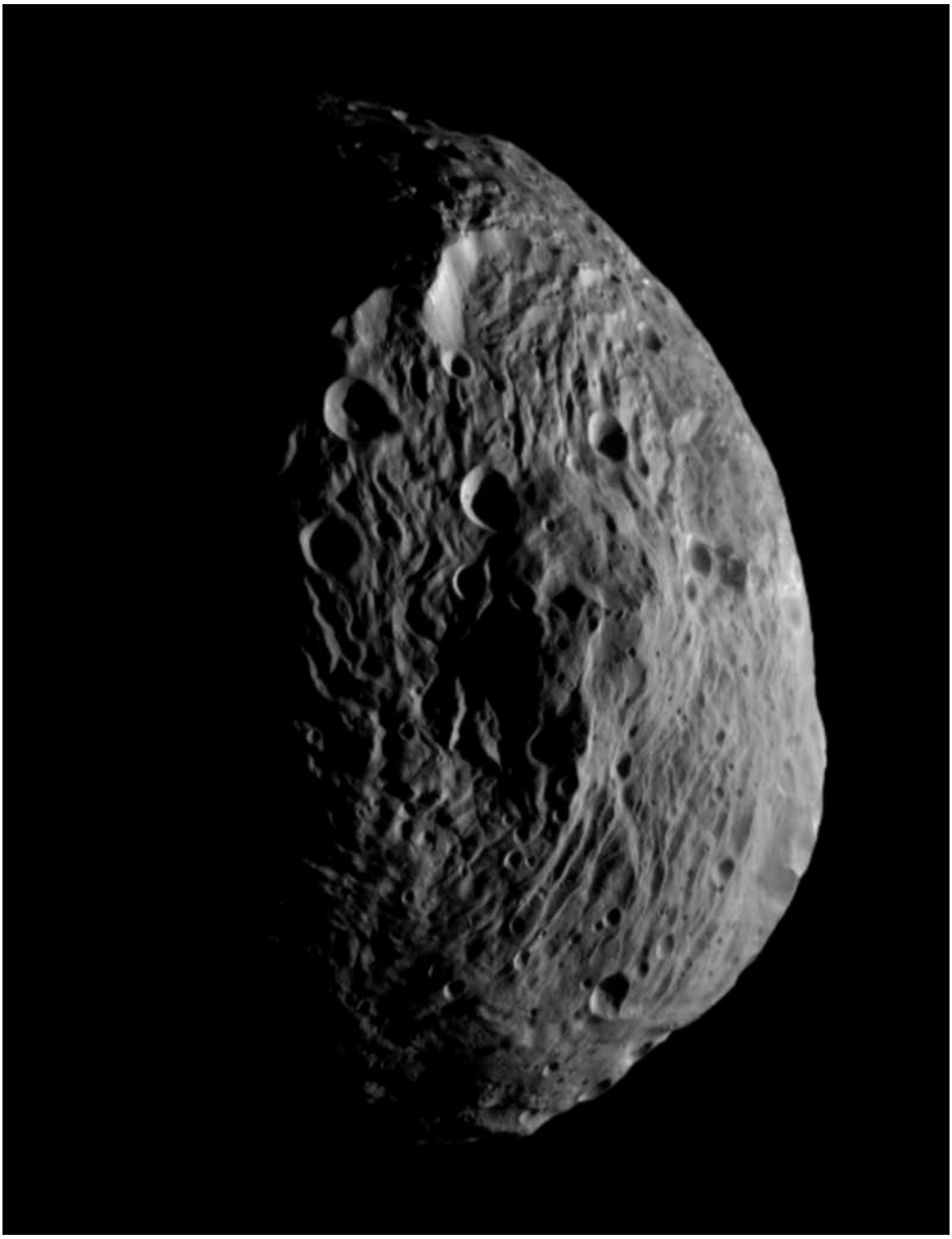


Vesta: The top image uses near-infrared filters.

