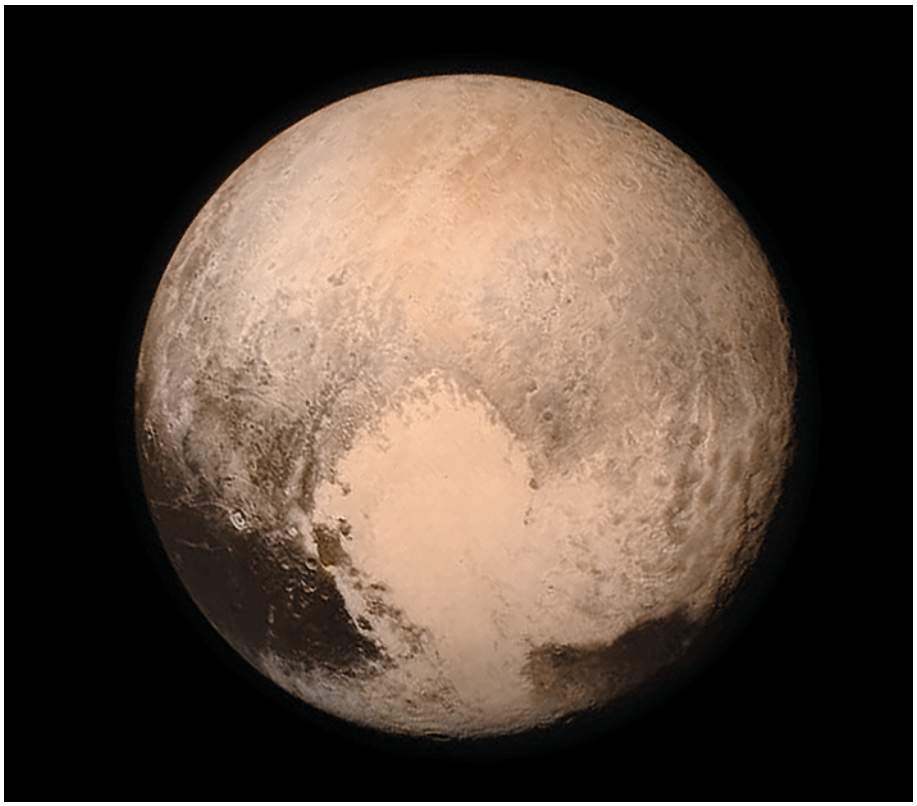
NEWS IN FOCUS



NASA/JHUAPL/SWRI

Pluto's surface, including its distinctive heart, is covered by several different types of ice.

PLANETARY SCIENCE

Vibrant Pluto seen in historic fly-by

Entranced scientists find a world made anew.

BY ALEXANDRA WITZE

They are 5 billion kilometres from the Sun in the dim, far-flung outskirts of the Solar System, but Pluto and its large moon Charon turn out to be astonishingly vital worlds.

Images from NASA's New Horizons spacecraft, which flew within 12,500 kilometres of Pluto on 14 July, reveal frosty plains, soaring mountains and much more geological activity than anyone anticipated. "What's unexpected to me is how dynamic a world both Pluto and Charon are," says Mark Sykes, director of the Planetary Science Institute in Tucson, Arizona. "Who would have expected to see such young surfaces? They are absolutely spectacular and fascinating."

Giant icy mountains in Pluto's southern hemisphere tower more than 3,500 metres high in the first high-resolution images that New Horizons sent back. The peaks' sheer height signals that they are made of water ice, the only material that could buttress such huge ridges at Pluto's frigid temperatures of less than −223 °C, just 50 °C above absolute zero. Bright rims near the tops of the peaks — named after Nepalese explorer Tenzing Norgay — could represent a fresh coat of frozen nitrogen or other types of ice.

Nearly every feature coming into view is shaped by ice in some fashion. Planetary scientists already knew from ground-based observations that Pluto had nitrogen, methane and carbon monoxide ice on its surface. The images are now beginning to reveal just where those frosts lie, and how they behave.

