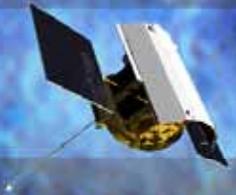




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# MESSENGER

MErcury Surface, Space ENvironment, GEochemistry, and Ranging



## Revealing Mercury:

One year of images from MESSENGER, the first spacecraft to orbit the Solar System's innermost planet

Presented by:

**Dr. Nancy L. Chabot**

MDIS (Mercury Dual Imaging System) Instrument Scientist  
Johns Hopkins University Applied Physics Laboratory

Possible due to:

**The efforts of many!**

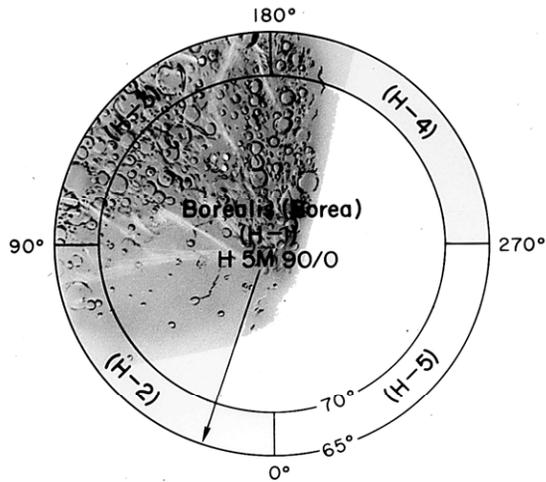
**March 10, 2012**

# Mariner 10: The First Mercury Mission

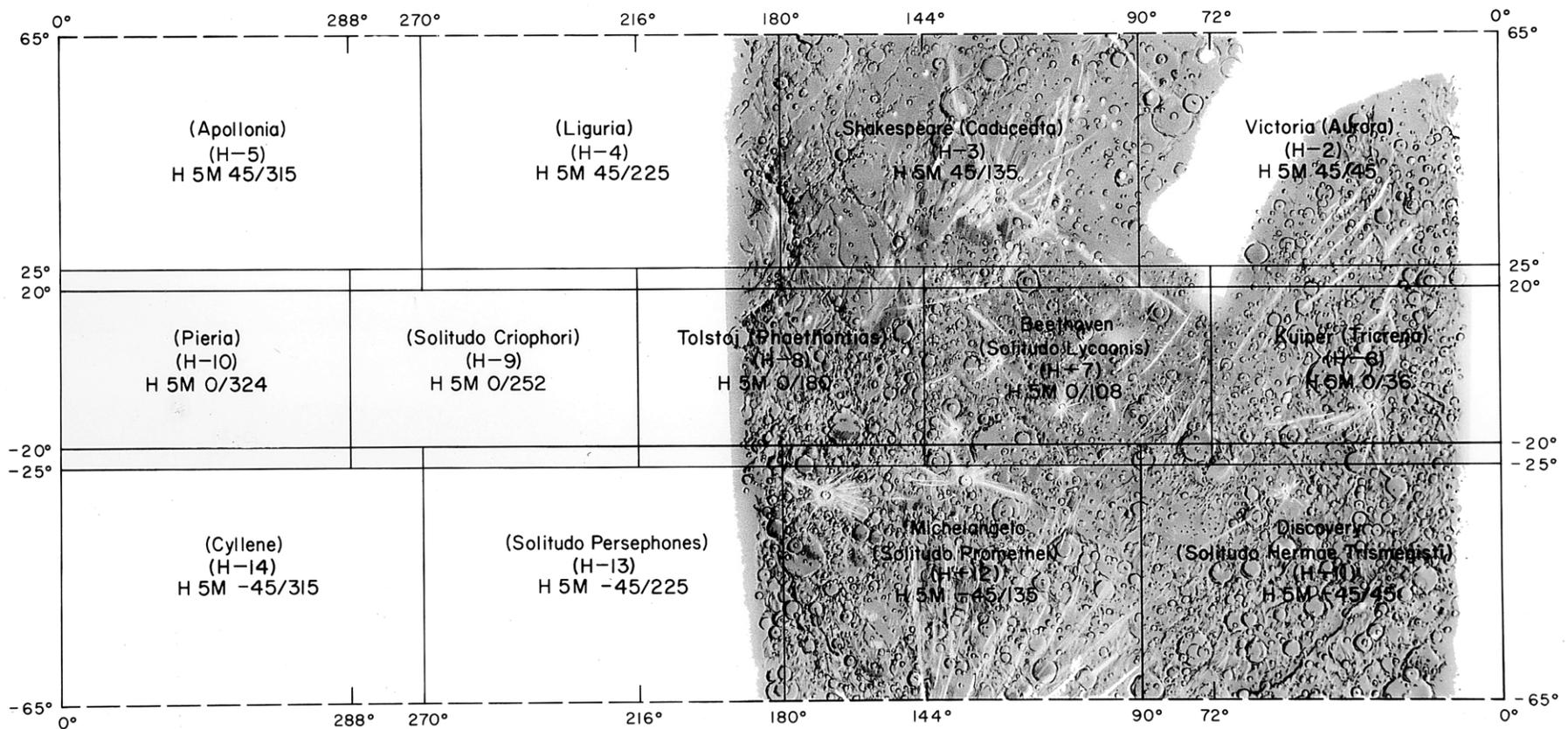
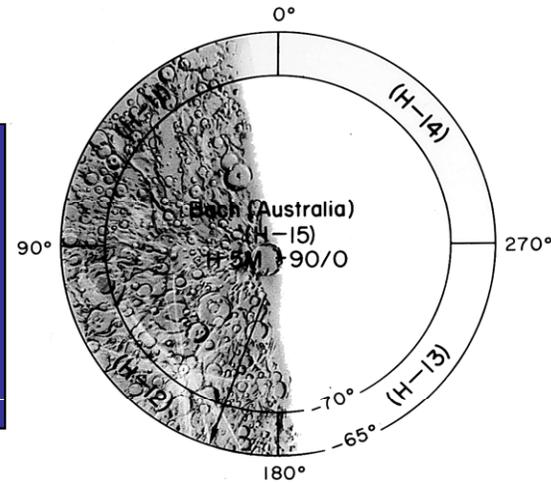
- Mariner 10 was launched Nov. 3, 1973.
- After an encounter with Venus on Feb. 5, 1974, it flew by Mercury three times: March 29, 1974; Sept. 21, 1974; and March 17, 1975
- **Mariner 10 was the only mission to Mercury until MESSENGER**



# Map of Mercury after Mariner 10



Obviously still a lot to learn about this planet!