The colorized image on the bottom was created with colors representing different rock or mineral types on Vesta.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

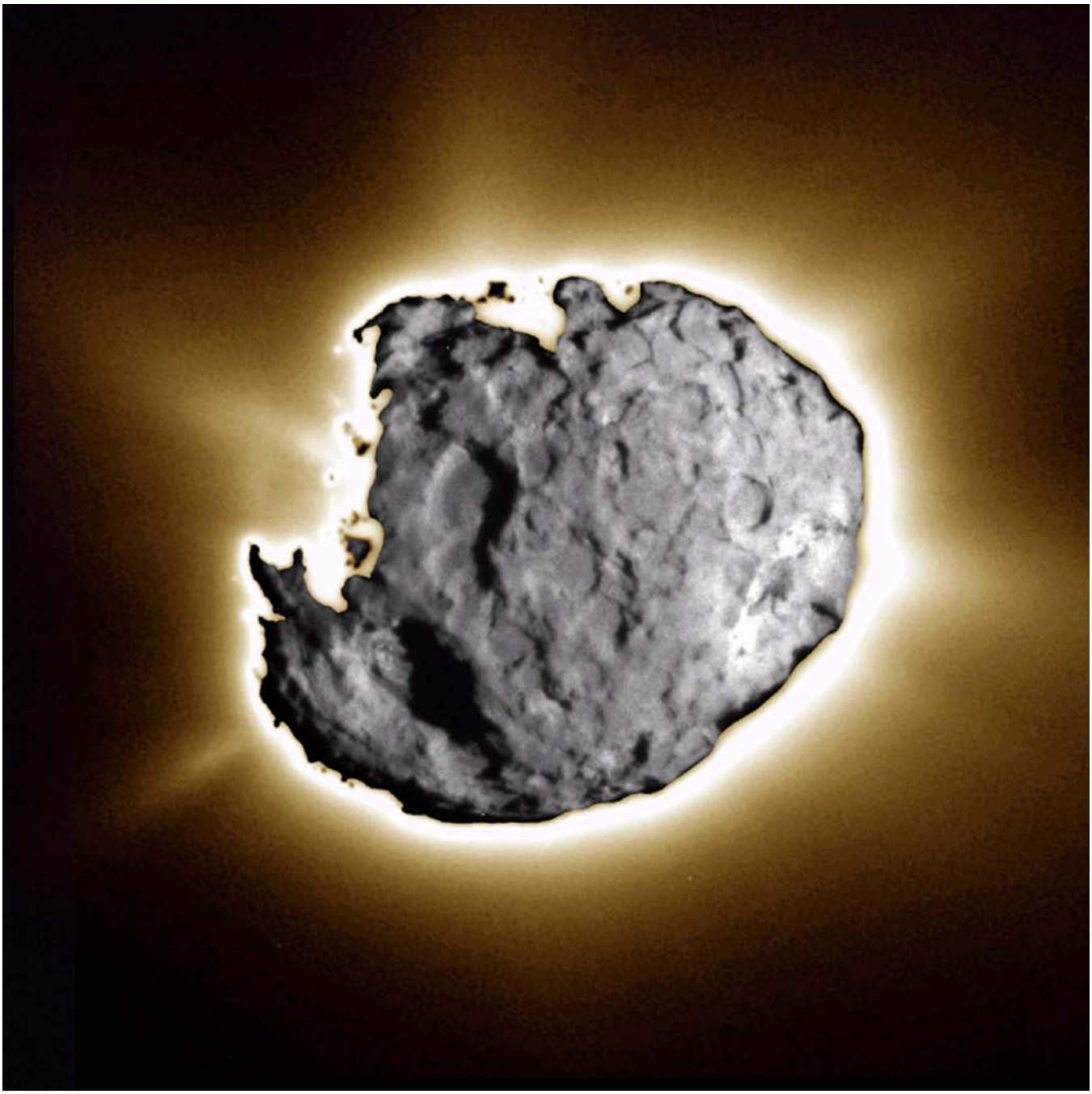




Whole Vesta

Vesta's diameter is close to the diameter of the state of Arizona!

