Exposing the Secrets of Mercury

Note to editor – Please include actual and accurate images and visualizations of the content below. I have tried to include as many images and links, but you will need to find much more.

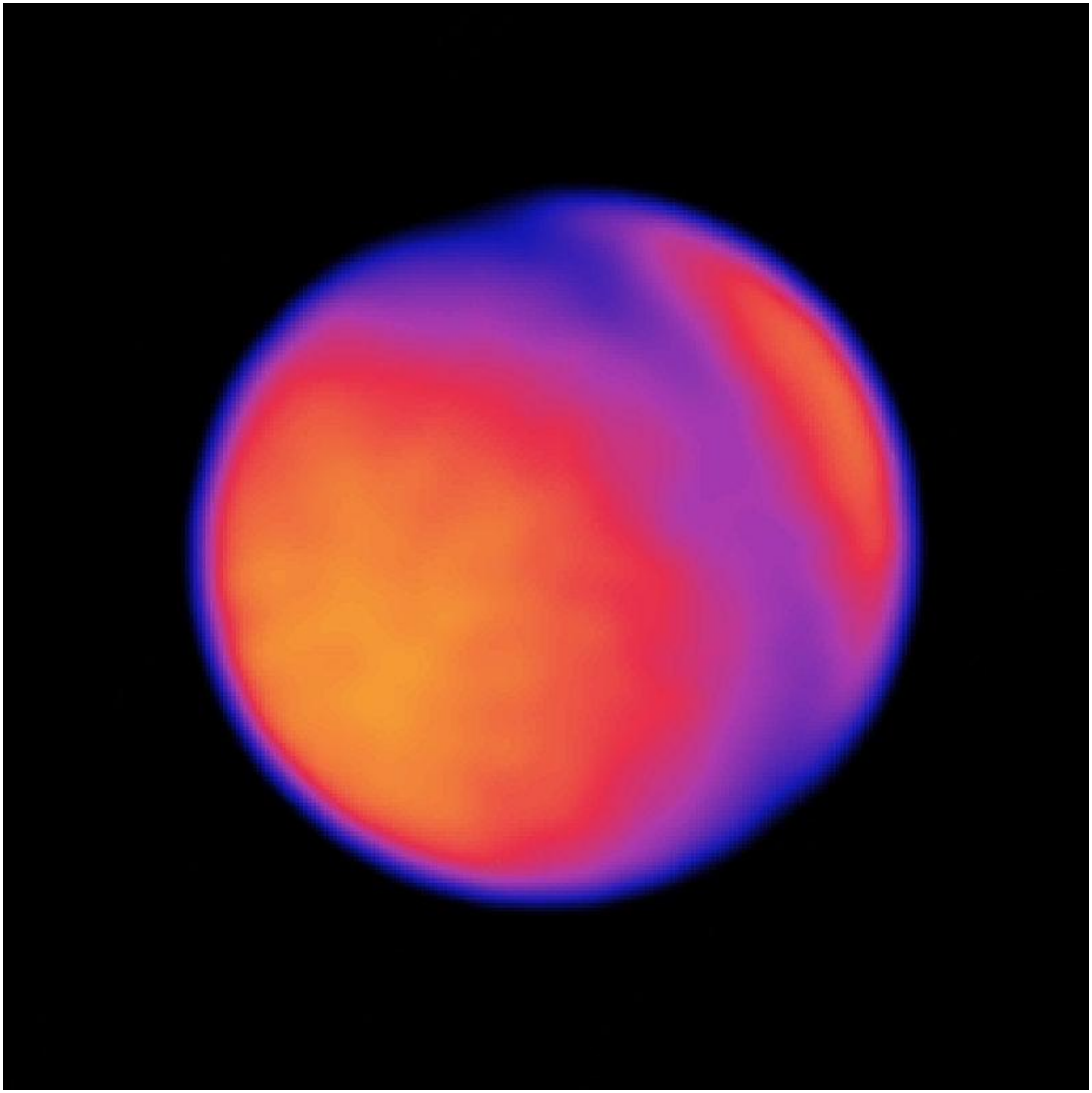
The closest planet to the Sun, Mercury, is named after the roman god of messengers. In Roman mythology, Mercury was known for his pace. His ability to travel distances rapidly was one of his key characteristics. Sporting a helmet and shoes that had wings, Mercury could travel far and wide with great speed. The Romans were notoriously known for taking ideas from the Greeks, which is why Mercury is almost identical to the Greek god Hermes.

The Roman god Mercury.

Mercury, the planet, is similar. Its orbit around the sun takes about 88 days to complete, and the planet travels at a tremendous speed of 29 miles per second, or 47 kilometers per second . Essentially, that's like having 1 birthday every 3

months. A little too many birthdays if you ask me. It doesn't come as a surprise though, Mercury being closest to the Sun, has a smaller revolution than the rest.

However, what's really peculiar about Mercury is its rotation. One day on mercury lasts an agonizing 58 days and 19 hours. With temperatures of 800 °F or 430 °C during the day, that would certainly be agonizing. It isn't any less harrowing during the night with temperatures of as low as -290 °F or -180 °C. Not an ideal vacation destination.



Mercury heat map
CME and planet Mercury from COR2-A - 30.6/1.7.23

Mercury is, however, very underrated when it comes to uniqueness. Not many delve deeper into the planet's intricacies. We've established that it's hot, and it's the closest planet to the Sun, but that's more than what most people talk about. Mercury has its secrets. Unique and profound. Let's dive in deeper to find out what makes this planet so special.

Discovery and Insight

The ancient Sumerians, around 5,000 years ago, possessed knowledge of Mercury. They associated it with Nabu, the deity associated with writing. Mercury was attributed distinct names as both a morning star and an evening star.

Sumerian astronomy

However, Greek astronomers observed that these names referred to the same celestial body. In fact, around 500 B.C., Heraclitus said that Mercury and Venus were in orbit around the sun, which was different from the usual idea that the universe revolved around Earth.

Although it was first observed through telescopes in 1631 by astronomers Galileo Galilei and Thomas Harriot, it is not known when the planet was first discovered. In the same year, Pierre Gassendi looked through a telescope from Earth as Mercury went around the Sun.

Note to editor - Like most other sections, adding visuals of Mariner 10, and MESSENGER 2004, will be crucial in this section. There are also several visuals of their flight paths and orbits that will be crucial to add in this section.

