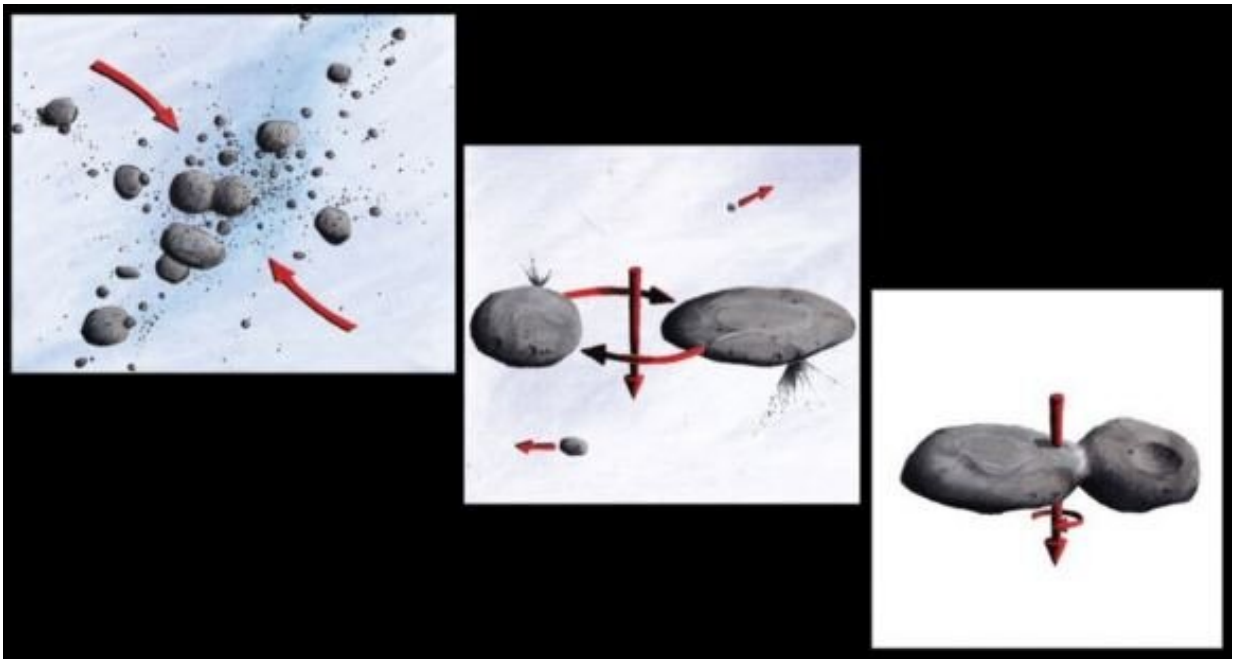
Pluto team updates science from the solar system's edge

March 15 2023, by Alan Boyle



This graphic shows how mounds of material could have come together to create Arrokoth. Credit: James Tuttle Keane / JPL / Caltech

Nearly eight years after its historic Pluto flyby, NASA's New Horizons probe is getting ready for another round of observations made from the icy edge of the solar system—and this time, its field of view will range from Uranus and Neptune to the cosmic background far beyond our galaxy.

Scientists on the New Horizons team shared their latest discoveries, and provided a preview of what's ahead, during this week's Lunar and Planetary Science Conference in The Woodlands, Texas.