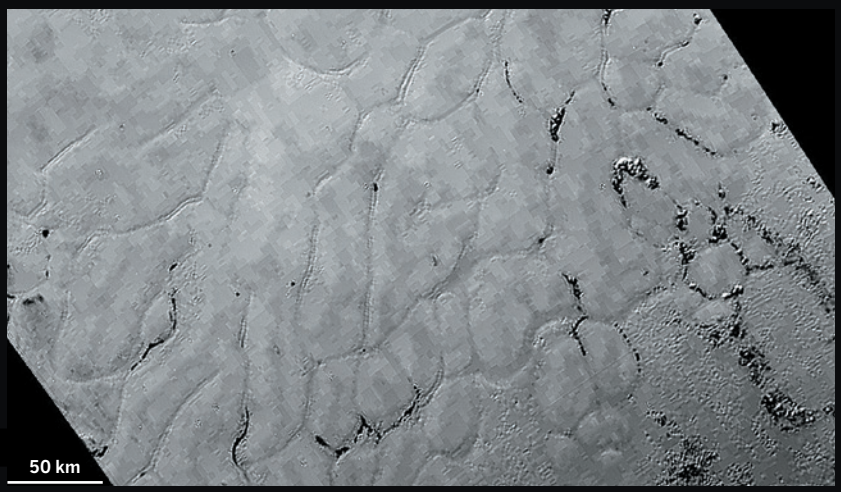
A bright, heart-shaped feature, informally dubbed Tombaugh Regio after Pluto discoverer Clyde Tombaugh, displays a concentration of carbon monoxide ice. Charon's dark-reddish polar cap is probably coloured by ultraviolet radiation that bombards the moon's surface, transforming ices into complex organic compounds.

There are relatively few impact craters on Pluto and Charon. Other Solar System bodies, such as Earth's Moon, are scarred by billions of years of meteorites slamming into their surfaces. Pluto seems to have some craters, but not nearly as many as expected. Charon looks a little more battered, but still has surprisingly few craters.

Some planetary scientists have interpreted this lack of craters to mean that the surfaces are incredibly young, geologically speaking. Frosty plains that sprawl near Pluto's mountain ranges could be just 100 million years old — a fraction of the dwarf planet's multibillion-year lifetime, says Jeffrey Moore, a planetary scientist at NASA's Ames Research Center in Moffett Field, California, who heads New Horizons' geology team.

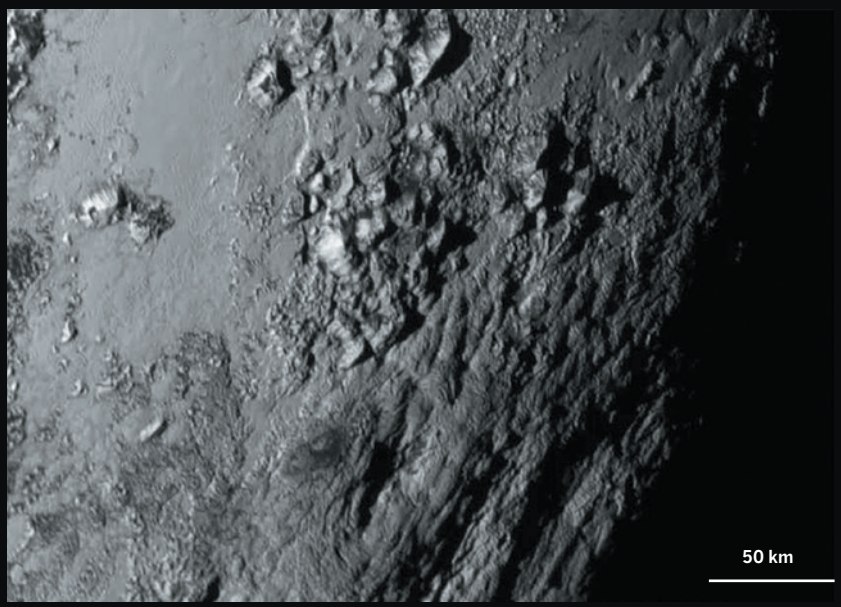
But researchers have yet to work out exactly how often objects would have hit Pluto and Charon throughout their history. Unlike the inner Solar System (near Earth, the Moon and Mars), the outer Solar System tends to be sparsely populated, with more space between the objects that fly around. "We need to understand the impact rate," says team member Veronica Bray, a planetary geologist at the University of Arizona in Tucson.