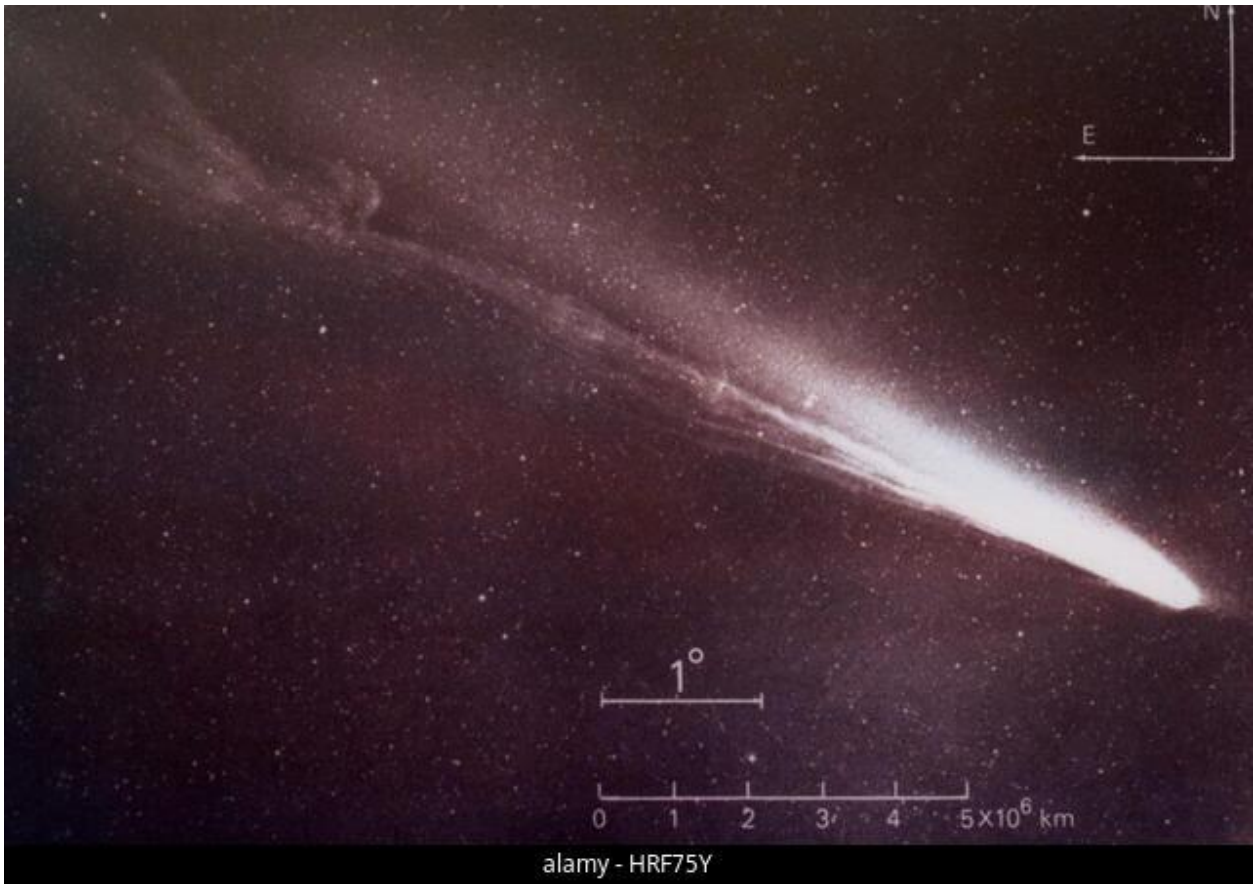
Mariner 10

The Mariner 10 Mission

To this point, Mercury remains the least explored terrestrial planet, with only two NASA spacecraft having ventured there. These robotic missions, commonly referred to as Mariner 10, were initiated in 1973. Mariner 10 holds

various records, including being the first mission to explore two planets, Mercury and Venus, in a single mission. It also utilized a gravity assist from Venus to change its flight path, marking the first time this technique was used. Additionally, the spacecraft employed the solar wind for orientation during its journey.

The primary objective of Mariner 10 was to examine Mercury's atmosphere, surface, and physical attributes. The spacecraft captured remarkable images of Earth and the Moon before reaching its destination. The mission encountered several technical hurdles, including issues with the high-gain antenna and attitude control system. Even though there were problems, Mariner 10 was able to collect scientific information about Comet C/1973 E1 Kohoutek. This was the first time a spacecraft has provided information about a long-lived comet.

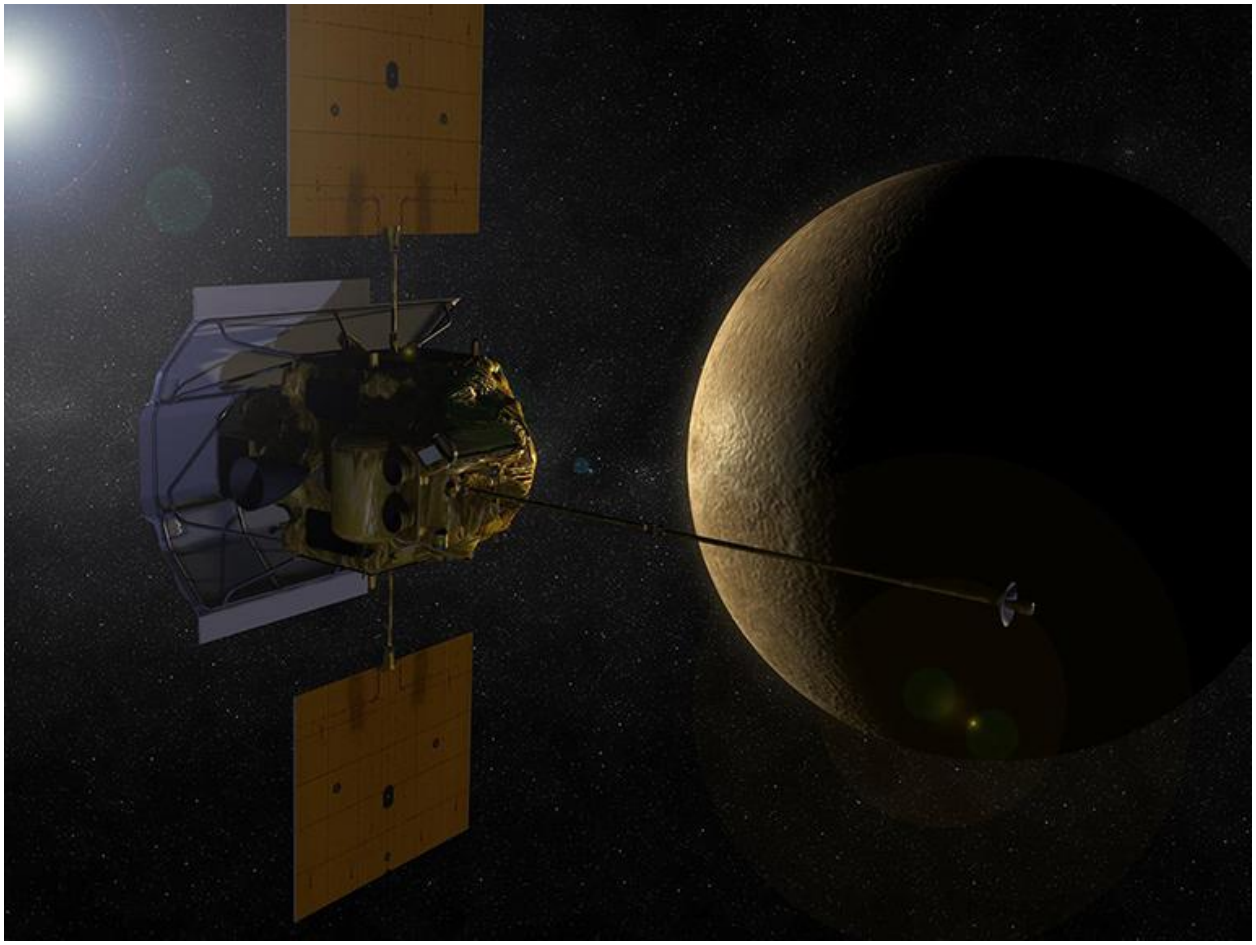


Comet C/1973 E1 Kohoutek

After utilizing the gravitational force of Venus for assistance, Mariner 10 approached Mercury, revealing a surface resembling that of the Moon,

complete with craters, ridges, and a chaotic terrain. The spacecraft's instruments detected a weak magnetic field and observed extreme temperature variations on the planet.

Mariner 10 flew by Mercury three times and took over 2,700 pictures of the planet's surface. The last contact with Mariner 10 took place in March 1975, after it had exhausted its supply of gas for attitude control. The mission was the last robotic probe to visit Mercury for more than three decades, making it a big step in the exploration of the planet.