# MESSENGER

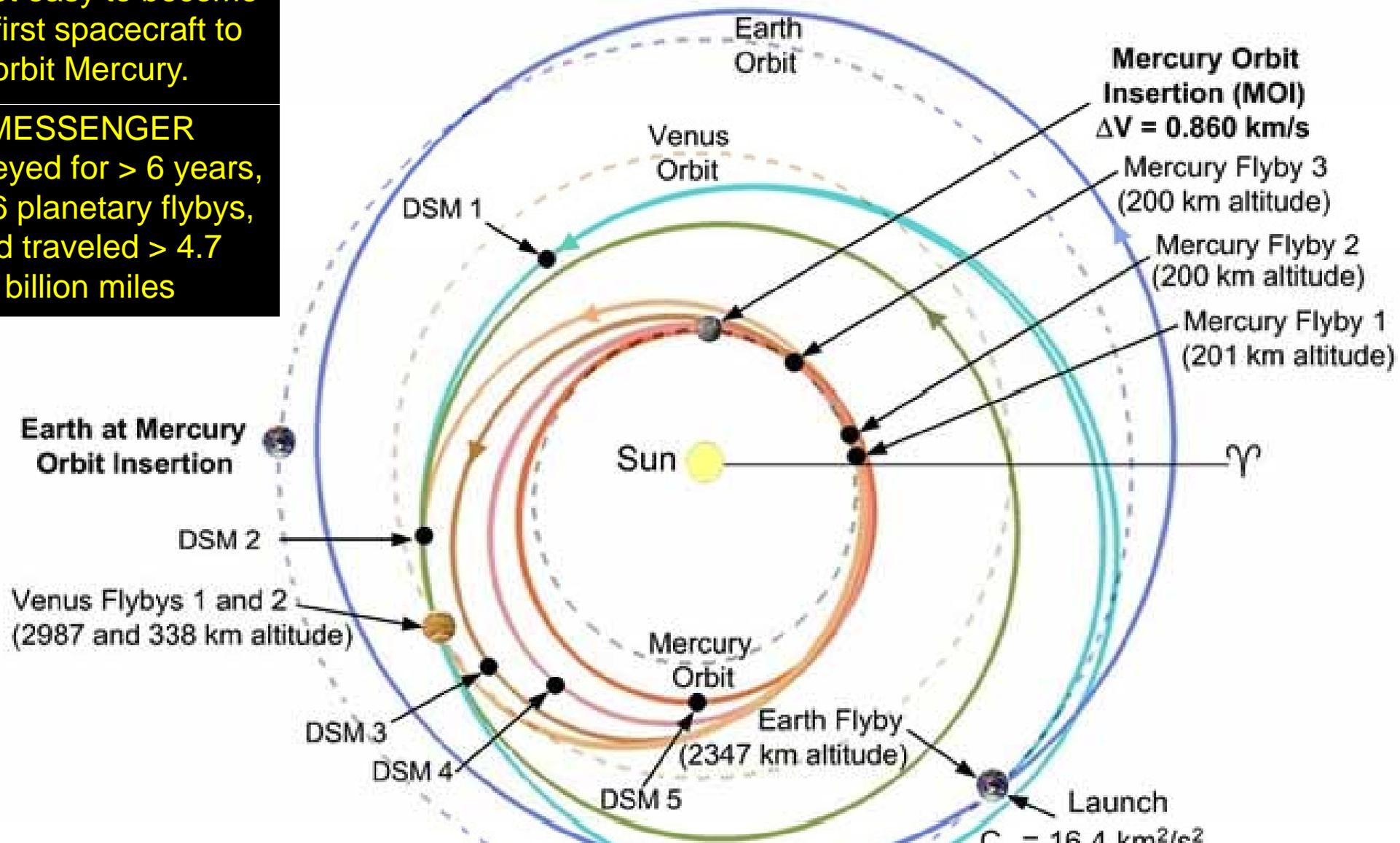
MErcury Surface, Space  
Environment, GEochemistry and  
Ranging

- Launched in 2004, the first mission to Mercury in 30 years
- **The First Mercury Orbiter!**
- Goal: Comprehensive investigation of Mercury's surface, interior, exosphere and magnetosphere



It's not easy to become the first spacecraft to orbit Mercury.

**MESSENGER** journeyed for > 6 years, had 6 planetary flybys, and traveled > 4.7 billion miles



DSM = Deep Space Maneuver

The timeline shows the sequence of events and dates for the MESSENGER mission:

- 8/03/04:** Earth (Launch)
- 8/02/05:** Earth (DSM 1)
- 10/24/06:** Venus (Venus Flyby 1)
- 6/5/07:** Venus (Venus Flyby 2)
- 1/14/08:** Mercury (DSM 2)
- 10/6/08:** Mercury (DSM 3)
- 9/29/09:** Mercury (DSM 4)
- 3/18/11:** Mercury (MOI)

Insert movie: MESSENGER\_trajectory.mp4 here

It's not easy to become  
the first spacecraft to  
orbit Mercury.

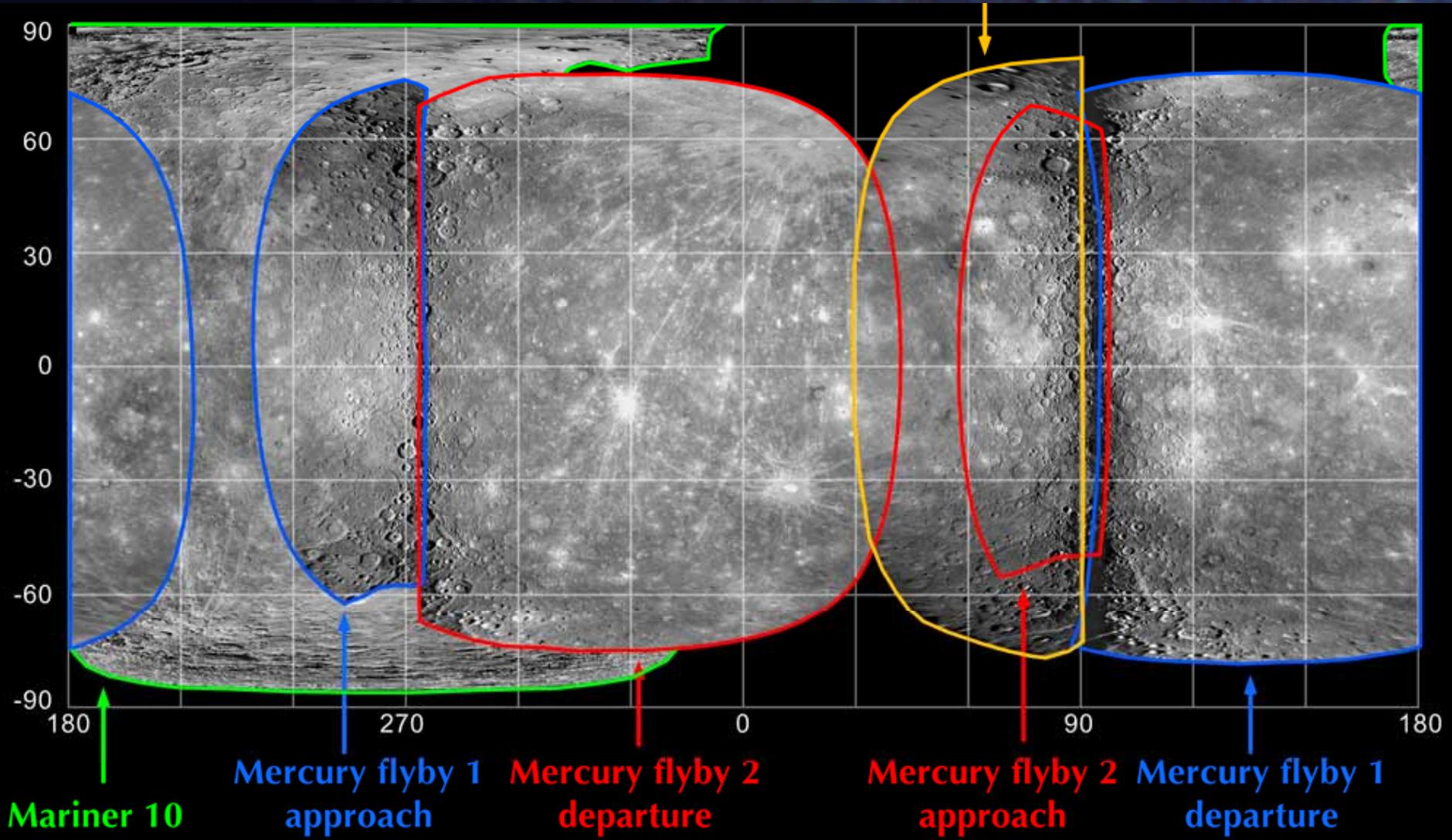
MESSENGER  
journeyed for > 6 years,  
had 6 planetary flybys,  
and traveled > 4.7  
billion miles



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# MESSENGER

MErcury Surface, Space ENvironment, GEochemistry, and Ranging



Mariner 10

Mercury flyby 1 approach

Mercury flyby 2 departure

Mercury flyby 2 approach

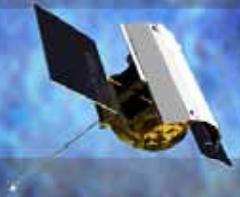
Mercury flyby 1 departure



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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



