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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!**

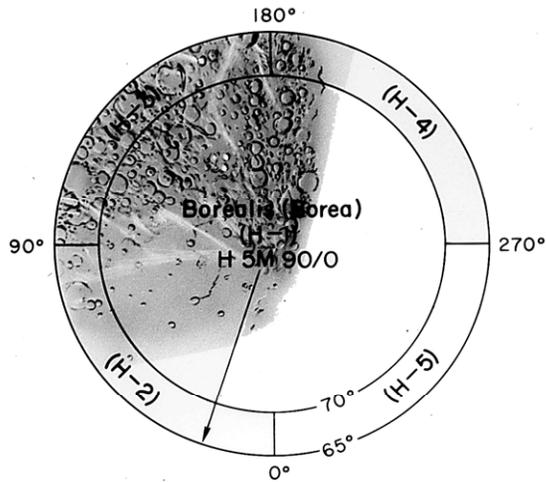
**March 10, 2012**

# Mariner 10: The First Mercury Mission

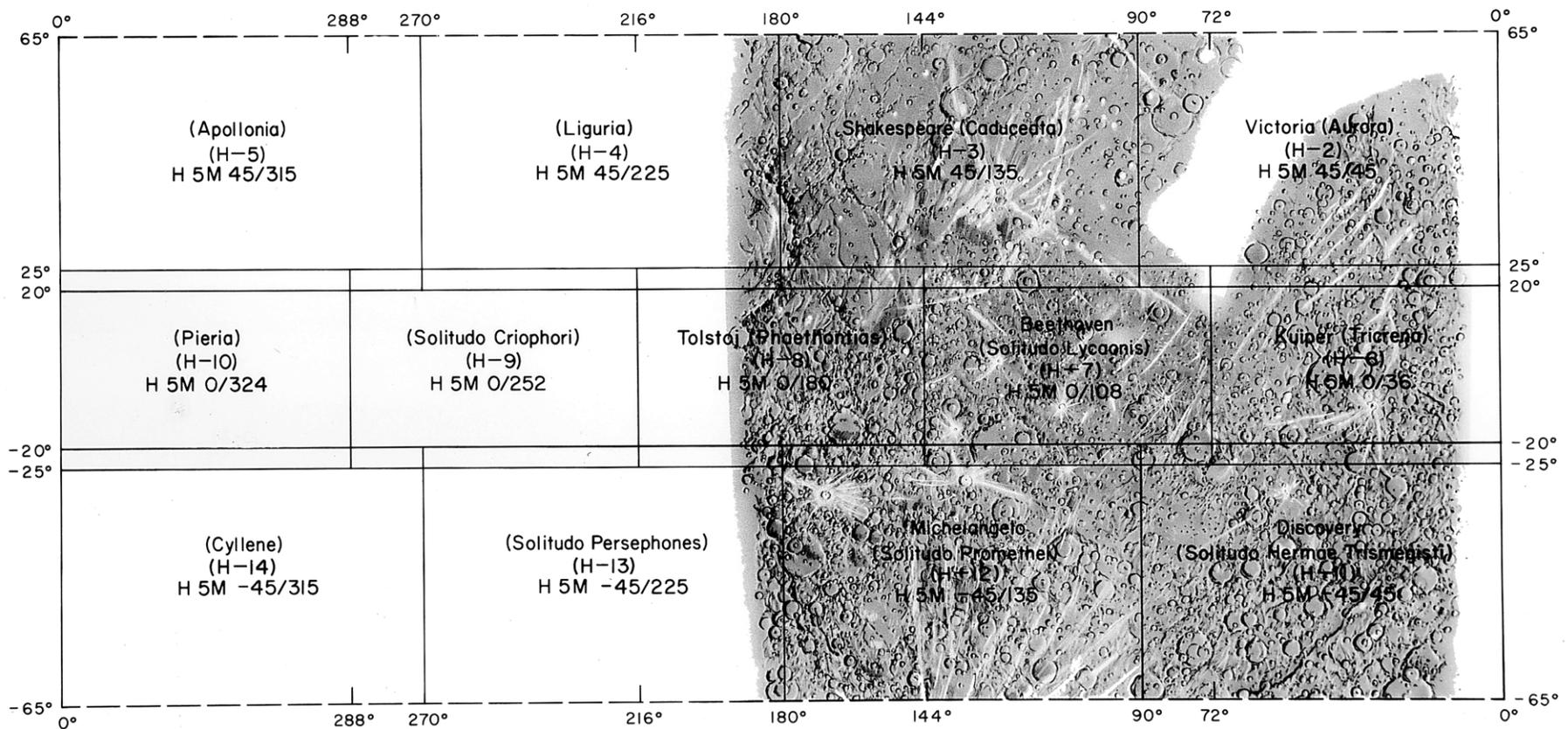
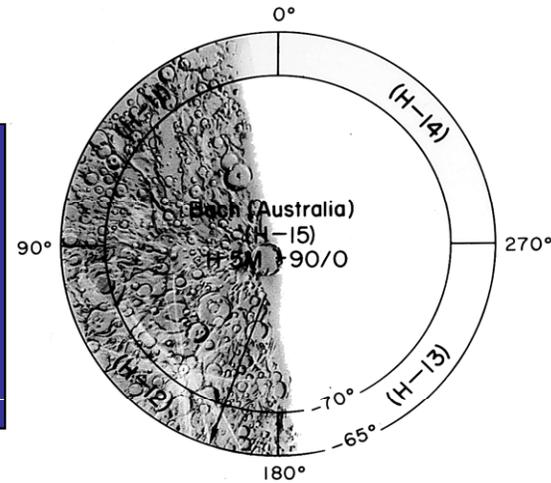
- Mariner 10 was launched Nov. 3, 1973.
- After an encounter with Venus on Feb. 5, 1974, it flew by Mercury three times: March 29, 1974; Sept. 21, 1974; and March 17, 1975
- **Mariner 10 was the only mission to Mercury until MESSENGER**



# Map of Mercury after Mariner 10



Obviously still a lot to learn about this planet!