MESSENGER 2004

Mercury Messenger Mission

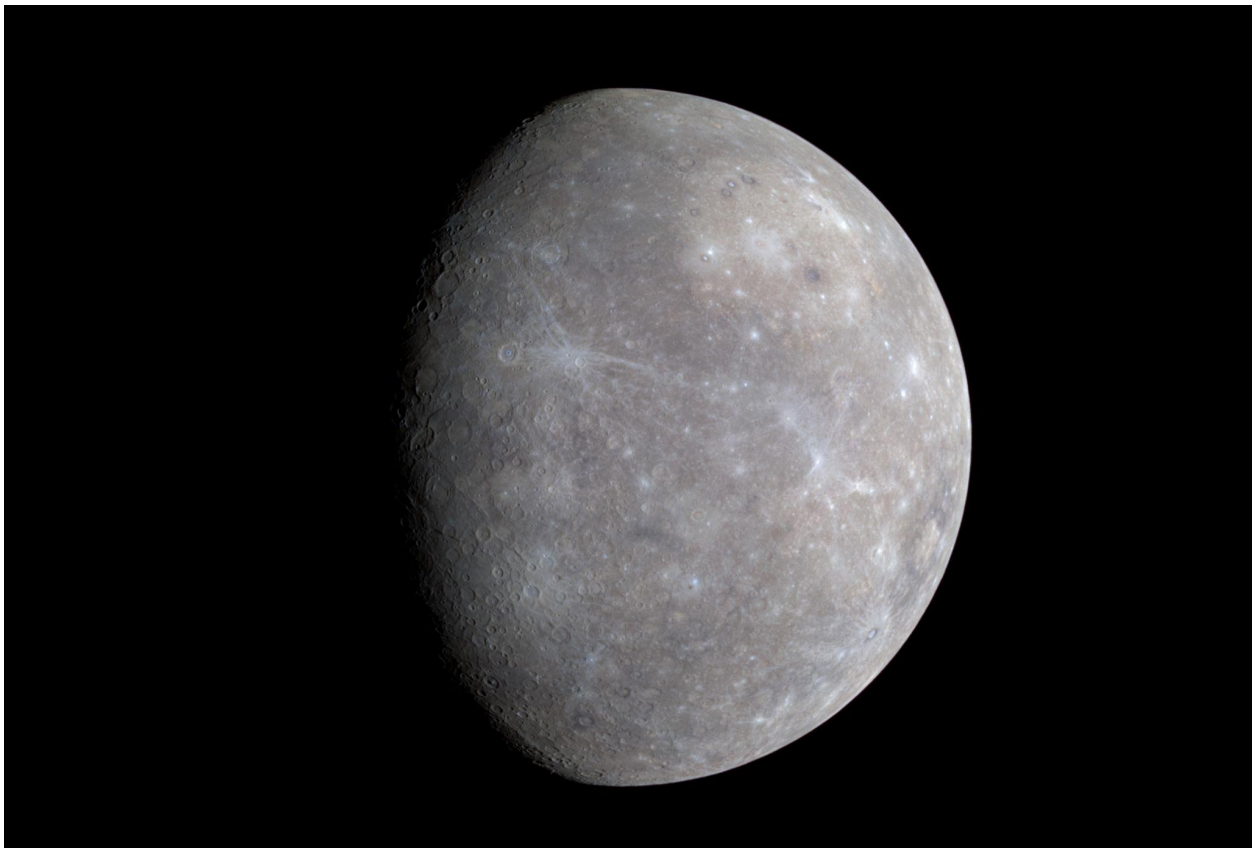
MESSENGER at Mercury

It wasn’t until 2004, when a spacecraft called MESSENGER set out on a new mission to explore Mercury and send us more information about the planet.

2011 saw it reach the planet's orbit, marking the first time a spacecraft has accomplished this feat. Over the course of four years, MESSENGER diligently gathered a vast quantity of data and captured numerous images of Mercury.

The valuable information collected by the probe was then transmitted back to Earth for further analysis by scientists. Unfortunately, in 2015, the mission ended when MESSENGER yielded to the gravitational pull of Mercury, ultimately impacting the planet's surface.

The Basics



Galleries | Mercury – NASA Solar System Exploration

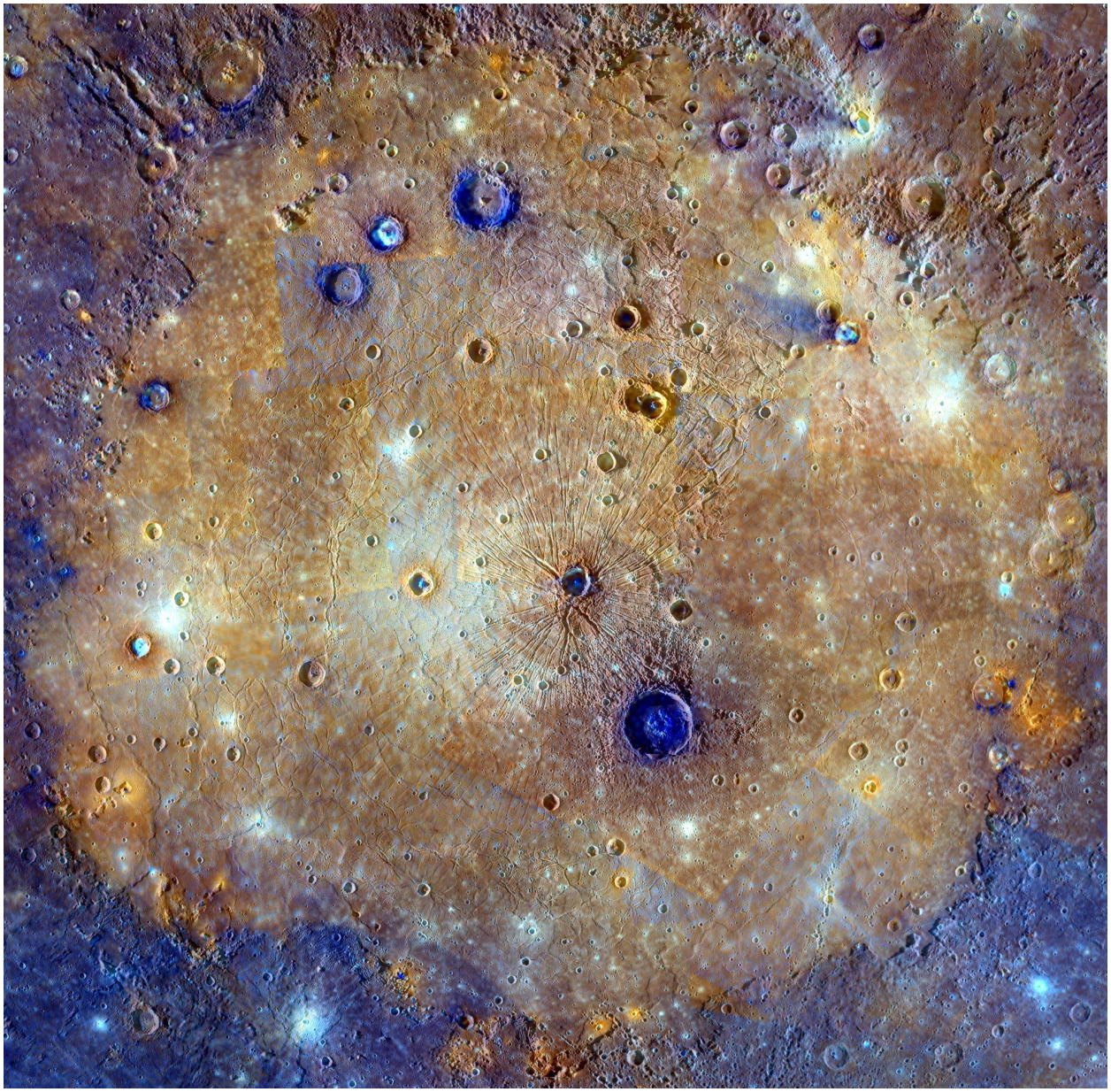
However, through all that data we got to learn a lot more about the special characteristics of it. This planet, which doesn't have any moons, orbits the sun swiftly, earning its name from the Romans, who associated it with their fleet-footed messenger god, like we mentioned earlier.