## View from 2009 Mercury Map

Second Mercury flyby

275 km

74°N,  
336°  
E



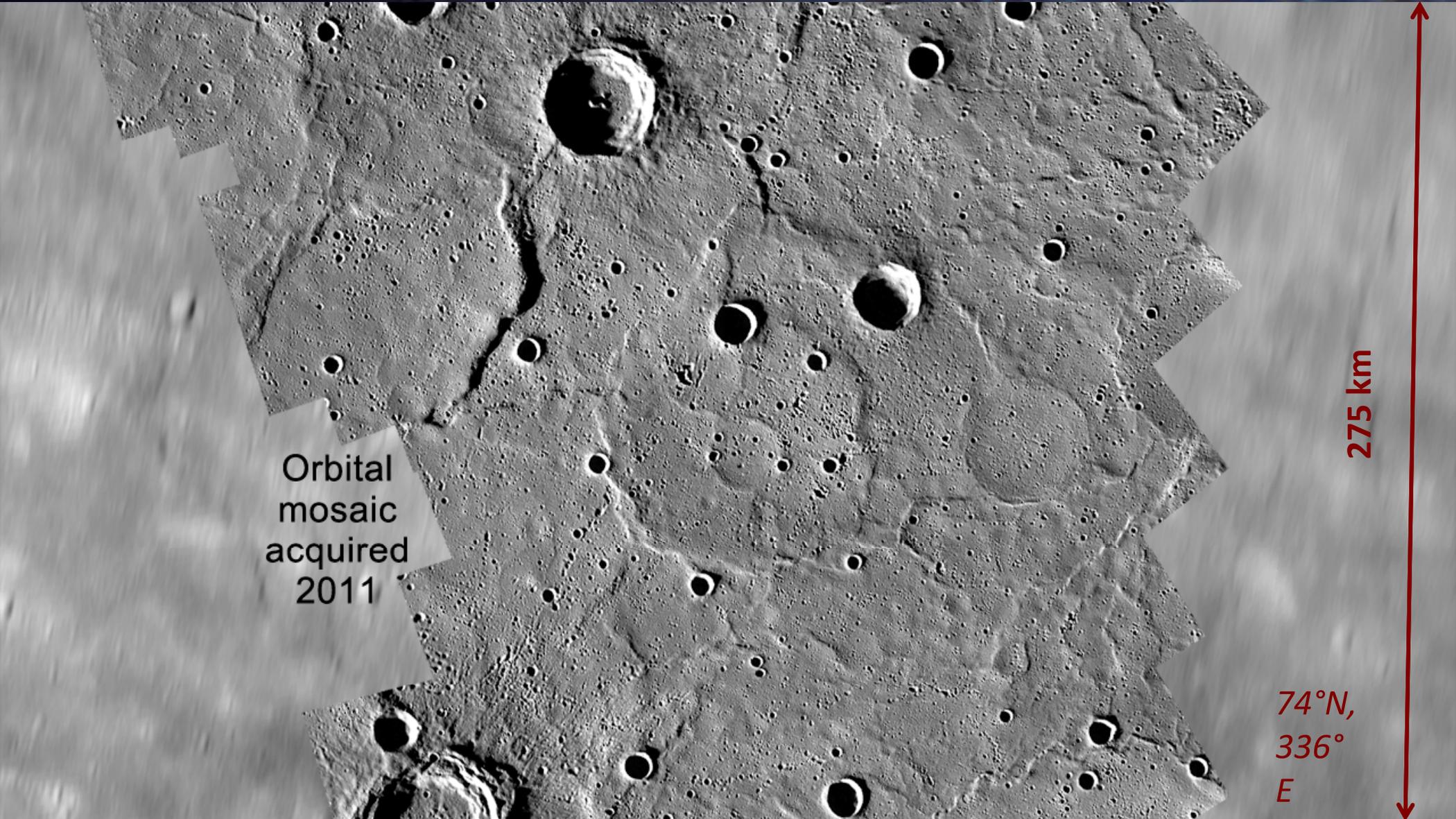
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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



## View from 2009 Mercury Map + Orbital Images



Orbital  
mosaic  
acquired  
2011

275 km

74°N,  
336°  
E



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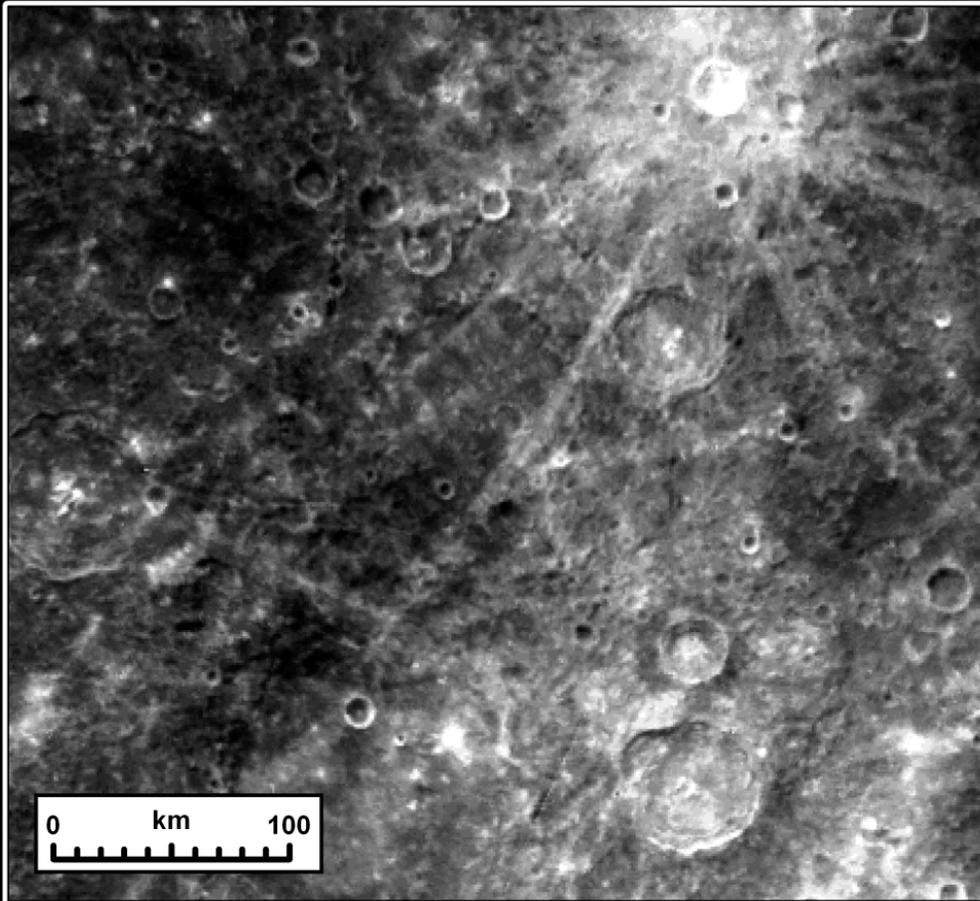
# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING

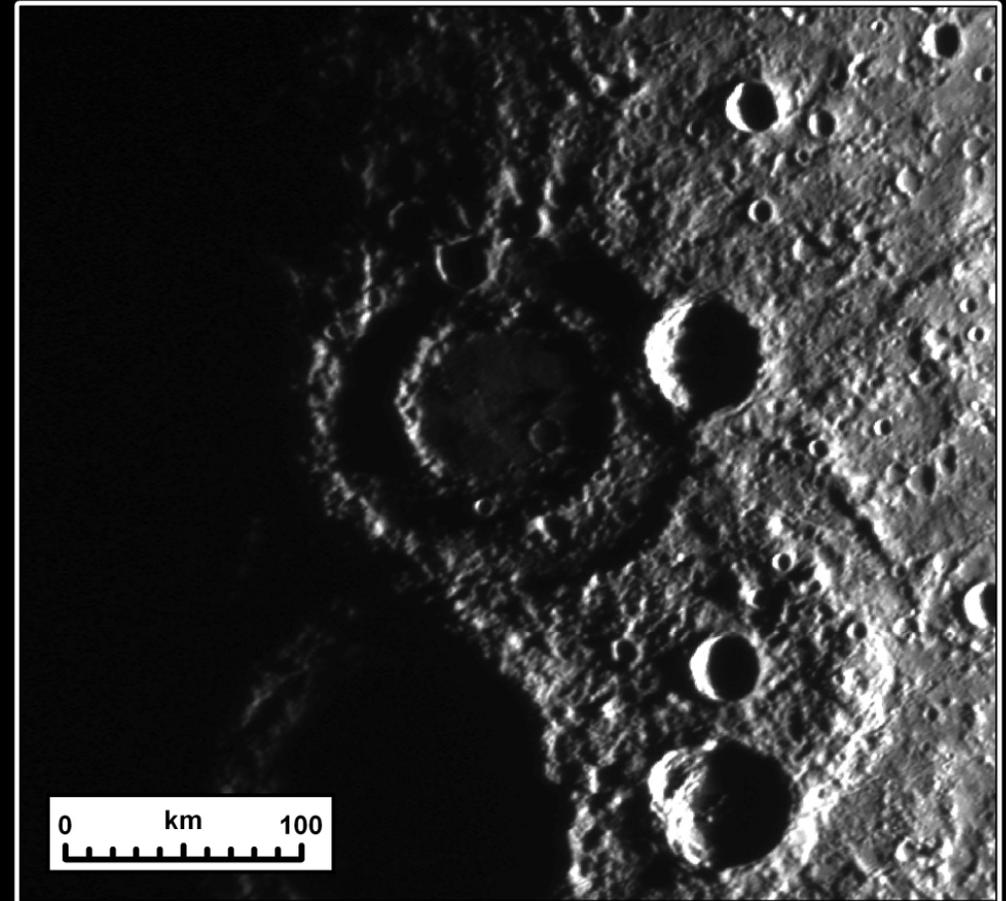


## Lighting conditions matter!

Need to image the surface with a range of lighting conditions to reveal Mercury's geologic history.



MARINER 10



MESSENGER



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# MESSENGER

MERcury Surface, Space ENVIRONMENT, GEOchemistry, and Ranging



## One Year of Orbital Operations (*well, almost!*)

March 18, 2012, will mark one year of orbital operations and the end of the primary mission. MESSENGER has been funded for a one year “extended mission.”

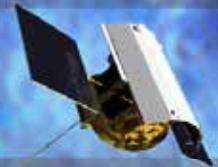
Insert movie: Orbital\_Ops.mp4 here



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# MESSENGER

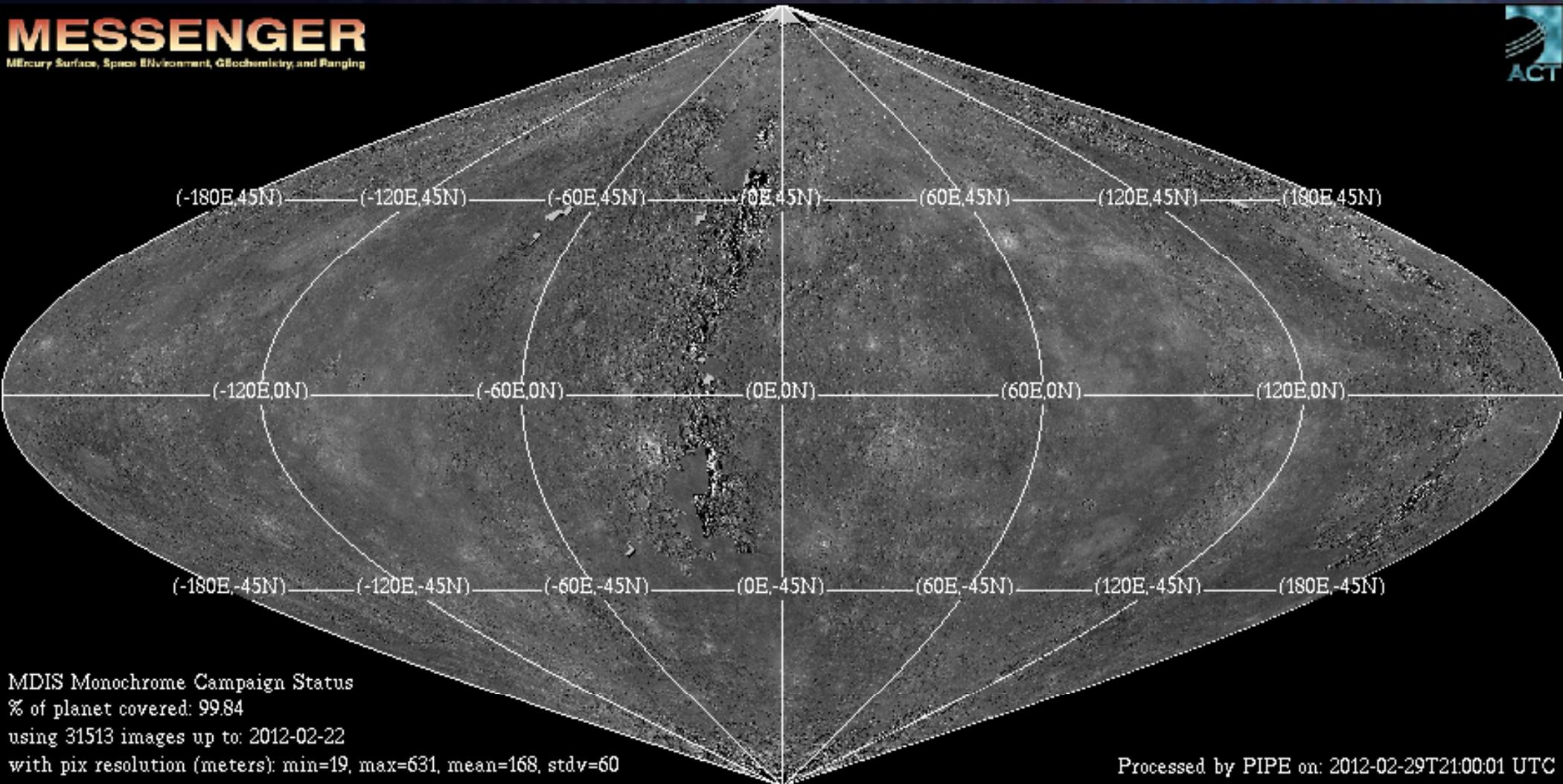
MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