Scientists are also struck by the sharp boundary between dark, cratered terrain and the brightness of Tombaugh Regio. "Pluto is a real place, with incredibly complex ▶



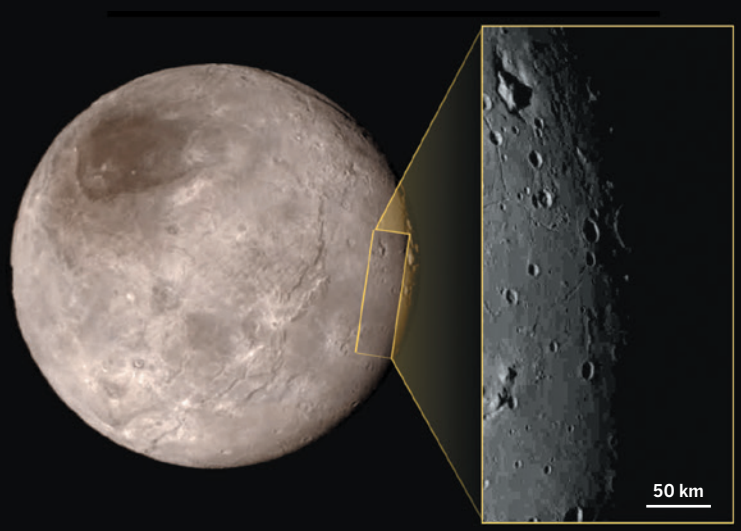
A plain on Pluto — tentatively named Sputnik Planum — is surprisingly smooth.

NASA/JHUAPL/SWRI



Mountains at the edge of Pluto's 'heart' resemble Earth's Rocky Mountains — but are made of ice.

NASA/JHUAPL/SWRI



A peak that sits in a depression on Pluto's moon Charon has puzzled scientists.

NASA/JHUAPL/SWRI

geology," says Ellen Stofan, NASA's chief scientist. "It is beautiful and it is strange."

Researchers are equally intrigued by Pluto's largest moon, Charon, which has a dark polar cap — dubbed Mordor — as well as chasms that are as much as 9 kilometres deep. Those canyons may have formed as an ancient buried ocean froze and pushed Charon's surface outwards, says Francis Nimmo, a team member and planetary scientist at the University of California, Santa Cruz. "The fact that Charon shows these deep canyons is consistent with there having been an ancient ocean that froze," he says.

"I knew it was going to be cool. I just didn't know it was going to be this cool."

Pluto itself may have a buried ocean even today, kept liquid by the warmth of radioactive elements trapped inside the dwarf planet's core. Other icy bodies in the outer Solar System — such as Saturn's moon Enceladus, which sports active geysers — are warmed by the tidal pull of a nearby gas-giant planet. Pluto — measured by New Horizons to be 2,370 kilometres across — has no such neighbour. It is warmed only by its own internal heat.

New Horizons collected nearly all of its most precious observations in a 24-hour window as it whizzed past Pluto, and those data will trickle back to Earth over the next 16 months. Early findings include the fact that Pluto does not have any other satellites apart from its five known moons — at least nothing larger than about 1.5 kilometres across. And instruments aboard the craft measured nitrogen ions escaping from Pluto's atmosphere much farther away from the dwarf planet than expected. That suggests that Pluto has a more tenuous hold on its atmosphere than scientists had thought, says team member Fran Bagenal, a space physicist at the University of Colorado Boulder. As Pluto's atmosphere drifts away, some of it may sweep past Charon, get captured and condense into the dark polar cap seen there.

The US$720-million spacecraft is already millions of kilometres on the other side of Pluto, sailing out into deep space. One of the team's next major tasks will be to decide, by August, which of two other objects to fly past in the coming years if NASA grants a mission extension. In November, mission engineers will briefly ignite the spacecraft's engines to deflect it onto a course towards the chosen target.

One of the candidates is easier to reach but potentially not as interesting; the other requires more fuel but is more intriguing because it is brighter and thus probably larger.

For now, Pluto and Charon are keeping scientists busy.

"I knew it was going to be cool," says team member Kelsi Singer, a planetary scientist at the Southwest Research Institute in Boulder. "I just didn't know it was going to be this cool." ■