# MESSENGER

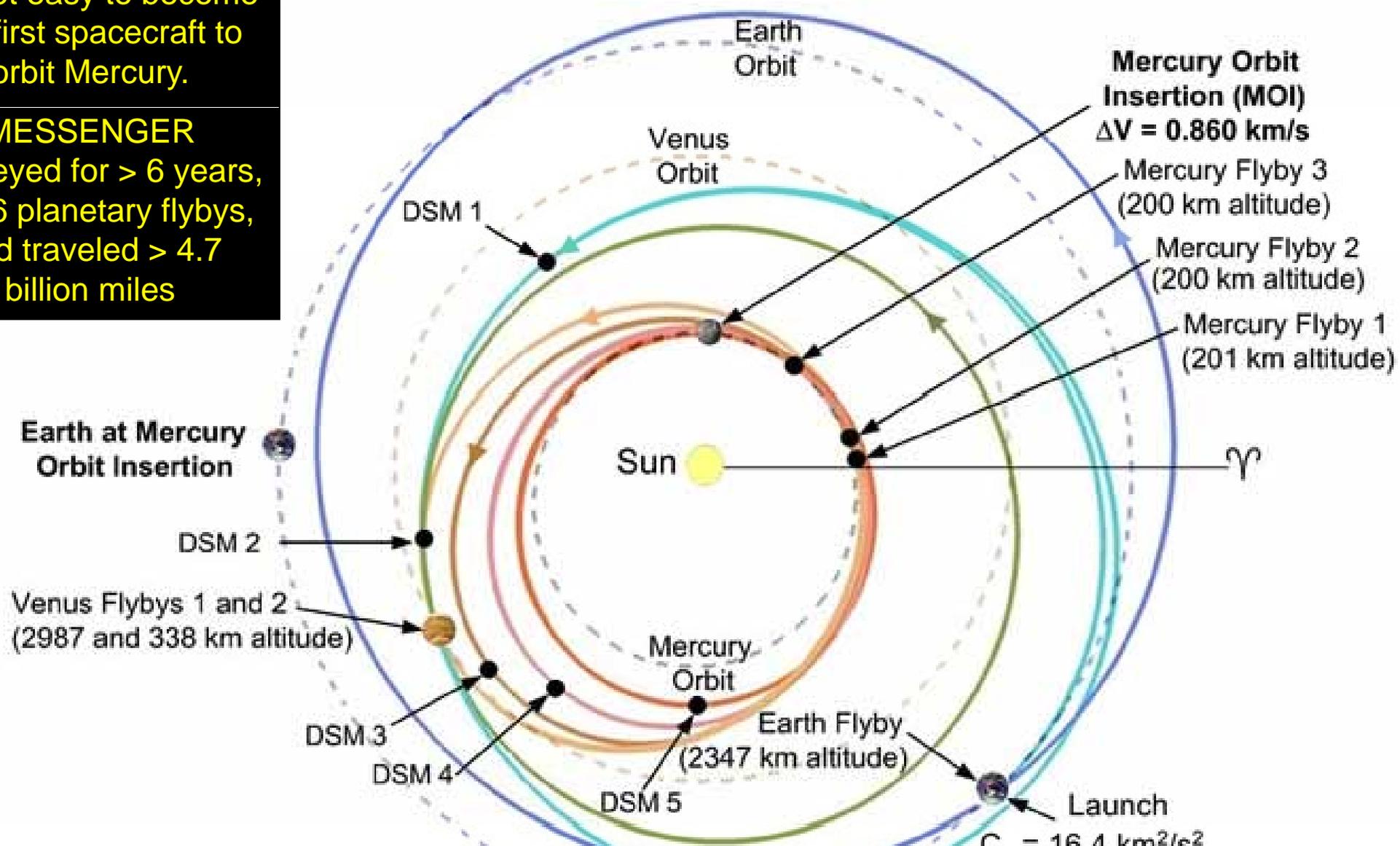
MErcury Surface, Space  
Environment, GEochemistry and  
Ranging

- 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 from Earth to Mercury:

- 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:** DSM 5 and MOI

Insert movie: MESSENGER\_trajectory.mp4 here

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

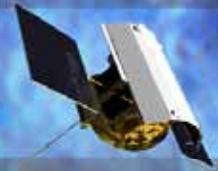
**MESSENGER**  
journeyed for > 6 years,  
had 6 planetary flybys,  
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billion miles



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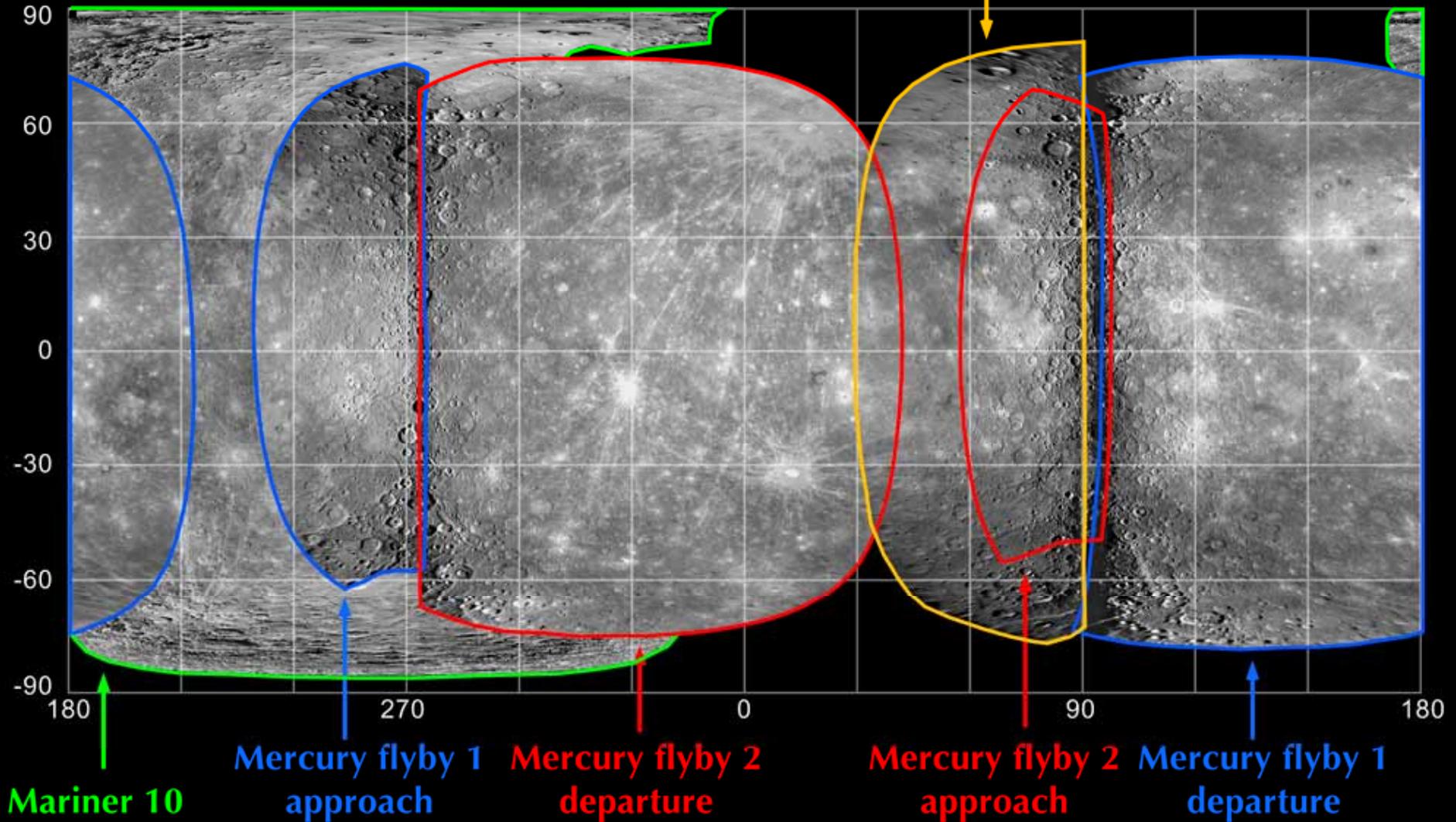
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## Mercury Map in 2009