## Global Morphology Base Map: >99% of Mercury covered!

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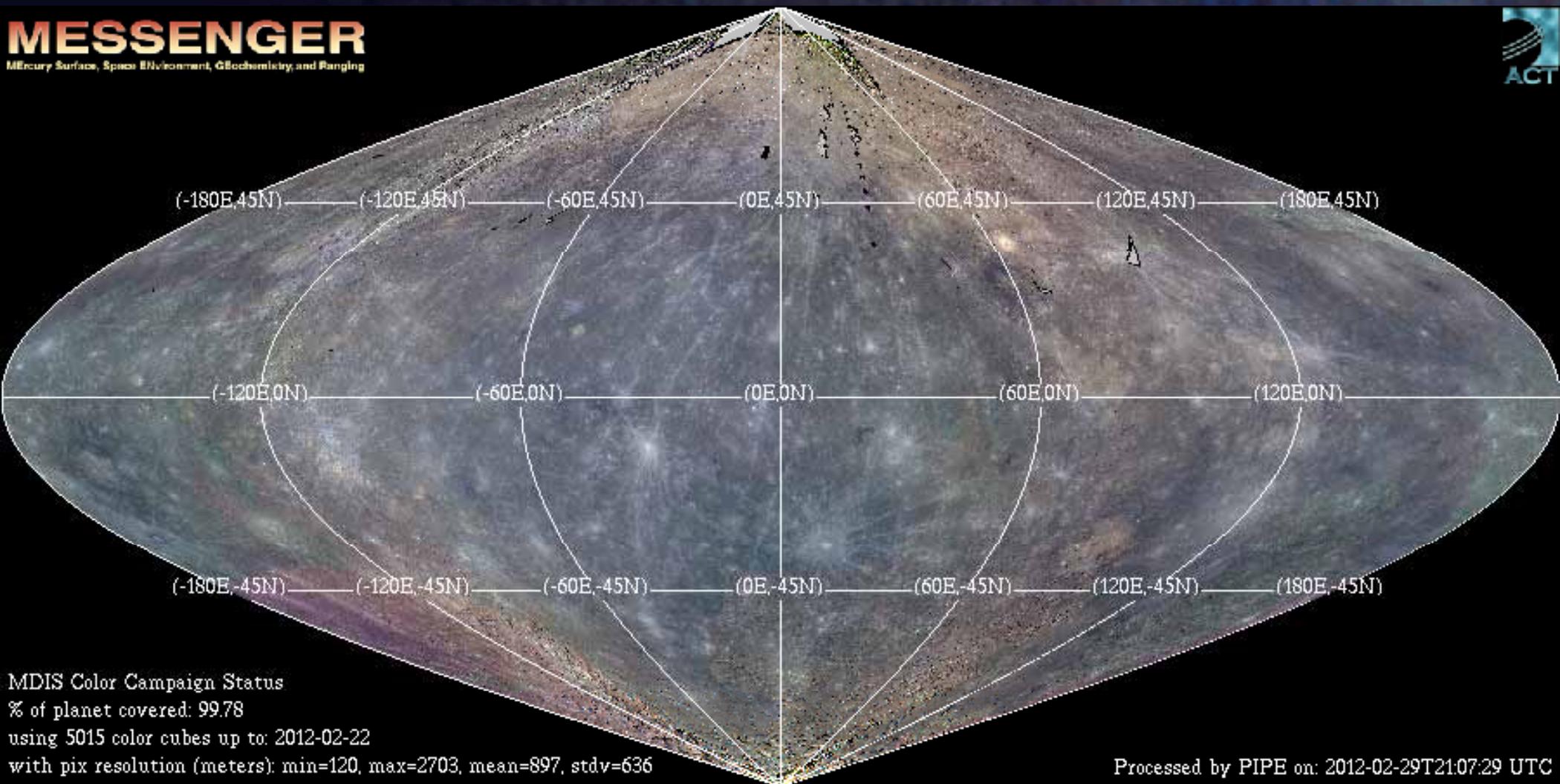
MErcury Surface, Space ENvironment, GEochemistry, and Ranging



## Global Color Base Map: >99% of Mercury covered!

### MESSENGER

MErcury Surface, Space ENvironment, GEochemistry, and Ranging



MDIS Color Campaign Status

% of planet covered: 99.78

using 5015 color cubes up to: 2012-02-22

with pix resolution (meters): min=120, max=2703, mean=897, stdv=636

Processed by PIPE on: 2012-02-29T21:07:29 UTC



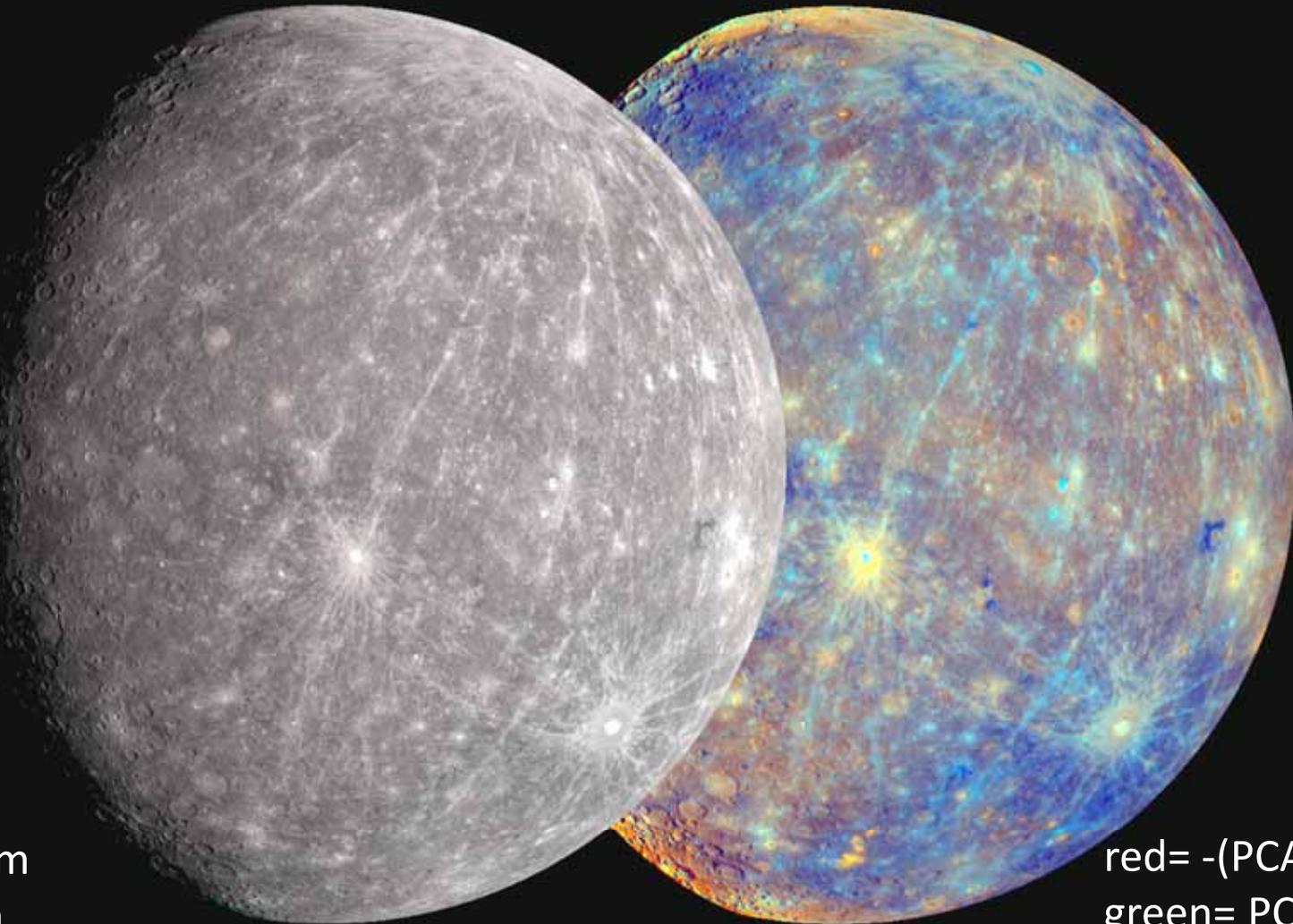
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## Mercury's "True" Color & Enhanced Color



red=630 nm  
green=560 nm  
blue=480 nm

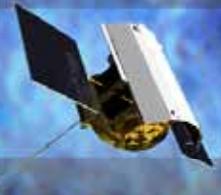
red= -(PCA1)  
green= PCA2  
blue=430nm/560 nm