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

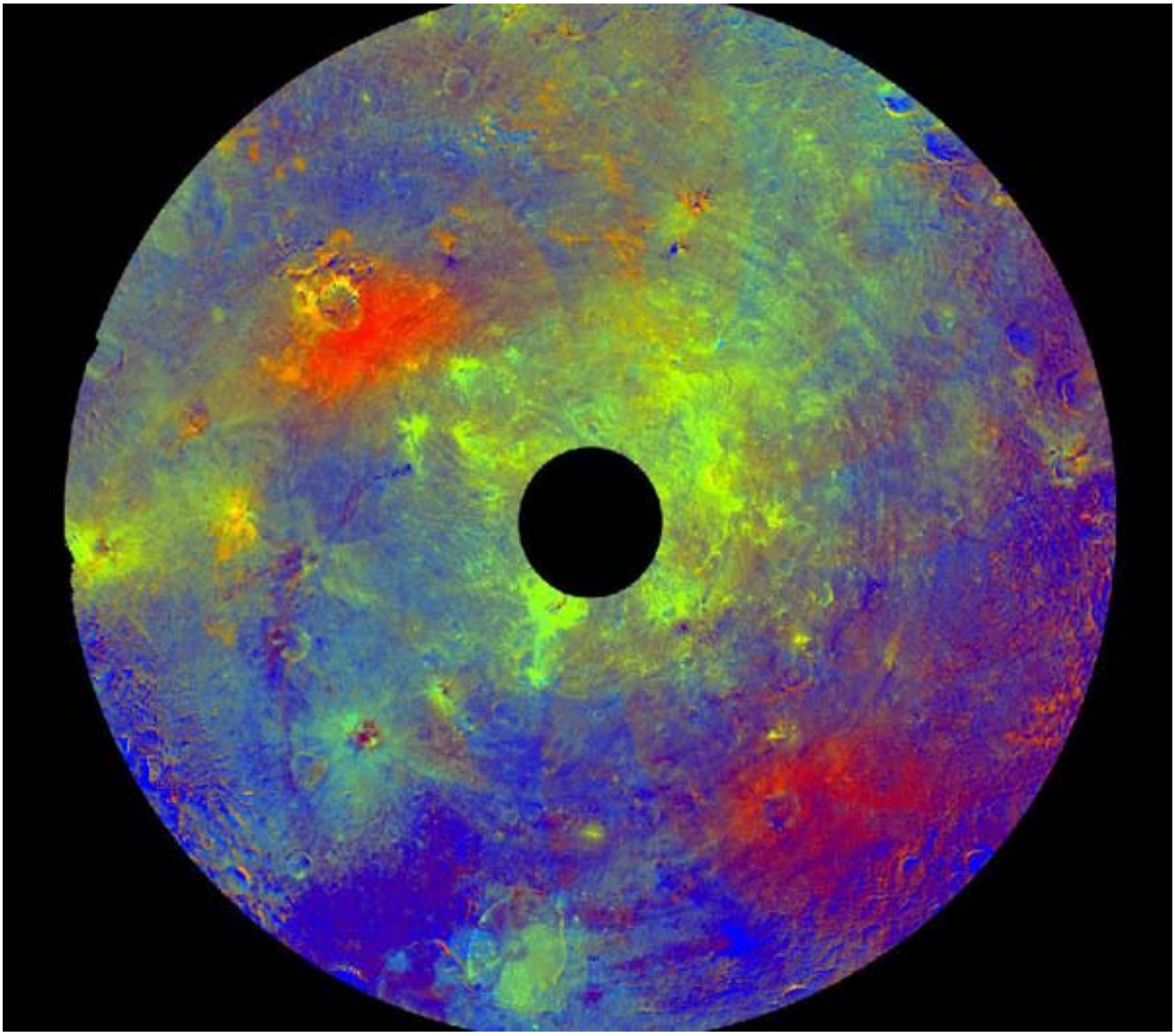


Comet Wild (*Vilt*) 2

Note the jets on the surface, which give rise to the coma, the bright aura around the comet's nucleus, and the long beautiful tails.