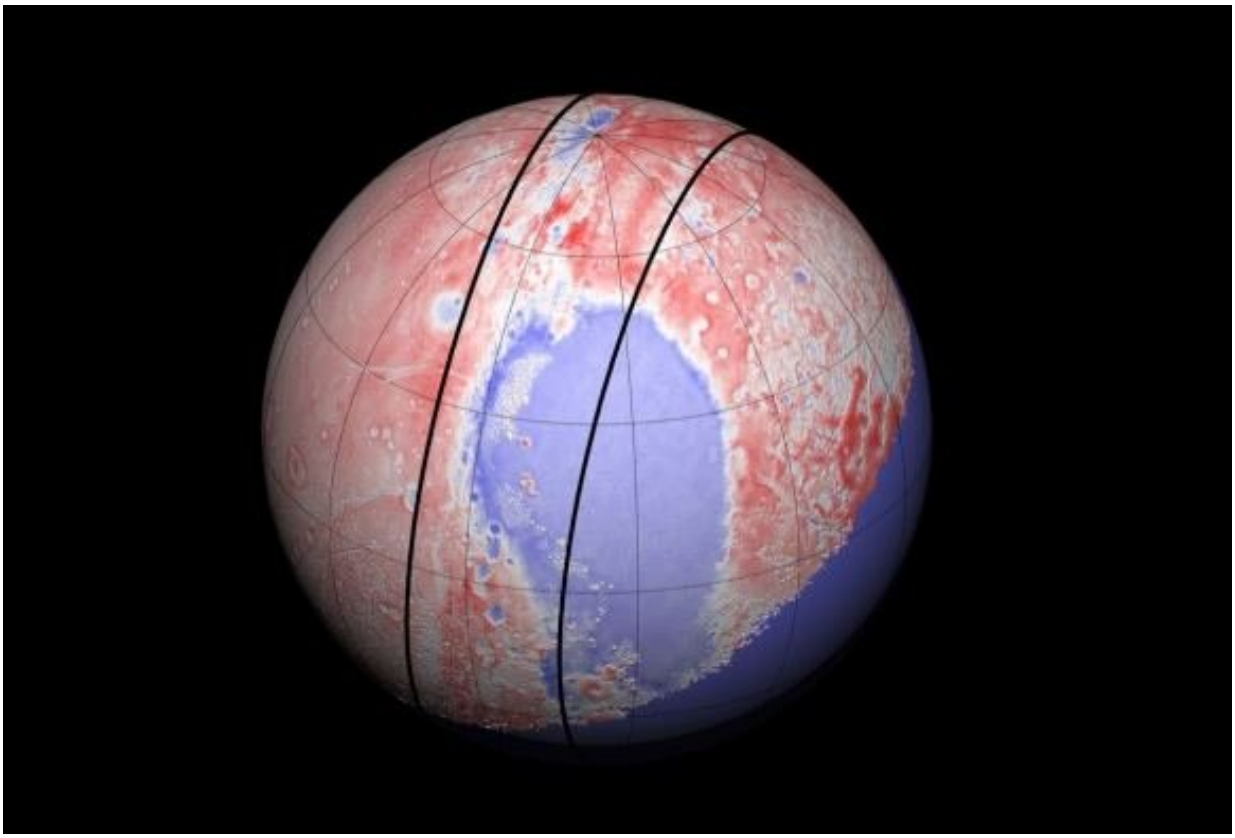
It's been 17 years since the piano-sized New Horizons spacecraft was launched toward Pluto and the Kuiper Belt, The primary mission hit its peak in 2015 when the probe zoomed past Pluto, but the adventure moved on to a second act that focused on a smaller, two-lobed object called Arrokoth—a name derived from the Powhatan/Algonquin word for "sky."

Arrokoth's origins

Alan Stern, a planetary scientist at the Southwest Research Institute who serves as the mission's principal investigator, said that close study of Arrokoth's structure has yielded fresh insights about the early days of the solar system.

"Because this object is orbiting so far from the sun, it's always been in a deep freeze," Stern explained. "The ultraviolet radiation out there is much lower than in the inner solar system, and so are the collisional rates. And so, like its brethren across the Kuiper Belt, Arrokoth is very primitive, very unevolved in that deep freeze over all these billions of years."

Stern and his colleagues noted that Arrokoth seemed to have been built up from smaller mounds of icy material, as if a bunch of snowballs were stuck together to form a larger whole.



A false-color image shows the boundaries of Pluto's ridge-trough system. Credit: James Tuttle Keane (JPL / Caltech) / NASA / JHUAPL / SwRI

"The individual lobes have similar properties … which is a clue to their origin, which we believe is telling us something very important about the formation of Arrokoth," Stern said. "And it's this, namely, that as the cloud of material that came to make Arrokoth was collapsing … that cloud apparently produced like-sized objects, those mounds, which came together to form the larger lobe."

Stern said the new findings about the mounds' characteristics are "a very important clue to how these planetesimals form across the outer solar system, maybe even in the inner solar system." Further computer