97.7% coverage at 500 m/pixel





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## View from 2009 Mercury Map

Second Mercury flyby

275 km

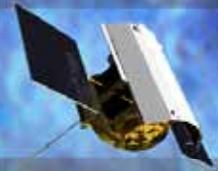
74°N,  
336°  
E



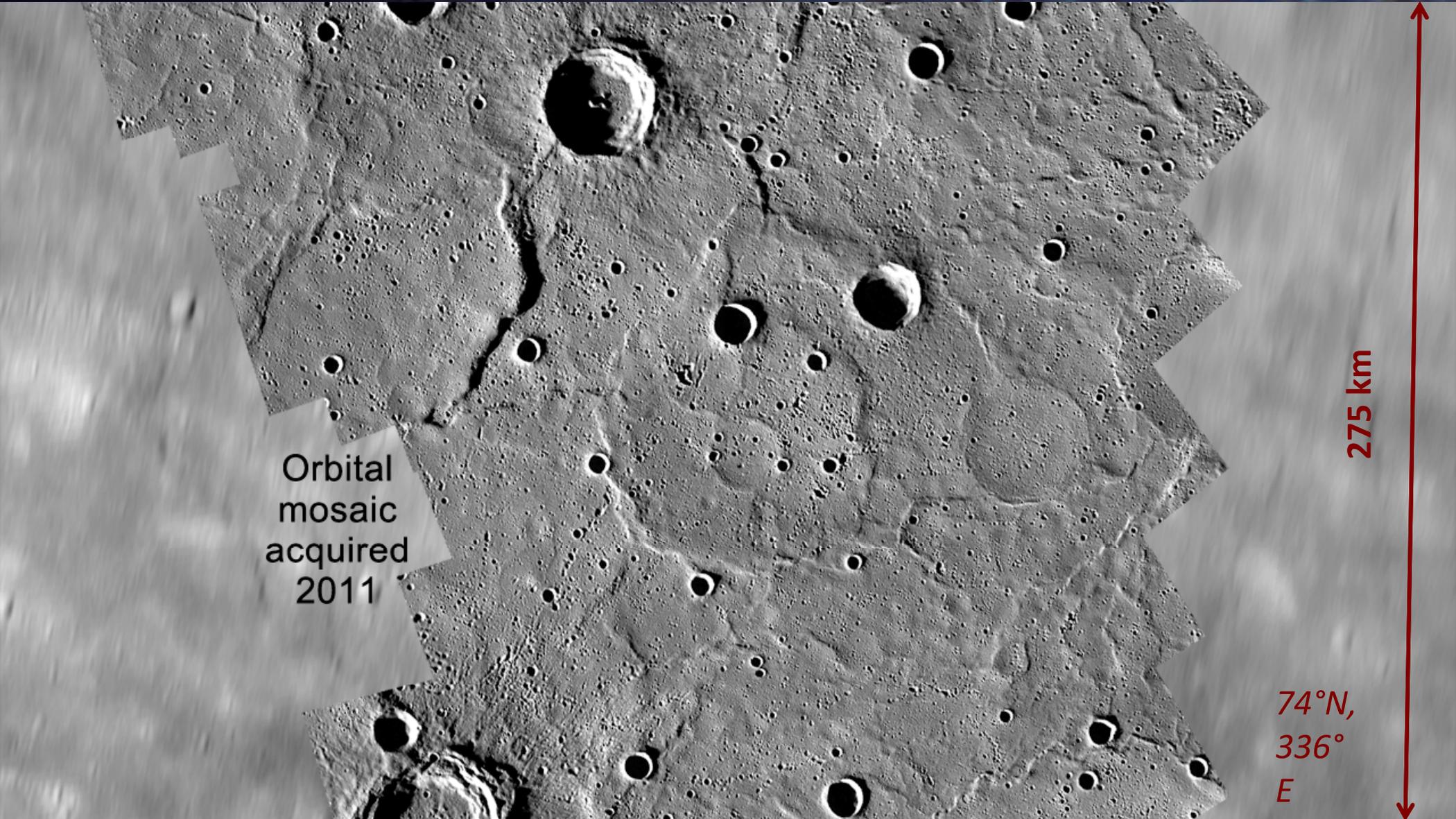
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## View from 2009 Mercury Map + Orbital Images