Note to editor - Adding visualizations of Mercury's core, and outer layer here will be crucial. There are several available. Please consider adding those.

Mercury has a remarkable feature, a colossal metallic core that spans approximately 2,200 to 2,400 miles, or 3,600 to 3,800 kilometers, in width. This makes up about 75% of the planet's diameter. The planet's outer layer, on the other hand, measures between 300 and 400 miles or between 500 and 600 kilometers in thickness. This peculiar combination of a massive core and its composition, rich in volatile elements, has long intrigued scientists.

Note to editor - please consider using an Earth to Mercury comparison here which is available.

Mercury is just a bit larger than Earth's moon, and lacks a significant atmosphere, resulting in a surface covered with craters from countless impacts. Approximately 4 billion years ago, a massive asteroid, approximately 60 miles or 100 km wide, collided with Mercury, scientist prioritize this as a planet changing event.



Caloris Basin

The impact generated a force equivalent to one trillion 1-megaton bombs and resulted in the formation of a vast crater with a width of approximately 960 miles or 1,550 kilometers. It is known as the Caloris Basin, and it is large enough to cover the entire state of Texas. It is also thought that another big impact could have caused the planet to spin the strange way it does, as research from 2011 suggested.

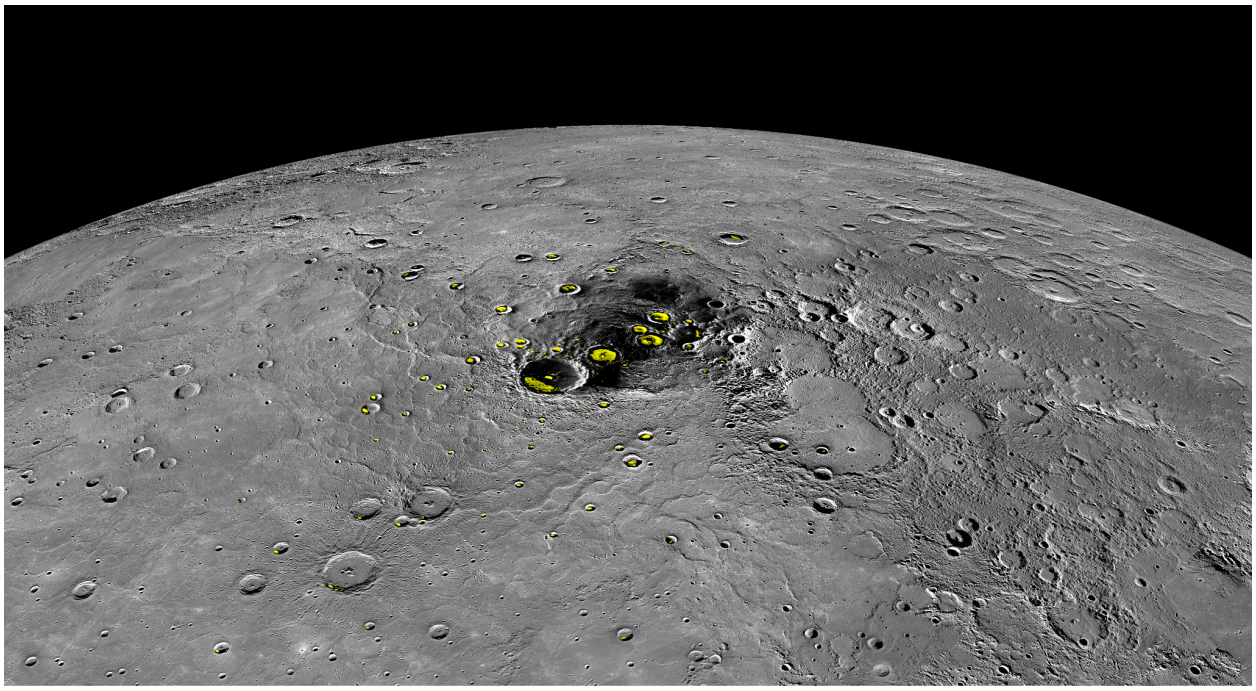
Mercury has very high surface temperatures because it is close to the sun, like I mentioned before. Not a great vacation spot. During the day, the temperature can soar to a scorching 840 degrees Fahrenheit or, 450 degrees Celsius. However, due to the planet's limited atmosphere, which is unable to retain heat, the temperature dramatically drops at night.

It's capable of dipping to minus 275 degrees Fahrenheit or minus 170 degrees Celsius. Again, not a great vacation spot. This incredible temperature swing of over 1,100 degrees Fahrenheit, or 600 degrees Celsius is the greatest among all the planets in our solar system.

Mercury's Surface

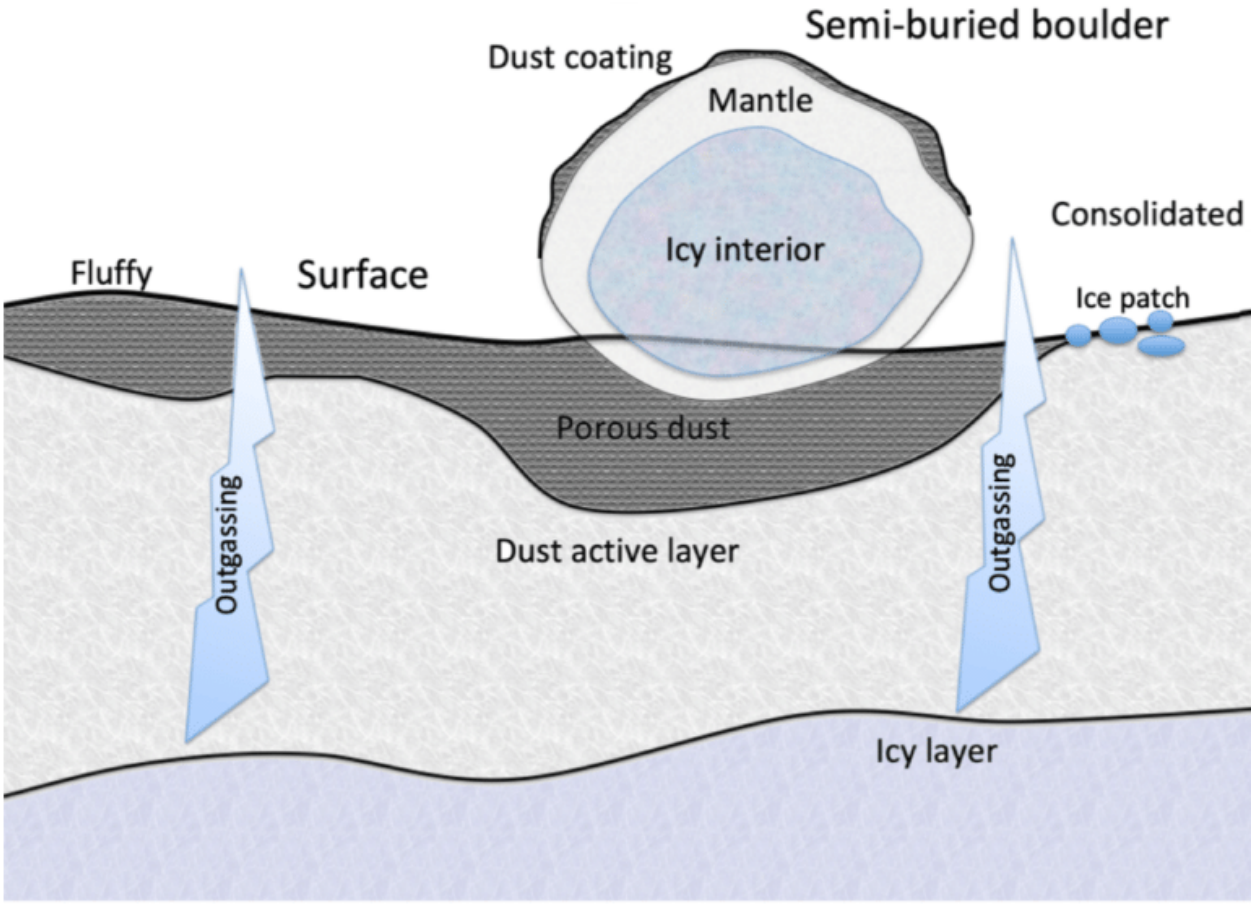
Note to editor - There are numerous visualizations online of Mercury's surface, consider adding those from good sources because adding a random visualization will only contradict the explanation in this section.