Yukon Delta, Alaska

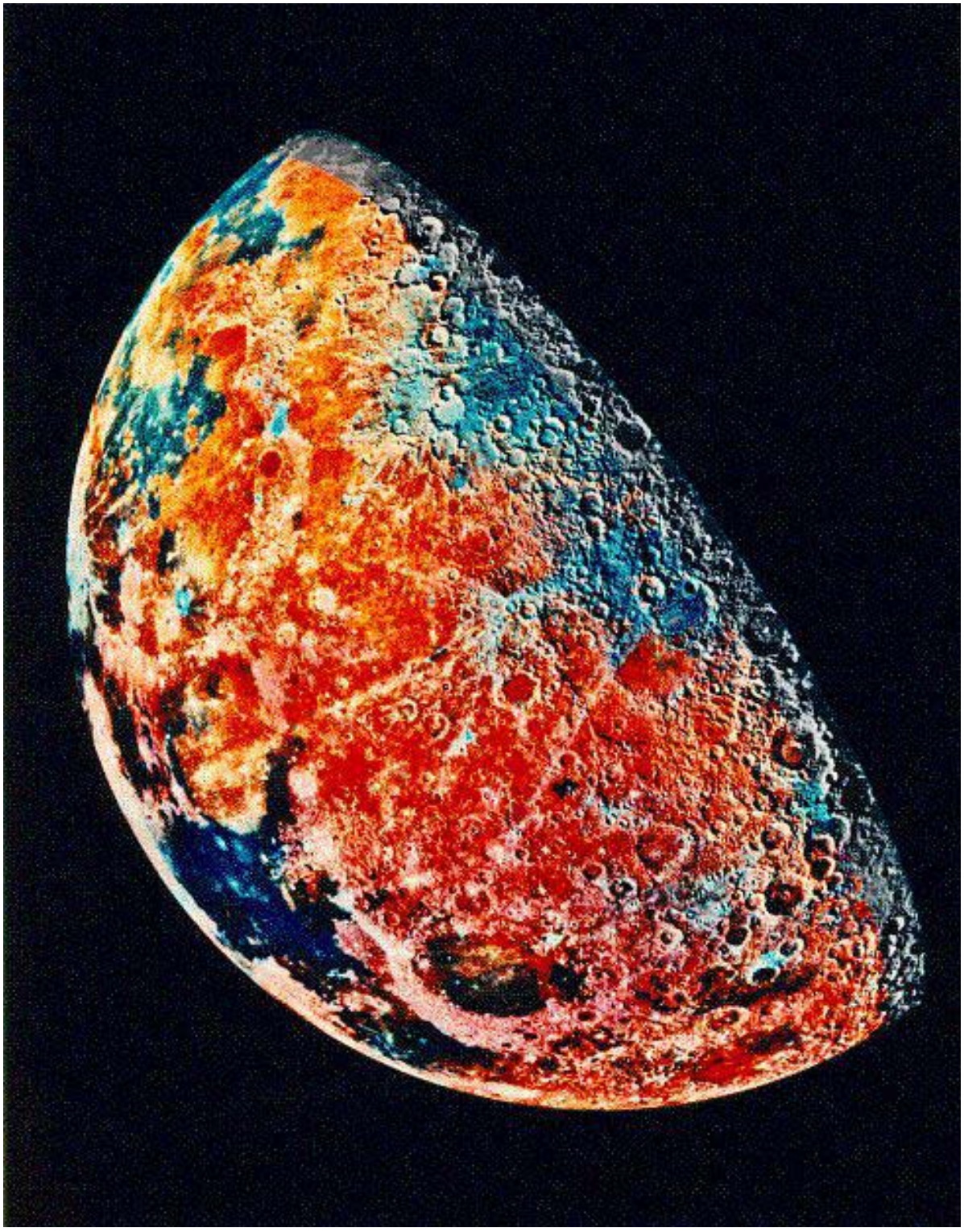
Astronomers and geologists look at topographical features (craters, volcanoes, mountains, patterns left by water, etc.) on Earth to help them understand patterns on distant planets, comets, asteroids…