Orbital  
mosaic  
acquired  
2011

275 km

74°N,  
336°  
E



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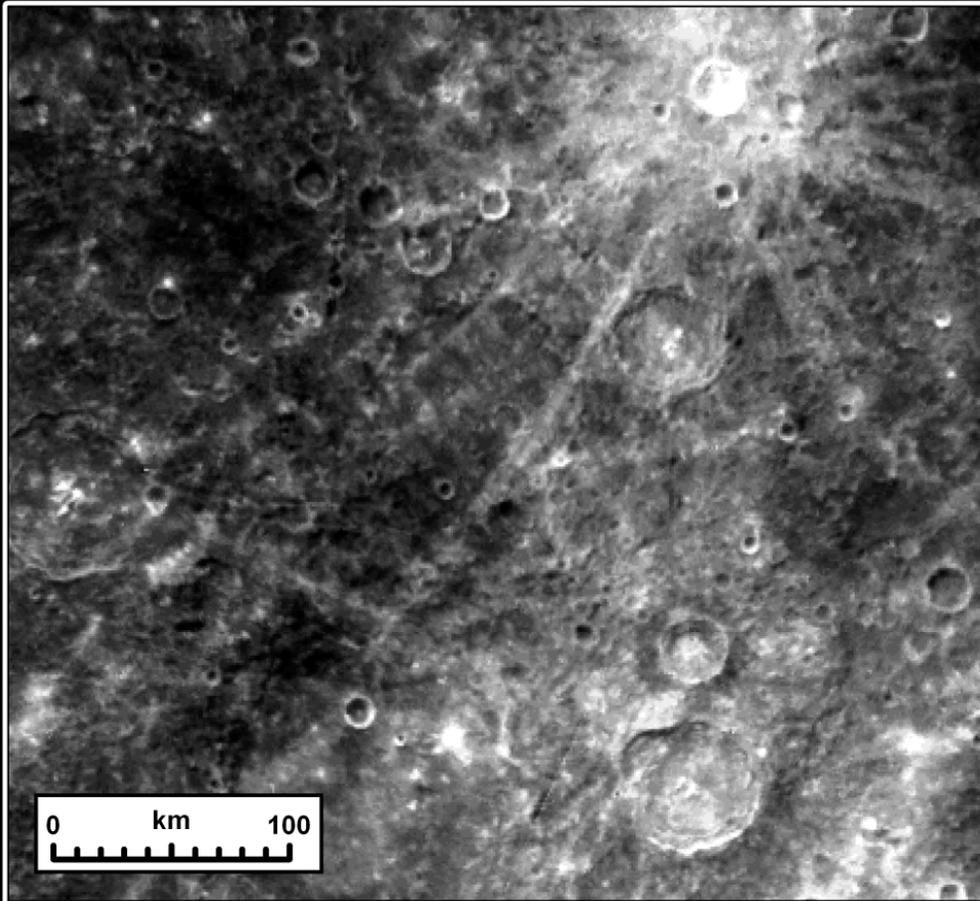
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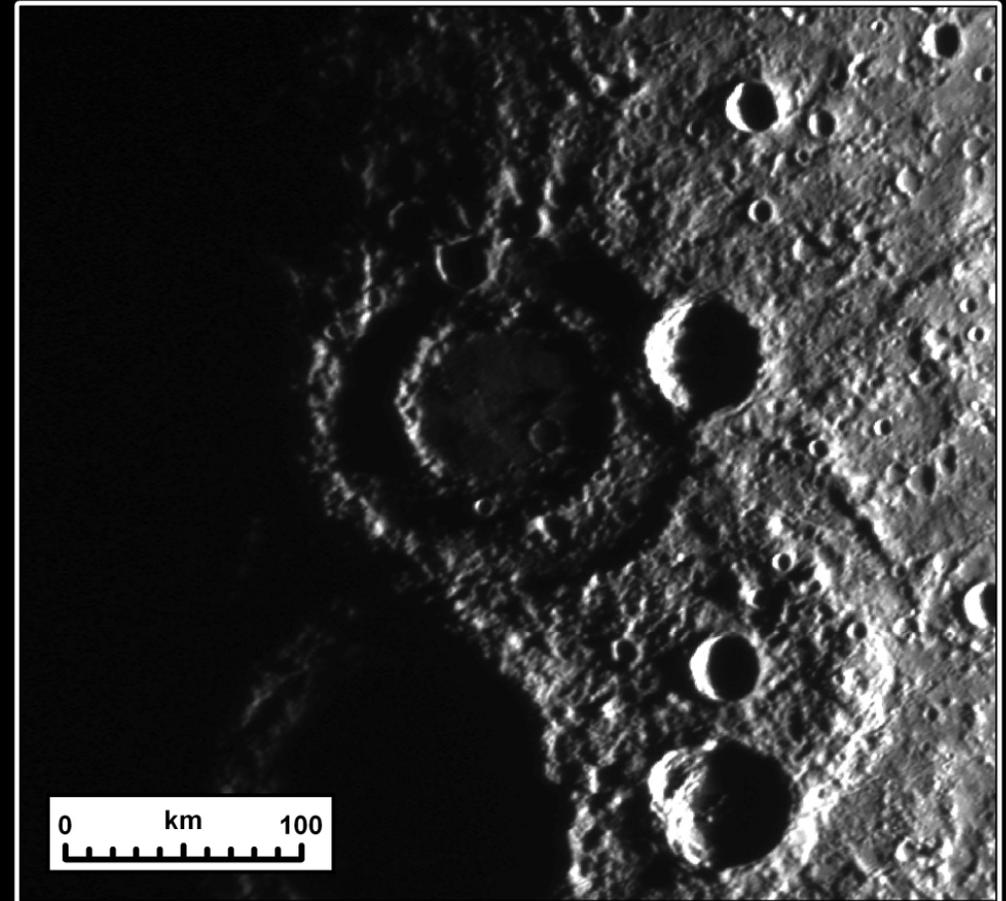


## Lighting conditions matter!

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



**MARINER 10**



**MESSENGER**



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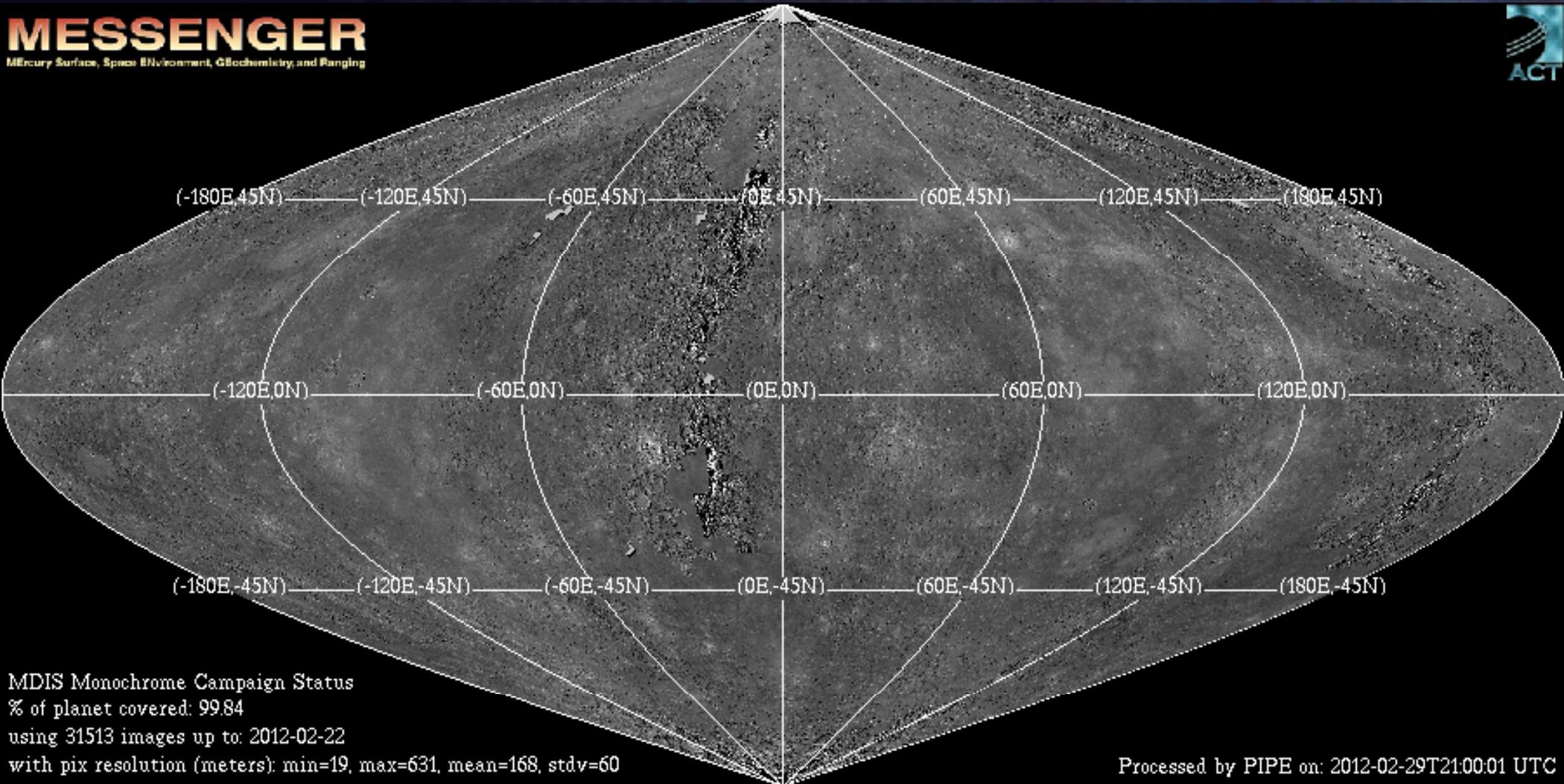
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## Global Morphology Base Map: >99% of Mercury covered!