The aforementioned, MESSENGER spacecraft from NASA made a significant find on the planet Mercury in 2012. It discovered water ice in the craters situated near the North Pole of the planet, where certain regions may be shielded from the sun's heat and remain permanently shaded.



Ice in the North Pole of mercury

Despite the fact that MESSENGER's orbit did not permit exploration of the southern pole, scientists believe that icy pockets may also exist there. The origin of this ice could be from comets or meteorites delivering it, or water vapor outgassing from within the planet and freezing out at the poles.

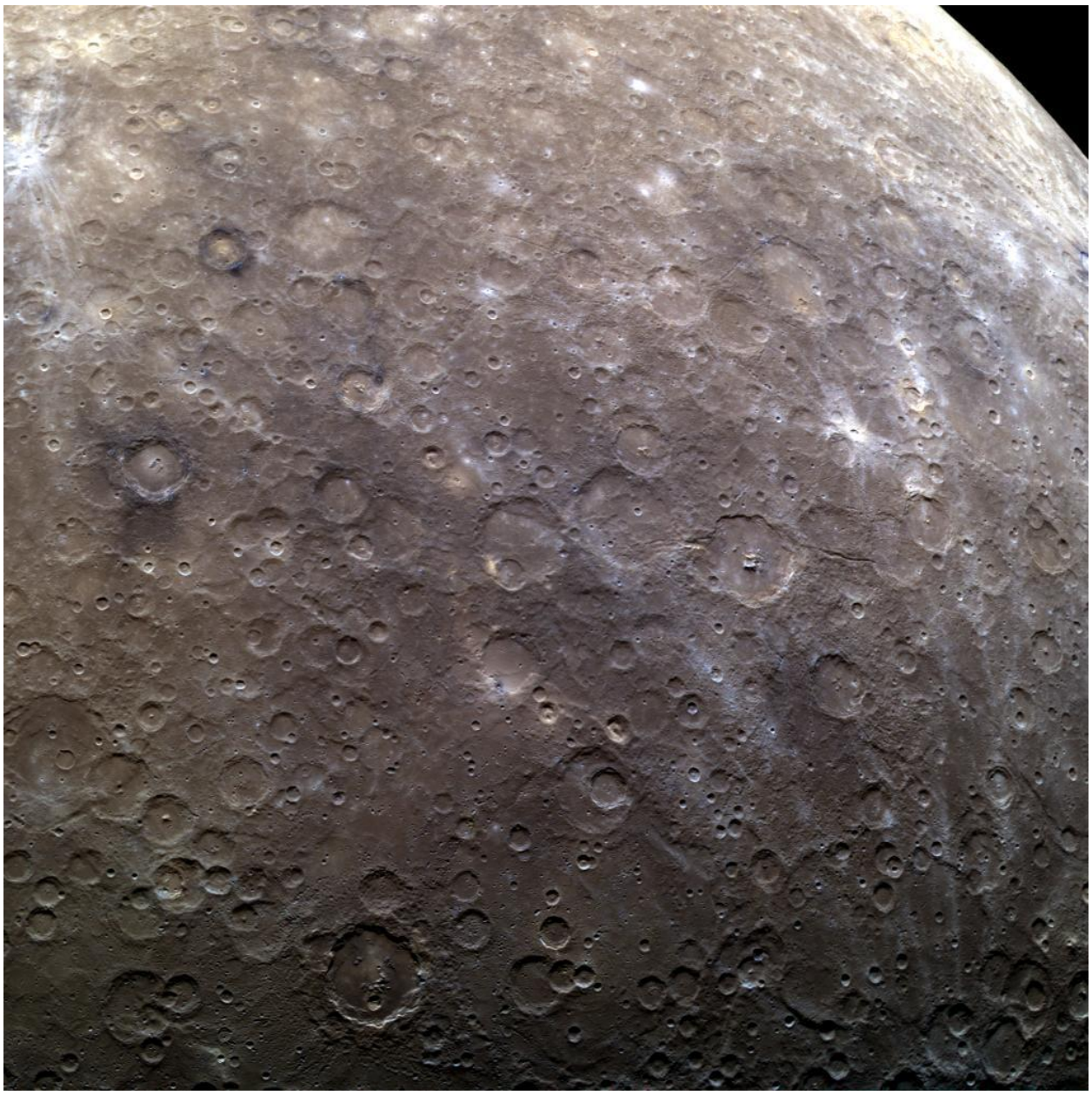


Outgassing

For those of you who are wondering, outgassing is when a gas is released from a material where it was trapped, frozen, or absorbed. It can occur when a substance transforms directly from a solid to a gas called sublimation, when a liquid transforms into a gas which is evaporation, or when a gas is released from a material due to cracks, internal spaces, or chemical reactions.

Despite its small size, Mercury has undergone a process of shrinkage over time, as documented in a report published in 2016. The planet consists of a

single continental plate atop a cooling iron core. As the core cools and solidifies, it results in a decrease in volume, later on leading to the planets' contraction.