Giant Asteroid Vesta's Southern Hemisphere

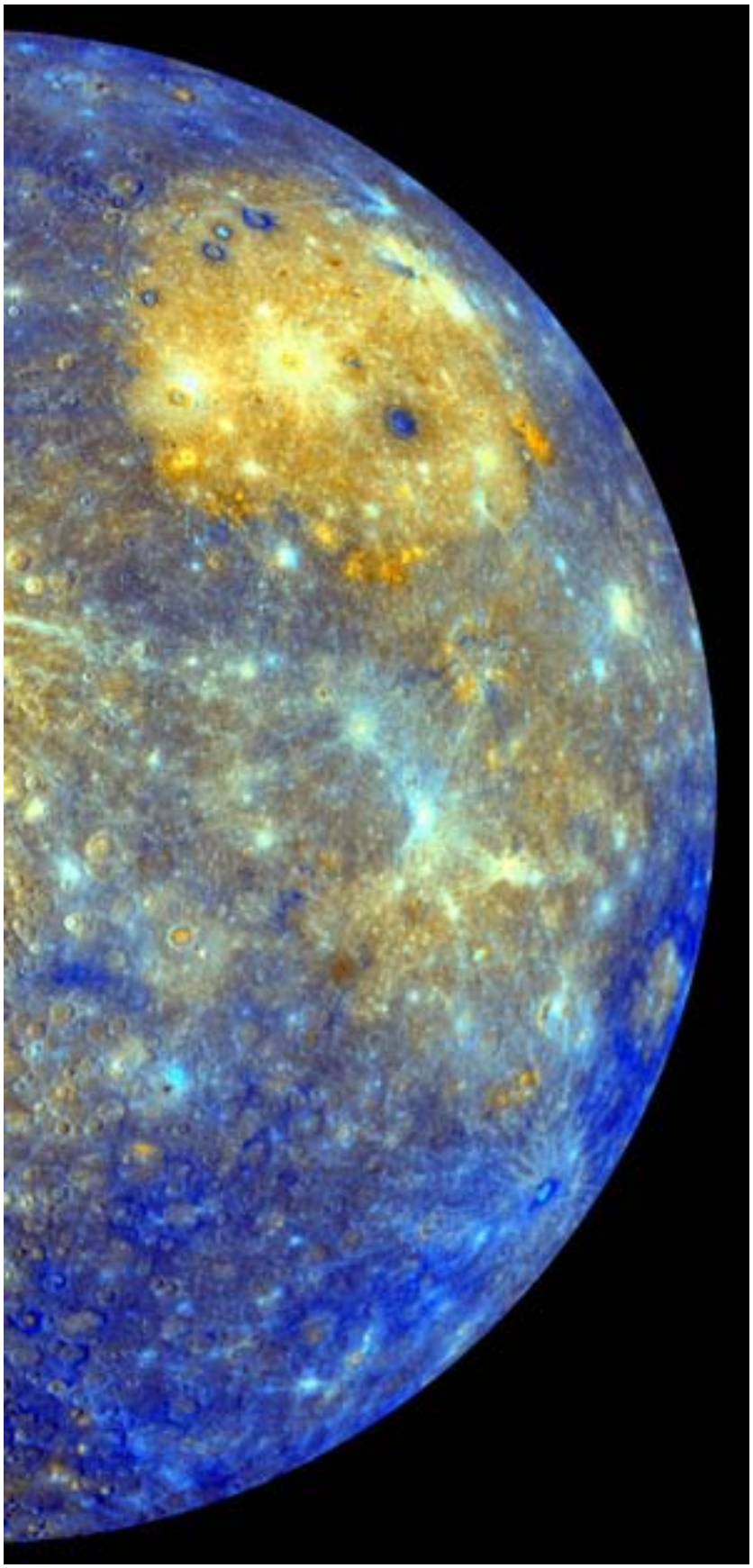
Focusing on the Rheasilvia Basin
(site of the two massive impacts and vast mountain)

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA



False Color Mosaic of the Moon by Galileo:

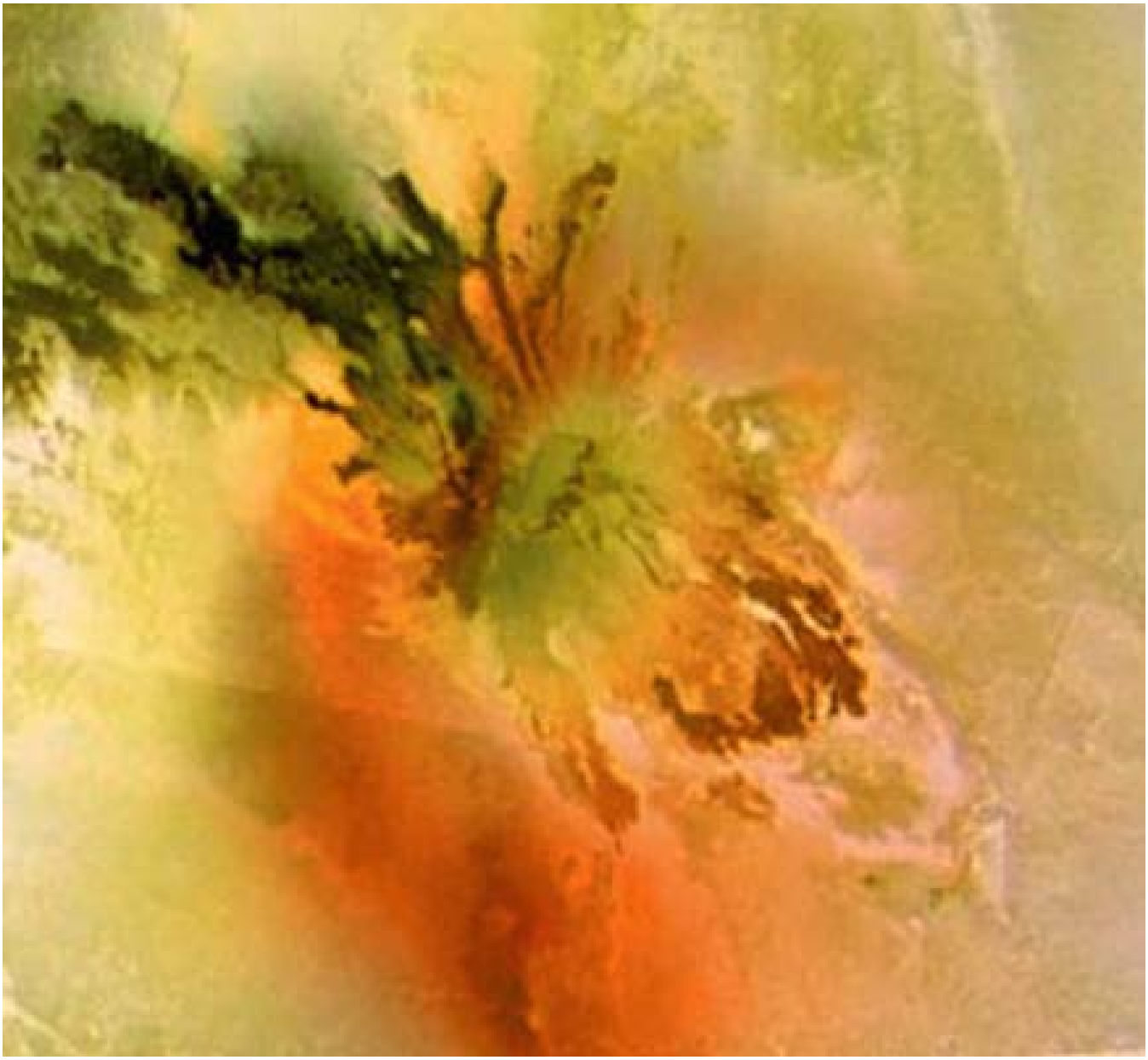
Bright pinkish areas are highlands materials, such as those surrounding the oval lava-filled Crisium impact basin toward the bottom of the picture. Blue to orange shades indicate volcanic lava flows. To the left of Crisium, the dark blue Mare Tranquillitatis is richer in titanium than the green and orange maria above it. Thin mineral-rich soils associated with relatively recent impacts are represented by light blue colors; the youngest craters have prominent blue rays extending from them.



Mercury by MESSENGER Colorized and Half-sized

Mercury is full of unusual geologic features: huge volcanic plains, spider-shaped rays, long rounded cliffs. With the first global picture of these surface features, it'll be possible to piece together the events that shaped Mercury from when it first formed 4.5 billion years ago to now.

—Image courtesy NASA/Johns Hopkins University Applied Physics Laboratory/Arizona State University/Carnegie Institution of Washington



Close up of Jupiter's moon, Io

Blobby shape…hmm, what could this be?

Culann Patera volcano
Image credit: NASA/Galileo