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MDIS Monochrome Campaign Status  
 % of planet covered: 99.84  
 using 31513 images up to: 2012-02-22  
 with pix resolution (meters): min=19, max=631, mean=168, stdv=60

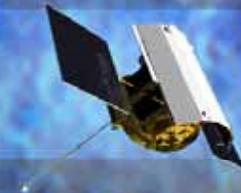
Processed by PIPE on: 2012-02-29T21:00:01 UTC



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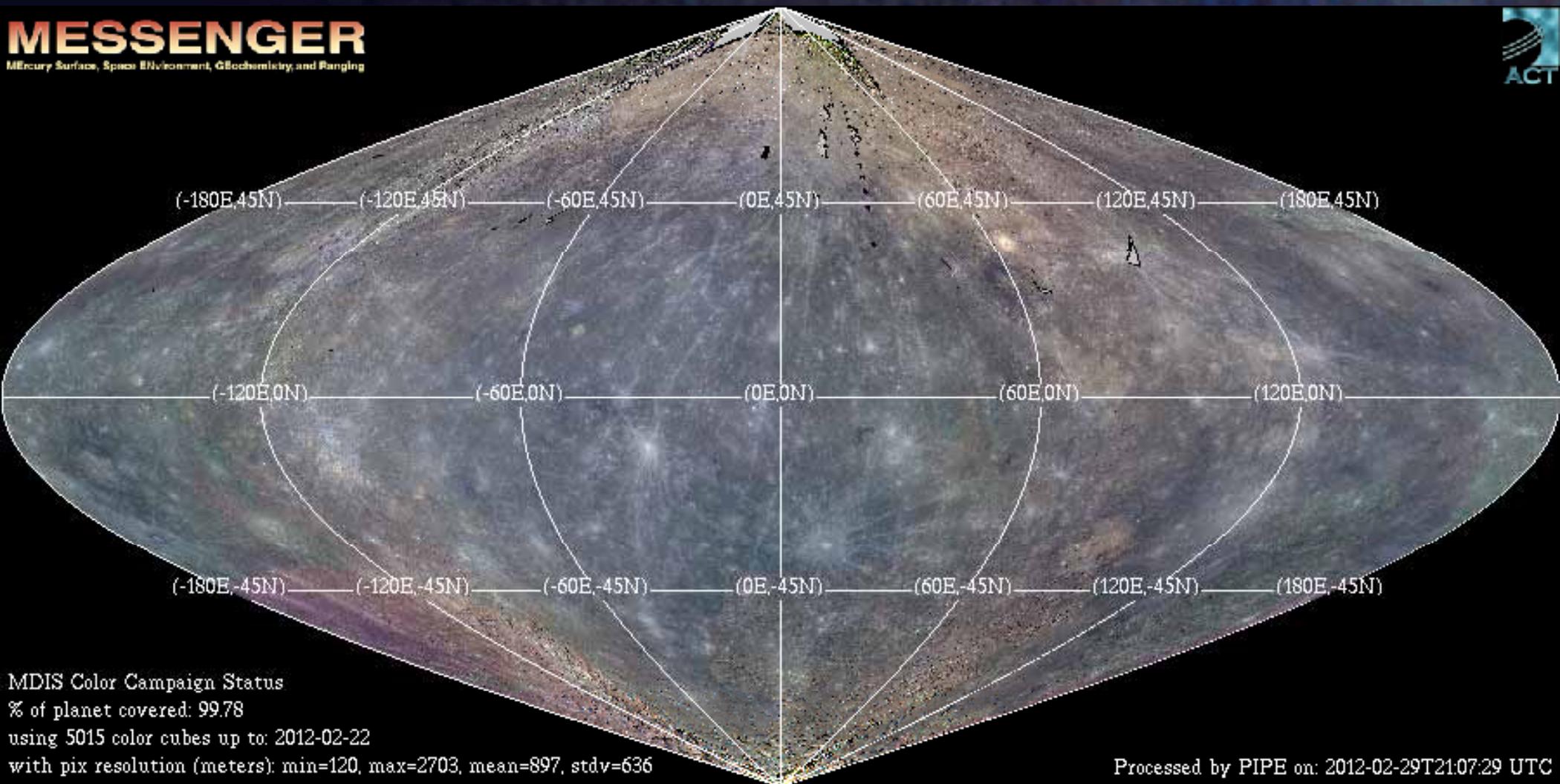
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## Global Color Base Map: >99% of Mercury covered!