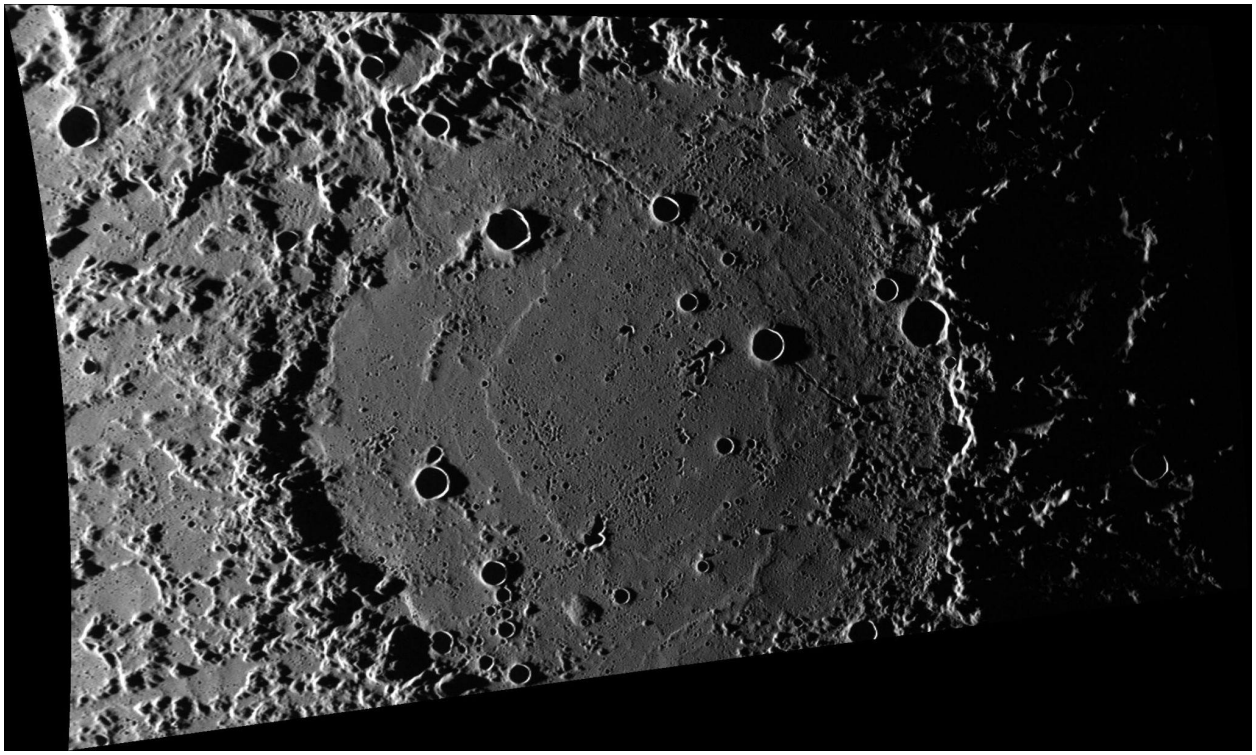


Mercury surface

Some scarps or cliffs on the surface are hundreds of miles in length and rise up to a mile high because of this process. Mercury also has the “Great Valley,” which is bigger than Arizona's Grand Canyon and measures about 620 miles long, 250 miles wide, and two miles deep, or 1,000 by 400 by 3.2 km. These

changes suggest that Mercury is experiencing ongoing tectonic activity, with new faults likely to form as the planet's interior continues to cool and contract.

On Mercury, there are two main types of flat areas called plains. The first type is found between craters, which are gently rolling and hilly plains. These are the oldest surfaces on Mercury and have wiped out many of the smaller craters. The second type is the smooth plains, which are flat areas that fill in depressions. They resemble the flat areas on the Moon called maria. Even though the smooth plains formed later, they have the same appearance as the older inter-crater plains. They are believed to have been created by volcanic activity.

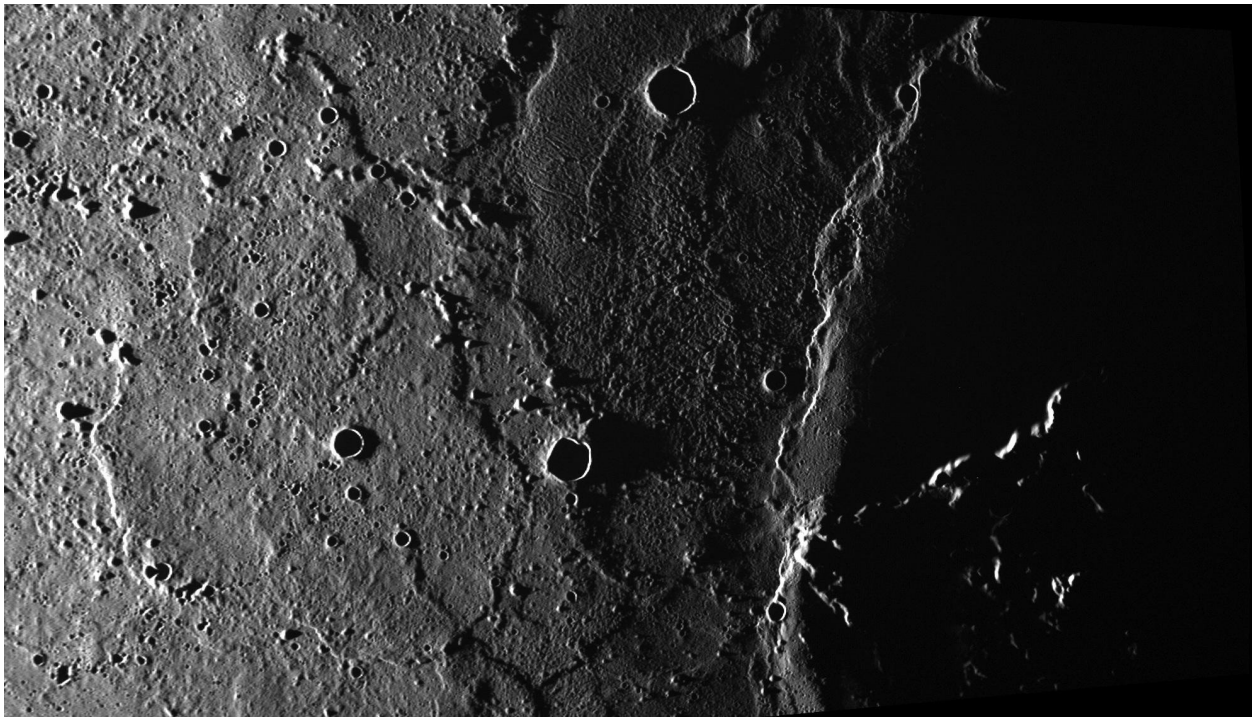


Van Eyck and the Formation | NASA Solar System Exploration

In 2016, scientists discovered that Mercury's surface has two types of features. The first group consists of older material that melted at higher pressures near the core-mantle boundary, while the second group consists of fresher material that grew closer to the surface. Another study from the same year indicated that the dark color of Mercury's surface is because of the presence of carbon.

Interestingly, scientists think that the carbon on the planet is not from comets hitting it, but instead comes from the planet's old crust.

In addition, there is evidence that Mercury has experienced both volcanic activity and earthquakes in the past. However, it is likely that volcano eruptions ceased around 3.5 billion years ago, while the presence of cliffs on the planet's surface indicates the possibility of ongoing 'Mercuryquakes' or earthquakes. These findings provide insight into the dynamic nature of Mercury and its geological evolution.



Odin Planitia | NASA Solar System Exploration

The planet's surface is dotted with evidence of volcanic activity, such as the presence of pyroclastic flows from low-profile shield volcanoes. These flows are volcanic materials that were erupted and flowed across the surface. The presence of impact craters suggests that volcanic activity occurred for a long period of time.

In the southwest rim of the Caloris Basin, there is a complex system of volcanic vents. These vents overlap with each other and look like volcanic craters that were formed by explosive eruptions or collapse due to the withdrawal of