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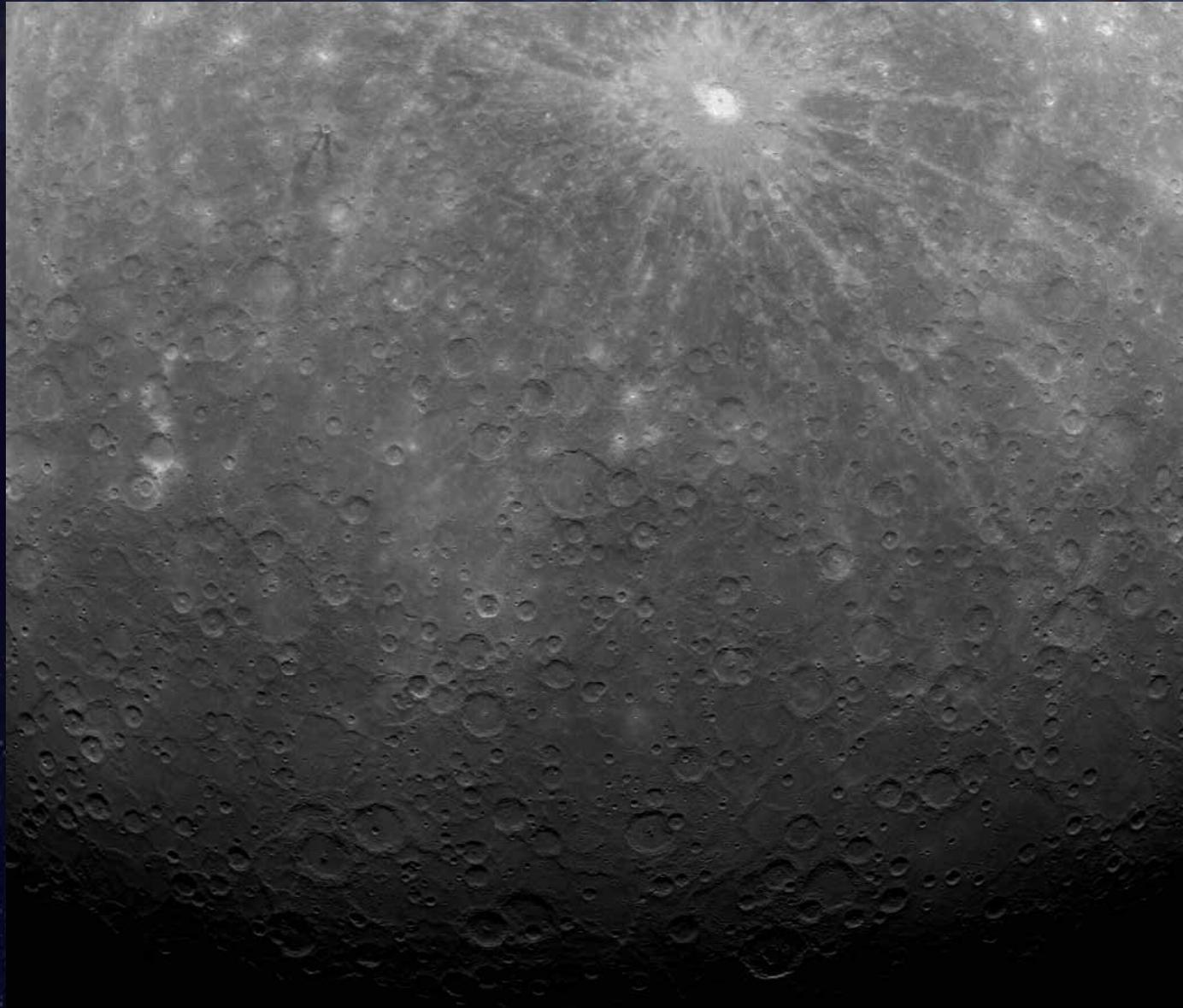
**To date, MESSENGER  
has acquired  
>86,000 images from  
orbit!**

## **Some Personal Favorites**

**First image  
ever obtained  
from Mercury  
orbit!**

**March 29,  
2011**

*(Rayed crater Debussy has a  
diameter of 80 km)*

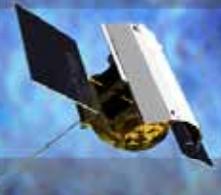




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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



**To date, MESSENGER  
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>86,000 images from  
orbit!**

## **Some Personal Favorites**

### **“Blue tongue” crater!**

Dark impact melt that  
has flowed out of a  
young rayed crater

*(The center crater has a  
diameter of 14 km)*

*The central wavelengths of 1000,  
750, and 430 nm displayed in red,  
green, and blue, respectively*

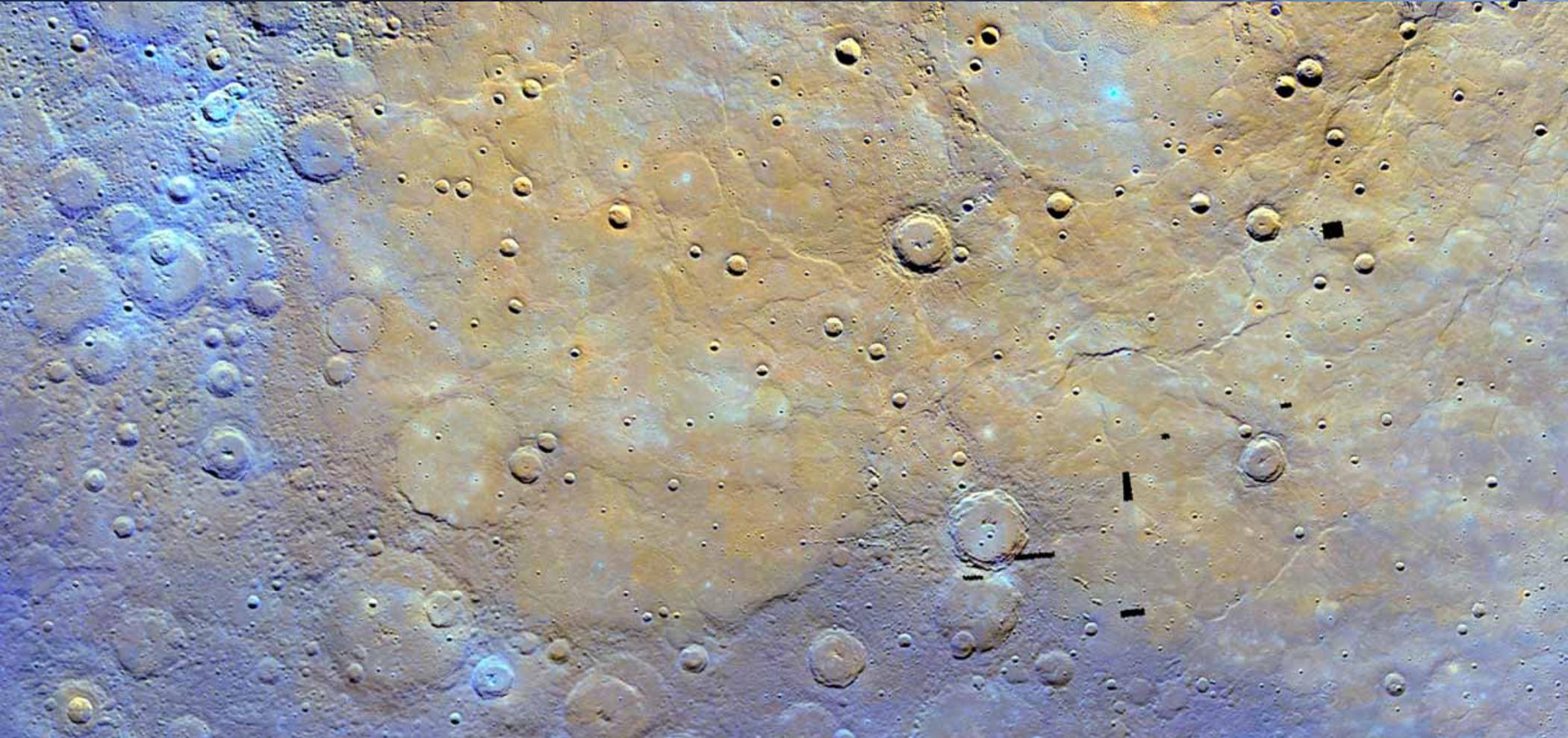




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250 km

An edge of Mercury's immense  
(~5 million km<sup>2</sup> !) northern volcanic plains

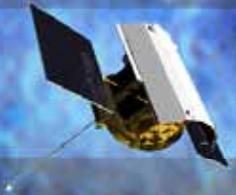
*Principle component analysis and color ratio used in red, green, and blue channels*



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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING

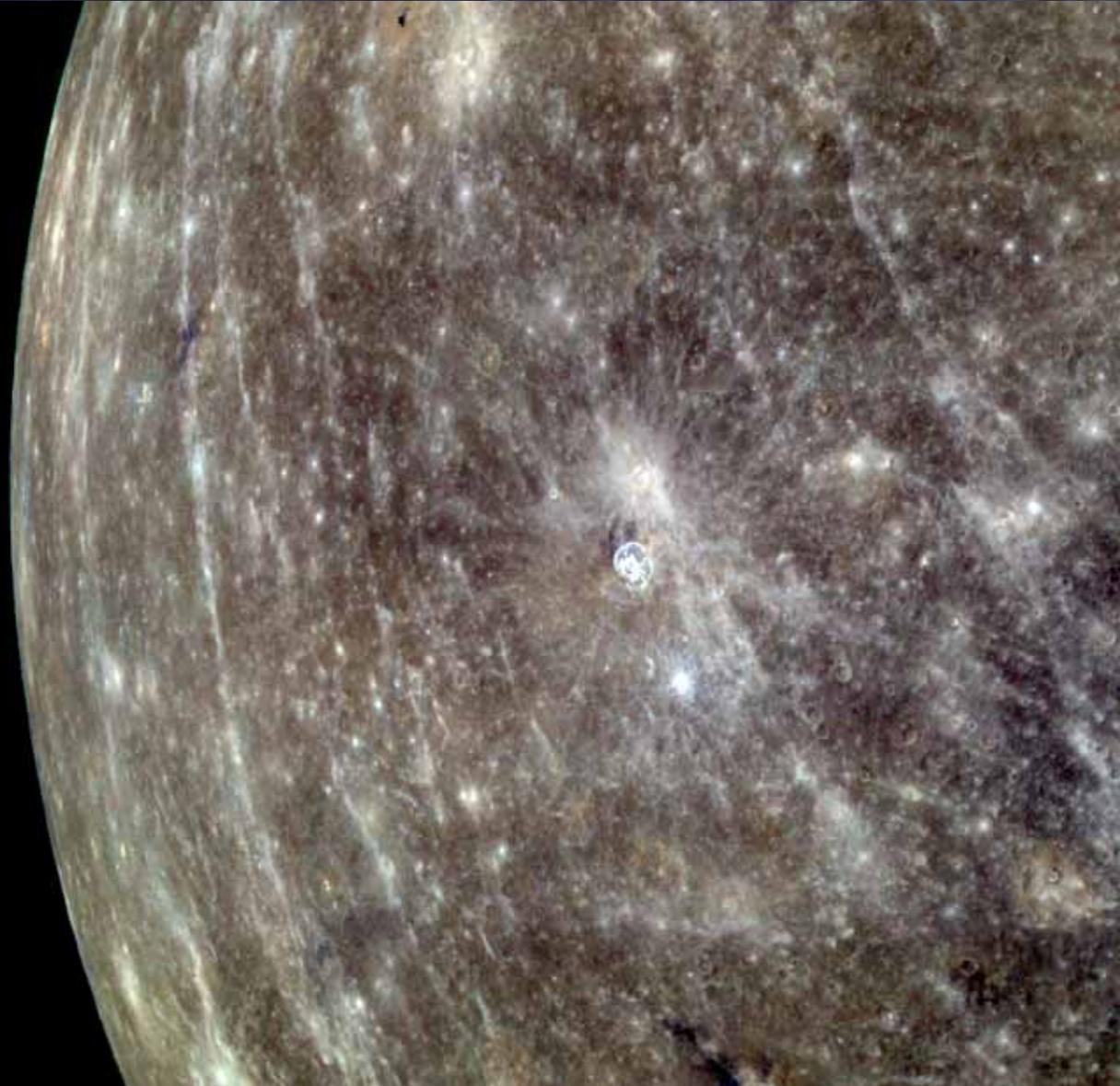


*images from orbit!*

## Some Personal Favorites

Colorful view of Mercury against the blackness of space

*The central wavelengths of 1000, 750, and 430 nm displayed in red, green, and blue, respectively*





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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



*To date, MESSENGER has acquired >86,000 images from orbit!*

## Some Personal Favorites

**Looking from older towards younger, rougher to smoother**

A more cratered surface is older than a less cratered one

*(The bottom of this scene is 220 km across)*





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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



**To date, MESSENGER has acquired >86,000 images from orbit!**

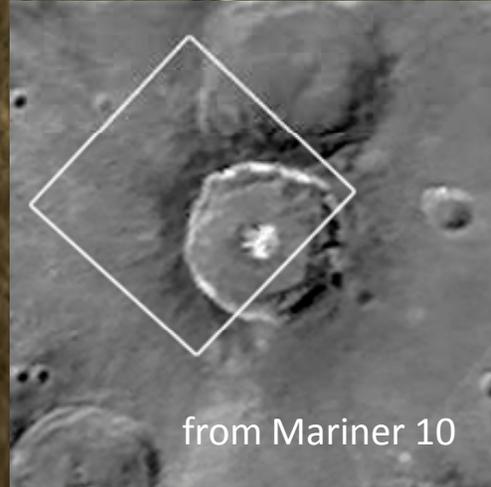
## Some Personal Favorites

### Degas crater!

As never seen before at 90 meters/pixel

*(Degas crater has a diameter of 52 km)*

*The central wavelengths of 1000, 750, and 430 nm displayed in red, green, and blue, respectively*



from Mariner 10

from MESSENGER!





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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



## Some Personal Favorites

**To date, MESSENGER has acquired >86,000 images from orbit!**

*(This scene is 20 km tall)  
Principle component analysis and color ratio used in red, green, and blue channels*



## Mercury's "hollows"

MESSENGER images reveal a newly discovered landform on Mercury!  
Hollows may have formed by Mercury's surface losing volatile materials; this is a surprise, as Mercury was thought to be a volatile-poor planet.



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## Terminator shot

Separating the sunlit dayside from the dark nightside

*The central wavelengths of 1000, 750, and 430 nm  
displayed in red, green, and blue, respectively*