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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



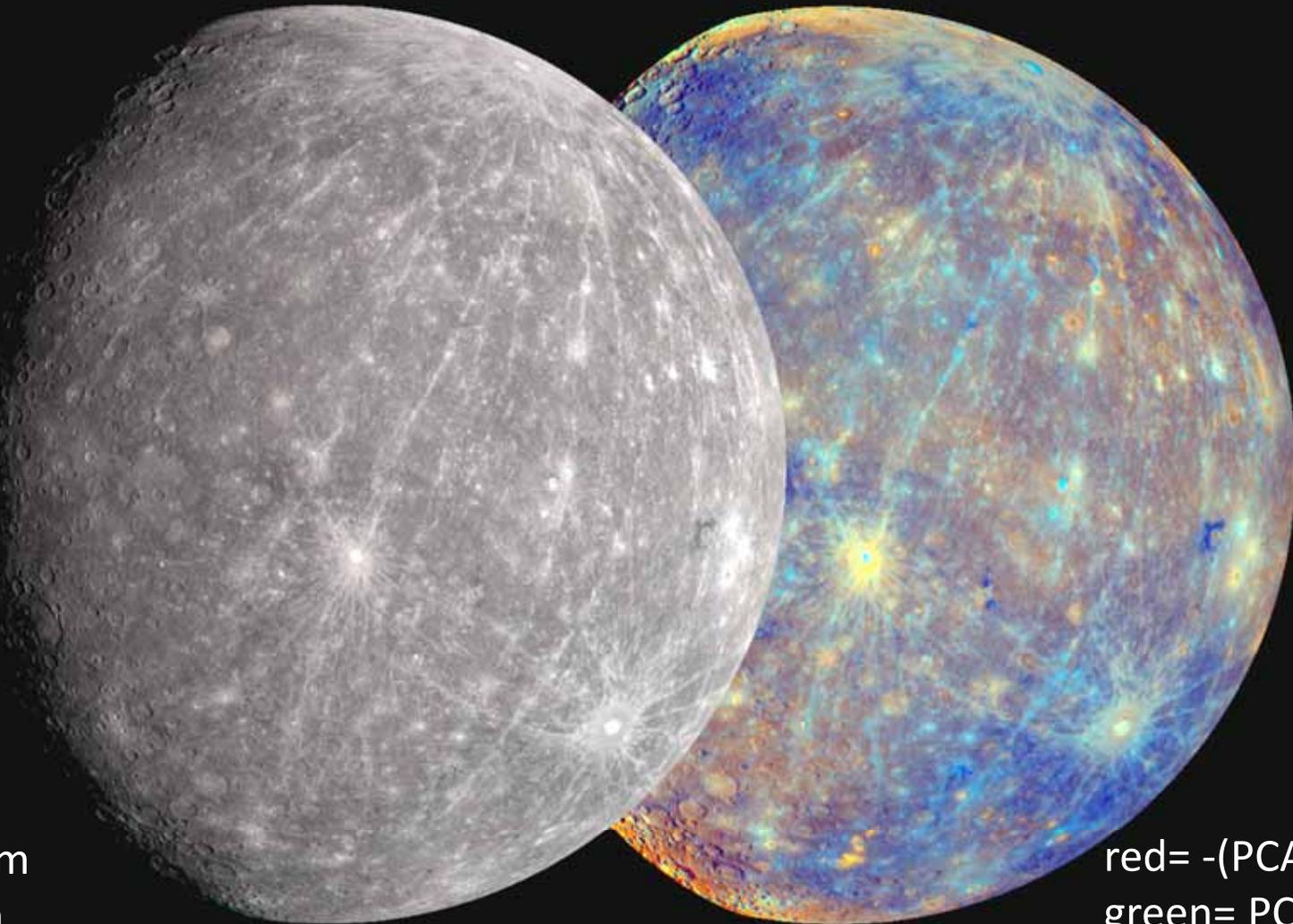
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## Mercury's "True" Color & Enhanced Color



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

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



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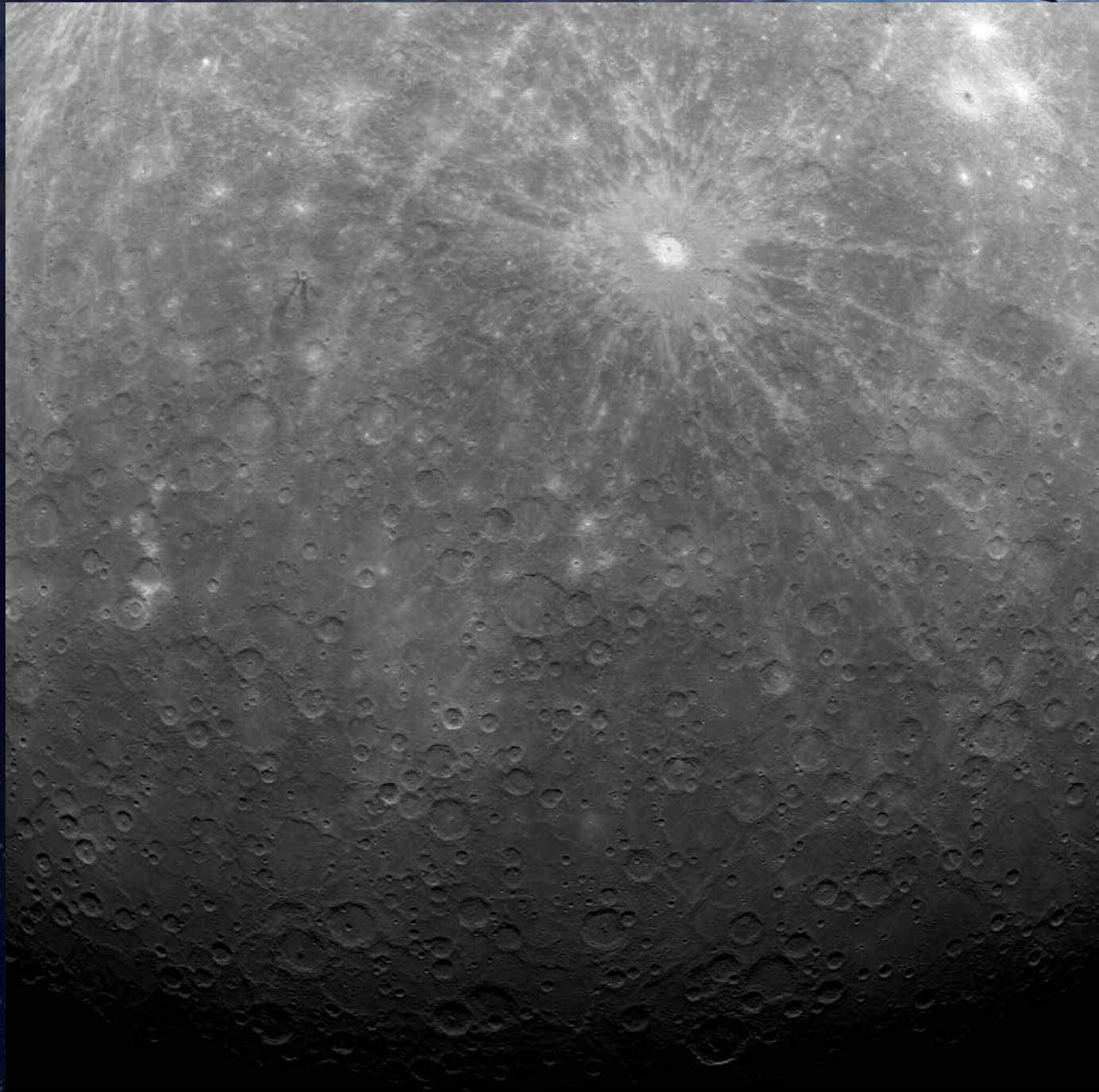
**To date, MESSENGER  
has acquired  
>86,000 images from  
orbit!**