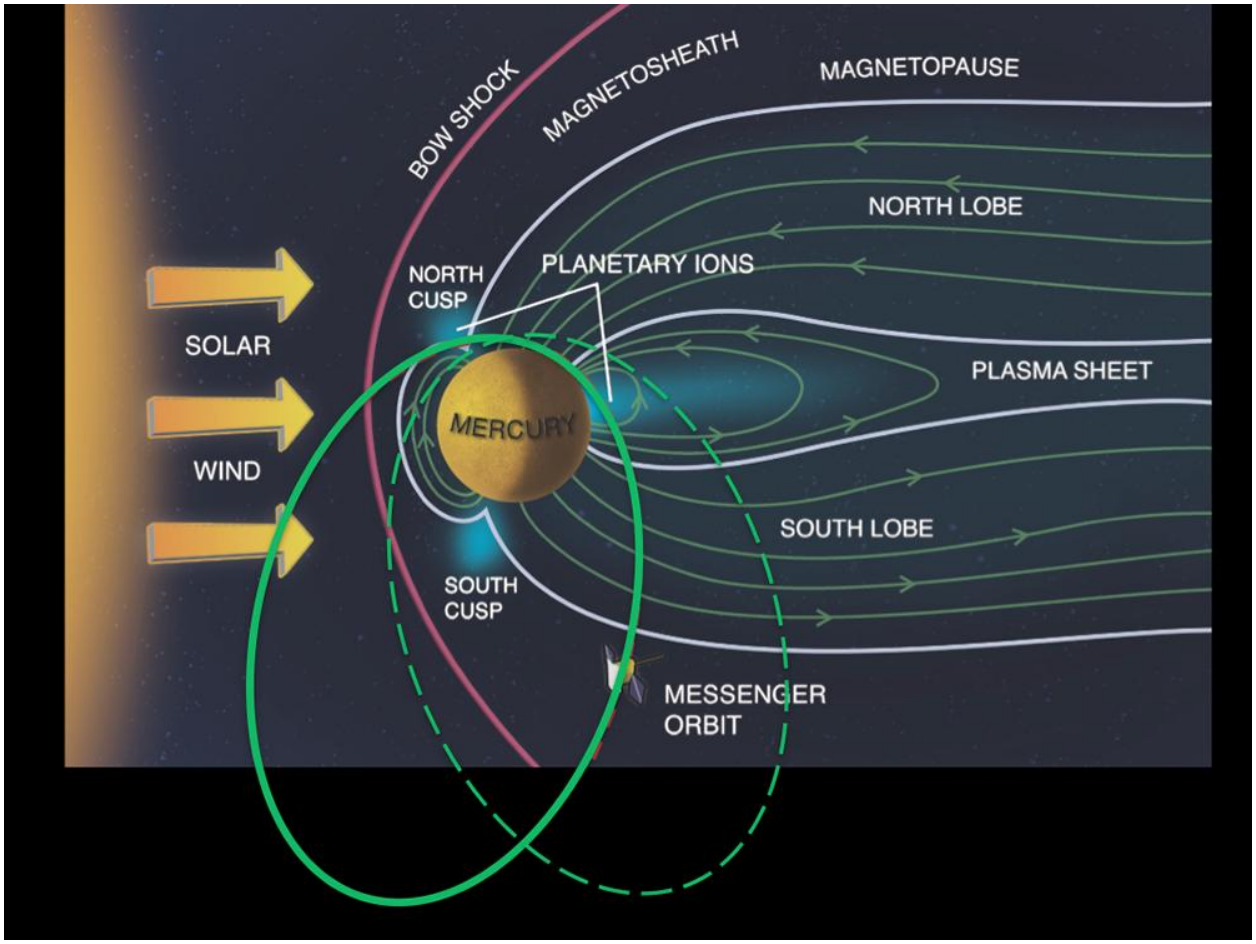
magma. The age of this volcanic system is unknown, but scientist predict that it could be around a billion years old.

Mercury's Incredible Magnetic Field

Note to editor - There are numerous visualizations online of Mercury's magnetic field showing the magnetosheath and magetopause, consider adding those from good sources because adding a random visualization will only contradict the explanation in this section.

On its mission, Mariner 10 found out that Mercury has a magnetic field. This finding was surprising because small planets like Mercury, which rotate slowly and have a cooled-off core, are not thought to have magnetic fields like larger planets do.

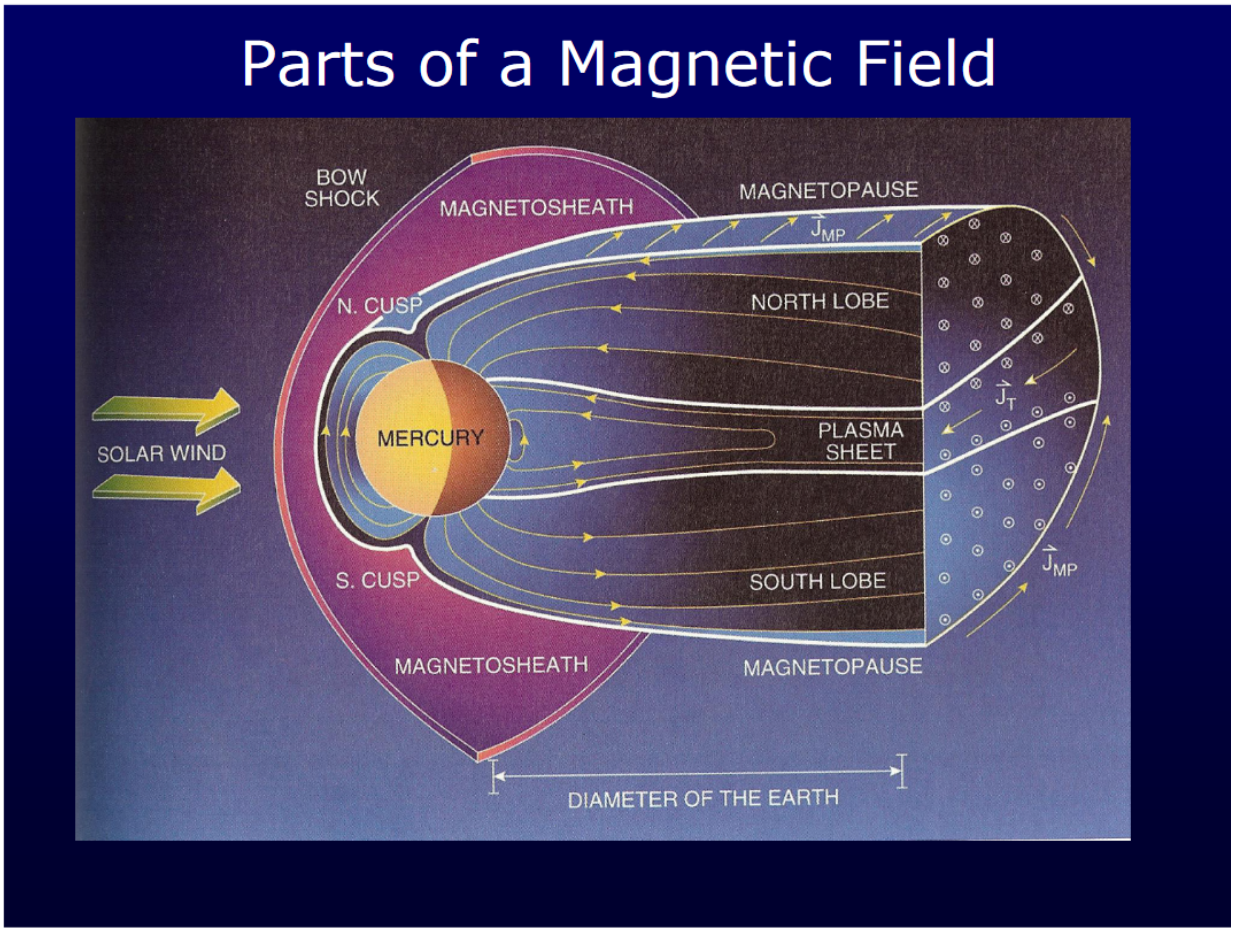
Initially, scientists held the belief that Mercury would exhibit a similar functioning to Earth, given its rocky composition and iron core. However, observations from the MESSENGER spacecraft showed a difference in the strength of Mercury's magnetic field between its northern and southern hemispheres.



Researchers came up with a theory to explain this, claiming that Mercury's iron core may be undergoing a transition from liquid to solid state at its outer boundary, rather than internally.

This unique behavior is compared to a snowstorm, where the snow, forms both at the top and middle of the cloud as well as at the bottom. In Mercury's case, the iron forms both at the top and middle of the core as well as at the bottom. The study of Mercury's magnetic field suggests that iron is "snowing" throughout the fluid that generates the planet's magnetic field.

The 2007 discovery that Mercury's core may still be molten helps shed light on its magnetism. Additionally, the solar wind, which is made up of charged particles from the Sun, plays a role in influencing and possibly dampening Mercury's magnetic field.