*(The scene is 1800 km wide)*

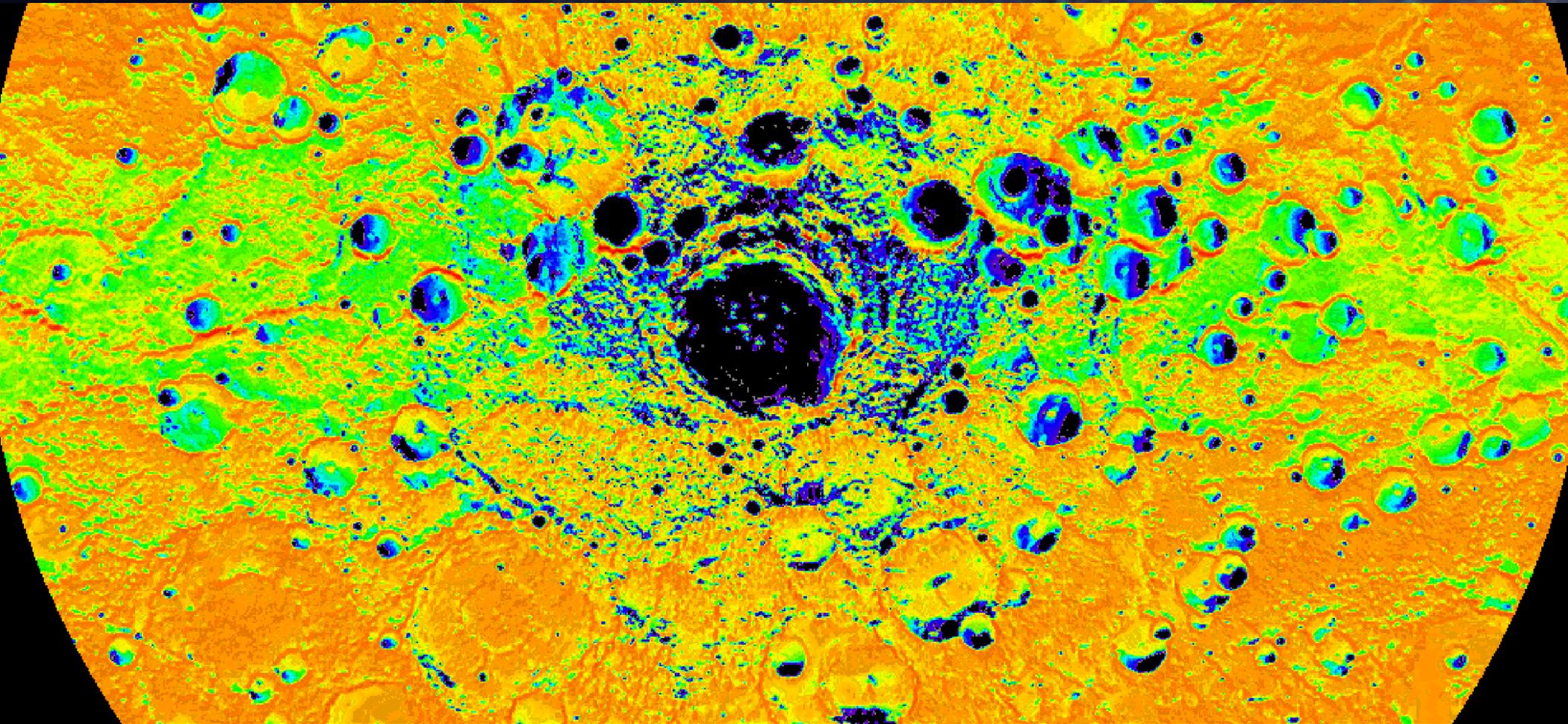




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## Shadowed craters at Mercury's south pole

Colors indicate the percentage of time that an area receives sunlight

*(Chao Meng-Fu crater  
near the center has a  
diameter of 180 km)*



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# MESSENGER

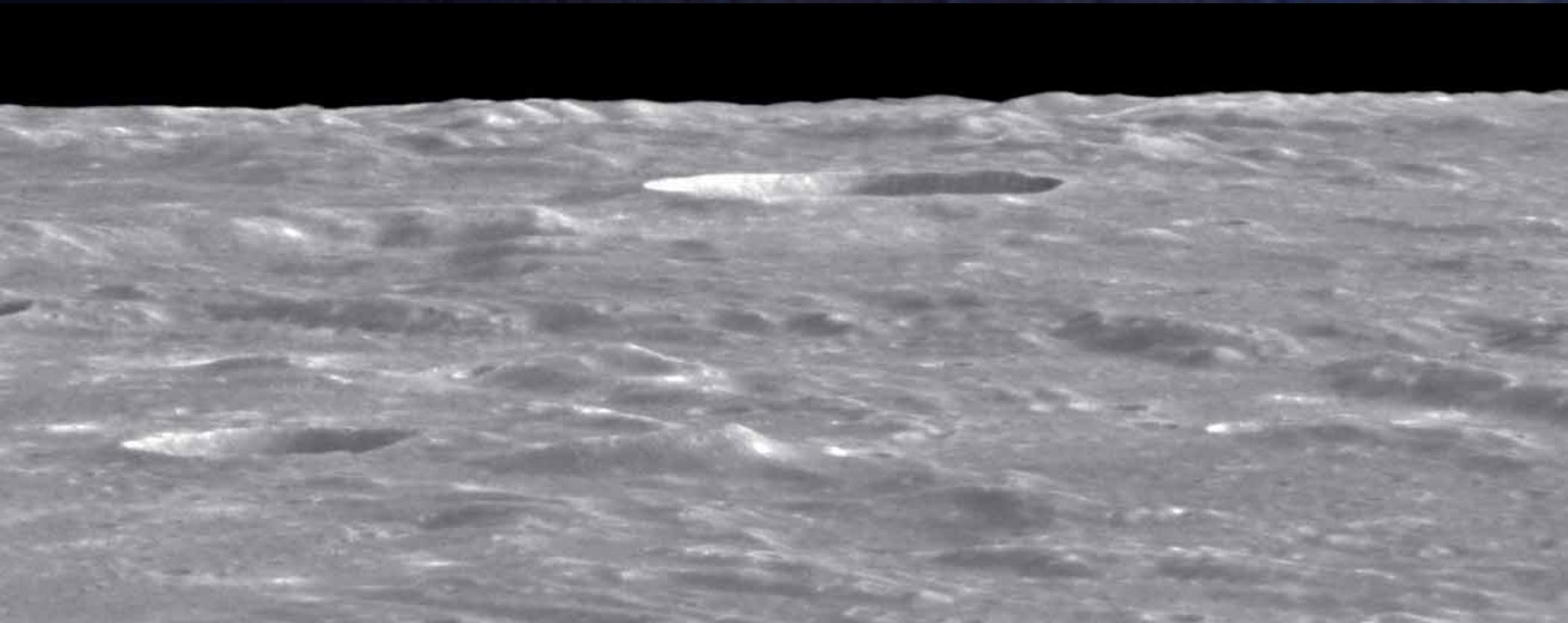
MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



## Some Personal Favorites

*To date, MESSENGER has acquired >86,000 images from orbit!*

*(The large crater near the center has a diameter of 17 km)*



**A spectacular view to Mercury's horizon!**



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*To date, MESSENGER  
has acquired >86,000  
images from orbit!*

## Some Personal Favorites

### **Kuiper crater!**

A bright rayed crater with  
reddish ejecta

*(Kuiper crater has a  
diameter of 62 km)*

*The central wavelengths of 1000,  
750, and 430 nm displayed in red,  
green, and blue, respectively*





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# MESSENGER

MERCURY SURFACE, SPACE ENVIRONMENT, GEOCHEMISTRY, AND RANGING



*To date, MESSENGER  
has acquired >86,000  
images from orbit!*

## Some Personal Favorites

A stark and  
beautiful crescent  
Mercury in black  
and white

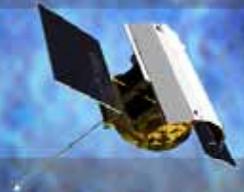
*(Mercury's radius is 2440 km)*



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To date, MESSENGER has acquired >86,000 images from orbit!

Visit the MESSENGER website and find your own personal favorites!

NEW global mosaic just released on March 8, 2012! Explore it in QuickMap!

A new image is posted every day!

<http://messenger.jhuapl.edu>

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Over 80,000 Images from Orbit about Mercury and Counting

Global Maps from the First Mercury Solar Day in Orbit

Mission News  
March 2, 2012  
MESSENGER Modifies Orbit to Prepare for Extended Mission  
MESSENGER successfully completed an orbit-correction maneuver this evening to lower its perihelion altitude - the lowest point of MESSENGER's orbit about Mercury relative to the planet's surface - from 405 to 200 kilometers (251 to 124 miles). This is the first of three planned maneuvers designed to modify the spacecraft's orbit around Mercury to commence operations transition from MESSENGER's primary orbital mission to its extended mission. [more]

Science Highlights  
February 15, 2012  
Mercury's Oddy Offset Magnetic Field  
Observations by the MESSENGER spacecraft have revealed that Mercury's magnetic field is dominated by a dipole offset to the north. read more

DAYS	HRS	MIN	SECS
2 7 7 2	1 7	0 4	2 4

Mercury Orbit Insertion  
March 18, 2011  
00:45 UTC

DAYS	HRS	MIN	SECS
0 3 5 4	2 2	3 5	0 5

Time since Insertion Burn

Orbits Around Mercury

Orbits completed: 715

Time until start of next orbit (hh:mm:ss): 10:53:02  
Orbit start is at maximum altitude.

Featured Images  
March 6, 2012  
Portrait of a Scarp [more]  
March 5, 2012  
Stay on Target... [more]  
March 2, 2012  
Moving in Stereo [more]  
March 1, 2012  
Uncovering a Dark Past [more]  
February 29, 2012  
Where the Craters Have No Name [more]