## **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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**To date, MESSENGER  
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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*

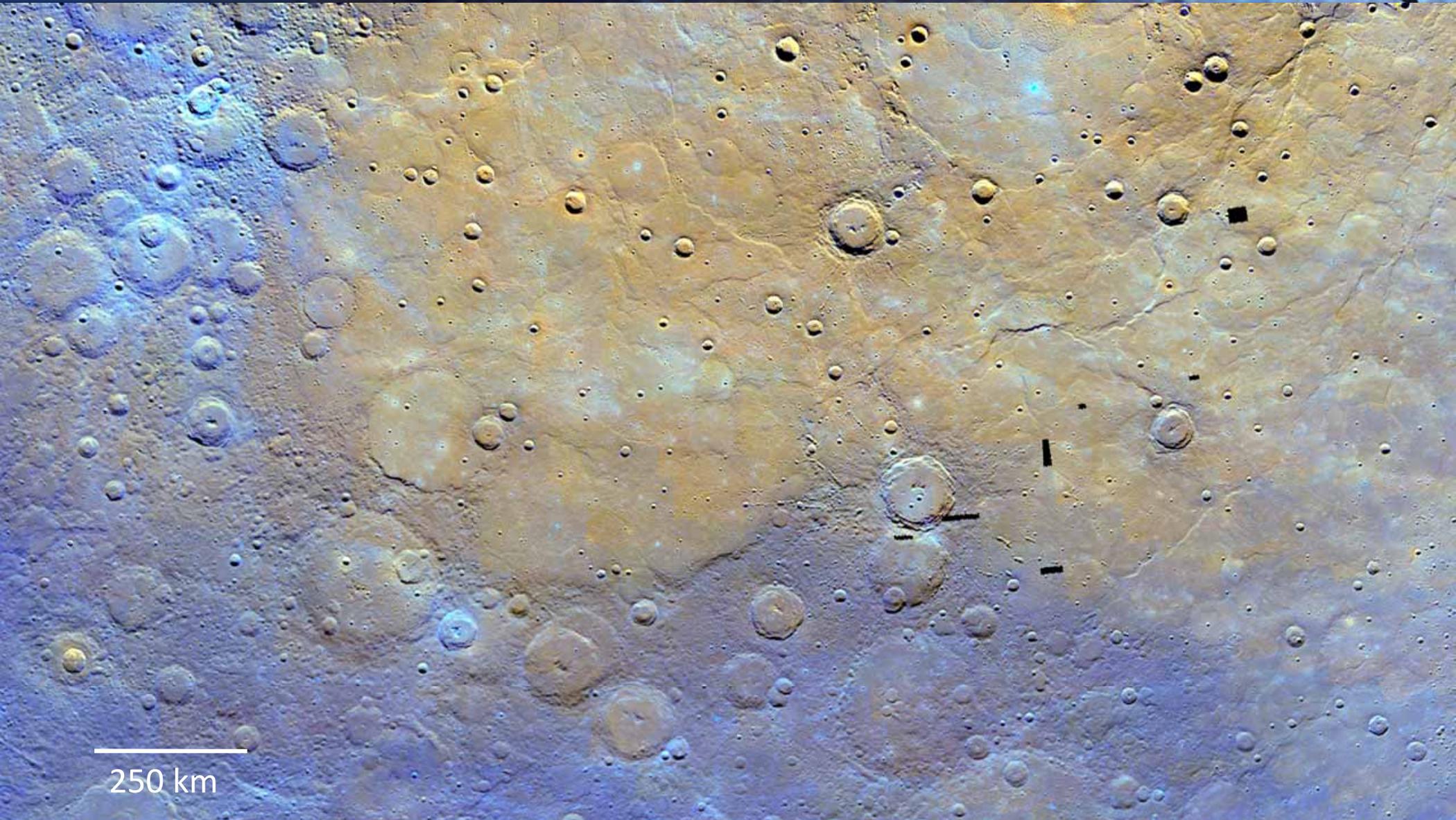




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250 km

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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*To date, MESSENGER  
has acquired >86,000  
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*

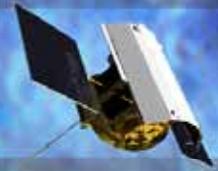




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MErcury Surface, Space ENvironment, GEochemistry, and Ranging



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

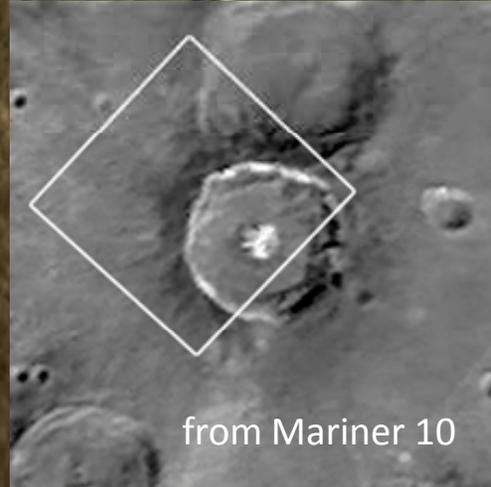
## Some Personal Favorites

### 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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## 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)*