Although Mercury's magnetic field is much weaker than Earth's, it is still very active. The interactions between Mercury's magnetic field and the solar wind result in potent magnetic tornadoes that propel the swift and hot plasma from the solar wind towards the planet's surface.

Mercury's magnetic field has scientists scratching their heads. Despite the fact that Mercury's magnetic field is only 1% as strong as that of Earth, it has the ability to cause considerable disturbance on the planet's surface in the form of magnetic tornadoes. NASA explains that when Mercury's magnetic field interacts with the solar wind, it may occasionally produce magnetic tornadoes.

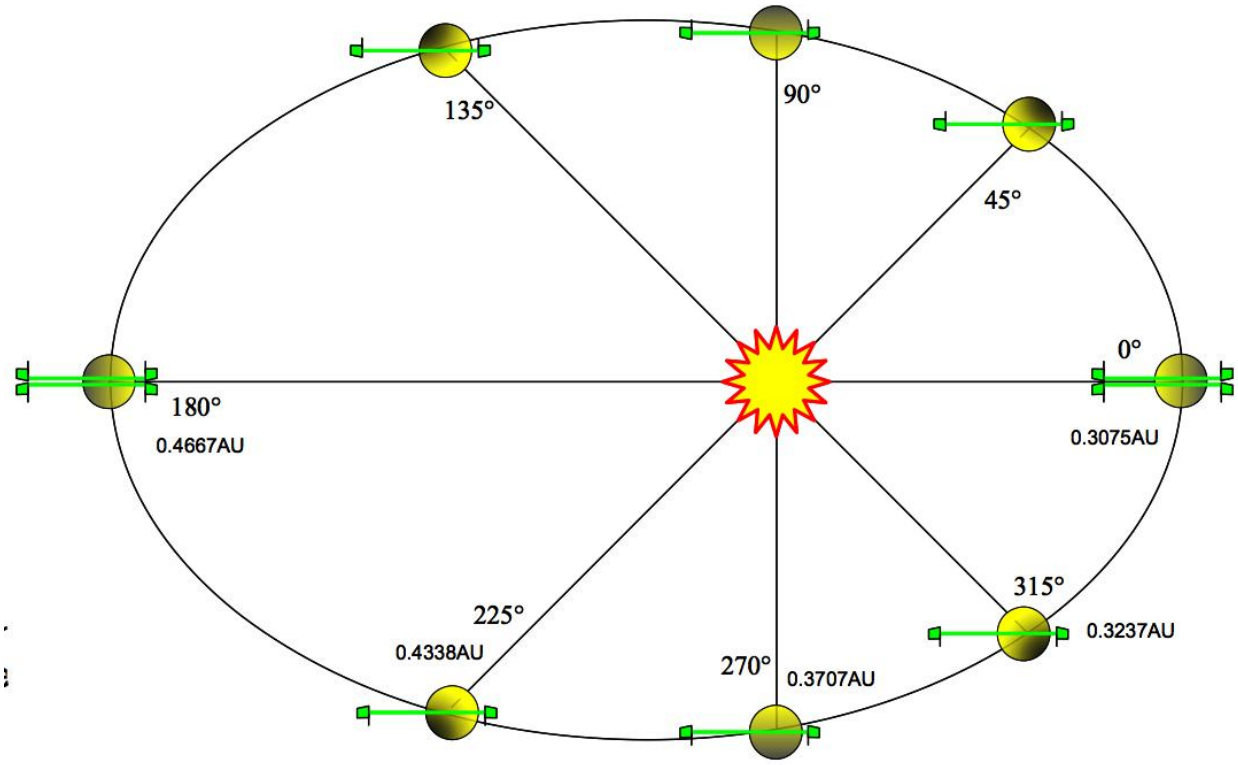
These tornadoes serve as conduits, directing the swift and hot plasma emanating from the solar wind towards the surface of the compact planet. The solar wind hits Mercury's surface and disturbs the atoms that are not charged. This causes loops to fly high up into Mercury's atmosphere. These magnetic tornadoes add to the mystery of Mercury's magnetic field.

Mercury's Orbit

Note to editor - Once again, there are numerous visualizations online of Mercury's orbit and diagrams of the way it circles the sun, consider adding those from good sources because adding a random visualization will only contradict the explanation in this section.

We've mentioned Mercury's orbit briefly before, but that doesn't stop it from being as intriguing as ever. Mercury goes around the sun every 88 Earth days and travels at a really fast speed of almost 112,000 miles per hour or 180,000 kilometers per hour. This makes it the fastest planet in our solar system.

Its orbit is shaped like an oval, highly elliptical, with the closest point to the sun at about 29 million miles or 47 million km, and the farthest point at approximately 43 million miles or 70 million km. If you stood on Mercury when it's closest to the sun, it would look over three times bigger than it does from Earth.



[Mercury Planetary Orbiter (MPO) - BepiColombo]

Mercury's Spin-Orbit Resonance (Animation)

Because of its orbit and slow rotation of about 59 Earth-days, a day on Mercury seems strange when seen from its surface. The sun rises, sets briefly, and then rises again before gliding across the sky in the west. Similarly, during sunset, the sun appears to set, briefly rise, and then set again.

In 2016, there was a rare event known as the transit of Mercury, where the planet crossed in front of the sun as seen from Earth. This occurrence provided valuable insights into Mercury's thin atmosphere, contributed to the search for exoplanets, and helped NASA refine its instruments.

Due to the fact that Mercury orbits the sun in a mere 88 Earth-days, whereas Earth takes 365 days, there are instances, approximately three to four times a year, when Mercury overtakes Earth. This creates an optical illusion, making Mercury seem to move “backward” across the sky for approximately three weeks, a phenomenon referred to as “Mercury in retrograde.”

Astrologers believe that Mercury in retrograde is a time of misfortune and miscommunication, as the perceived backward motion interferes with the planets' rules.

Glowing Tails

Mercury sodium tail movie - YouTube
Mercury's Sodium Tail | Science Mission Directorate.

Scientists have made another interesting discovery about Mercury, which is that it has tails similar to those of comets. Astrophotographers on Earth have captured these intriguing streaks in long-exposure photographs. The tails are thought to develop when sodium atoms in Mercury's outer atmosphere get excited by sunlight and begin to glow. Sunlight also has the ability to release these molecules from Mercury's surface and propel them into space.

In particular, the yellow glow from sodium is quite bright. A recent image captured in late May 2020, from Italy, utilizing a filter that primarily transmits yellow light emitted by sodium, depicts Mercury along with its sodium tail. The existence of Mercury's tail was predicted in the 1980s, and it was first observed in 2001. The details of these tails were also provided by the MESSENGER spacecraft, which orbited Mercury from 2011 to 2015.

Mercury is special. These were just a few of the numerous unique characteristics of the small planet, and the best part is, we've just hit the tip of

the iceberg. BepiColumbo captured its first views of Mercury during a gravity assist flyby in 2021. The spacecraft is scheduled to arrive at Mercury in late 2025 and gather data during its one-year nominal mission, with the possibility of an additional year. We're bound to know much more about the planet with further observations. Who knows what other secret's Mercury could be hiding.

What secret were you most fascinated with? Let us know in the comments below, and as always, thanks for watching.

Sources -

10 strange Mercury facts | Space

Mercury's Sodium Tail | Science Mission Directorate.

Mercury: Facts about the closest planet to the sun | Space

Overview | Mercury – NASA Solar System Exploration

What Is the Planet Mercury? | NASA

In Depth | Mercury

Planet Mercury | Natural History Museum

Mercury – NASA Solar System Exploration

Mercury (planet) - Wikipedia

In Depth | Mariner 10

What They Didn't Teach You at School about Planet Mercury | NASA's ME...

The First Real Images Of Mercury - What We Found?