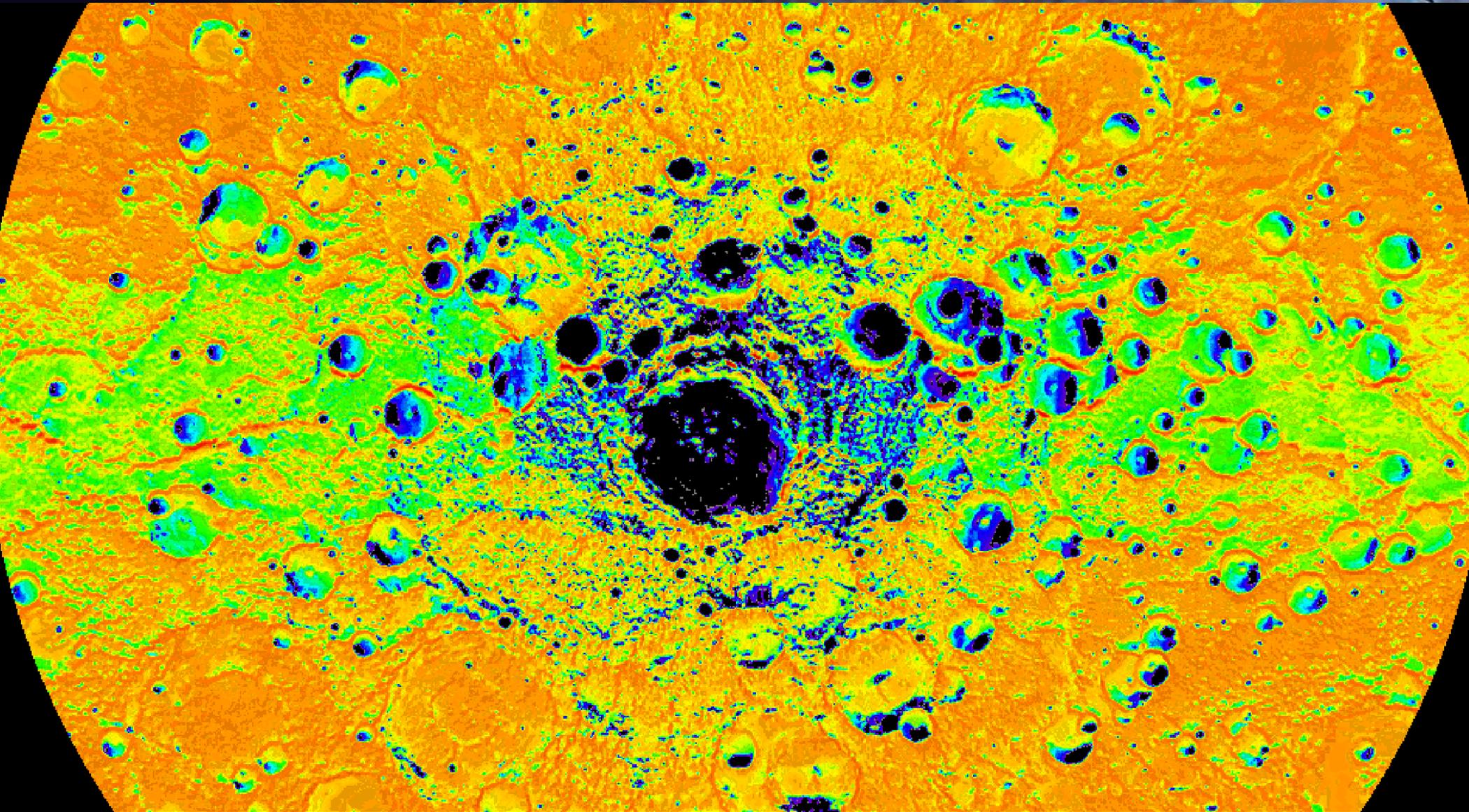




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## Shadowed craters at Mercury's south pole

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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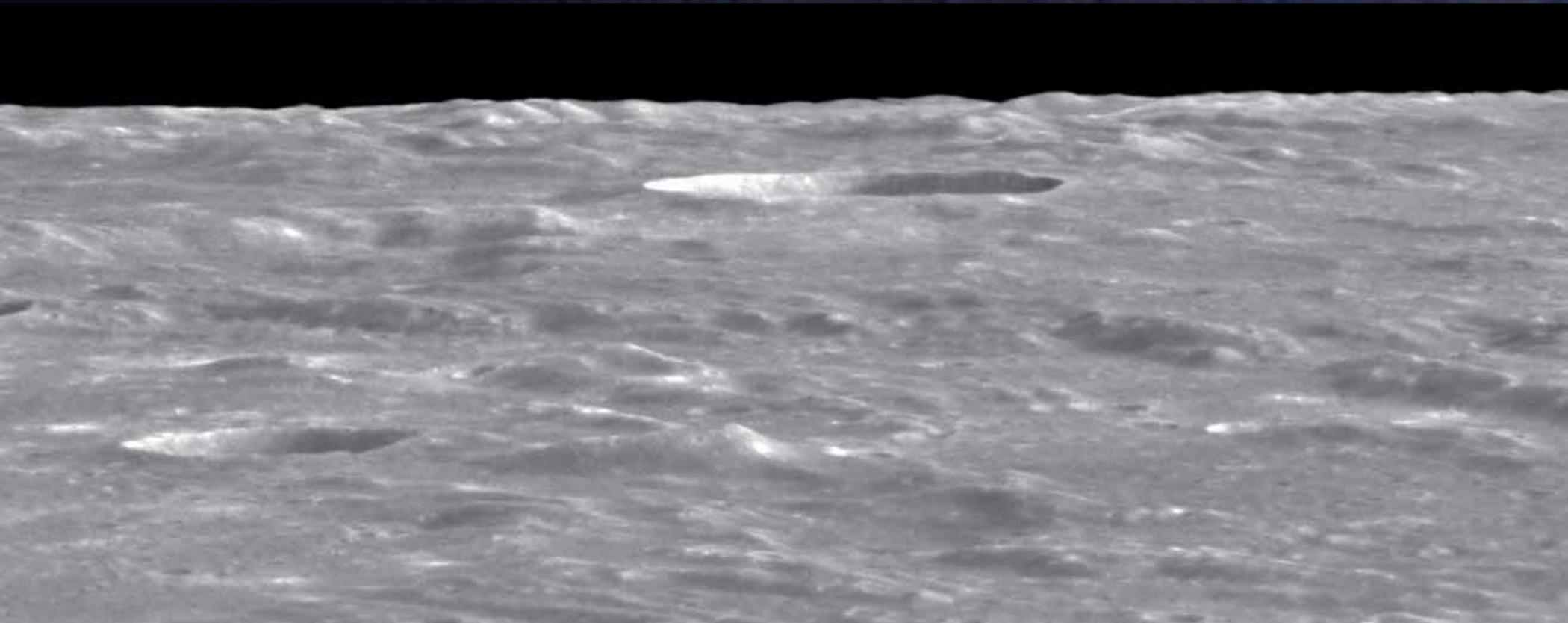
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## Some Personal Favorites

*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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*To date, MESSENGER  
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## Some Personal Favorites

A stark and  
beautiful crescent  
Mercury in black  
and white

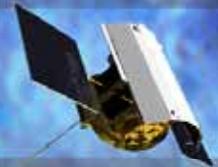
*(Mercury's radius is 2440 km)*



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A NASA Discovery mission to conduct the first orbital study of the innermost planet



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!

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**The Mission**  
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**News Center**  
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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

**Mission Elapsed Time**  
 August 3, 2004

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]

<http://messenger.jhuapl.edu>