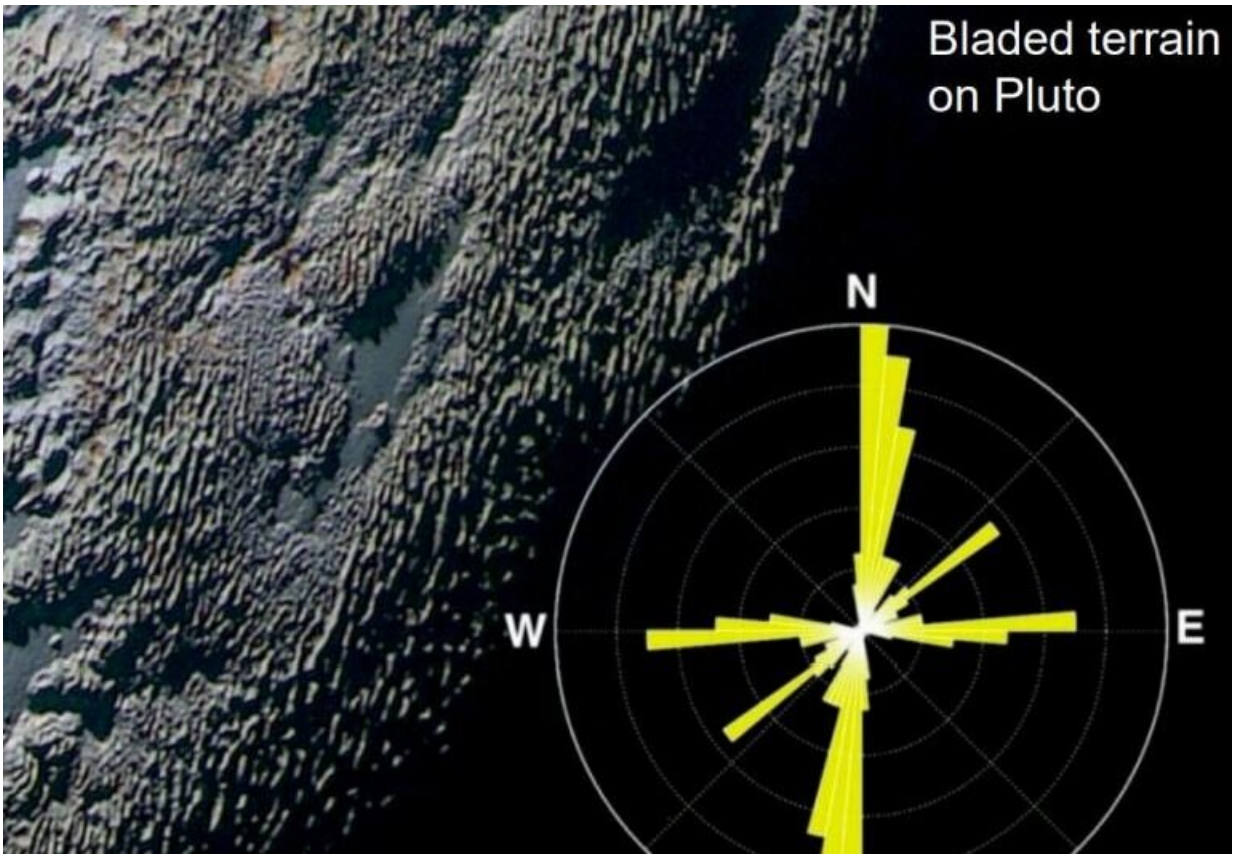
modeling could help scientists understand why the mounds are so similar to each other, and add new details to their picture of planetary formation.

Pluto's wandering poles

Planetary scientists say that Pluto's axis of rotation took on a substantial tilt early in its history, and that caused a shift in the latitudes and longitudes of surface features. "Pluto essentially flipped on its side," said Oliver White, a New Horizons co-investigator from the SETI Institute. "The locations of the rotational axes moved hundreds if not thousands of miles—if you imagine, like San Francisco moving to New York on Earth. It's an extremely important event. But there is a lot we still don't know about true polar wander on Pluto."

The New Horizons team analyzed the distribution of mass on Pluto—and determined that the formation of Sputnik Planitia, a sea of frozen nitrogen that forms part of the dwarf planet's distinctive heart-shaped feature, probably played a key role in the polar flip.

White pointed to an ancient system of ridges and troughs that might have been Pluto's original equator before true polar wander occurred. "We're seeing signs of ancient landscapes that formed in places and in ways we can't really explain in Pluto's current orientation," he said in a news release. "We suggest the possibility is that they formed when Pluto was oriented differently in its early history, and were then moved to their current location by true polar wander."



Upper image shows Pluto's bladed terrain. Lower image shows features known as penitentes. Credit: Moores et al, *Nature*, 2017

Blades of ice

Ishan Mishra, a science team contributor from NASA's Jet Propulsion Laboratory, concentrated on a swath of jagged landforms made almost entirely of methane ice, at the edge of the hemisphere visible to New Horizons at the time of closest approach.

"This is very reminiscent of 'penitente' on Earth … in the Atacama Desert in Chile, which are these landforms that are formed from sublimation of water-ice deposits," he said. "On Earth, these are about a

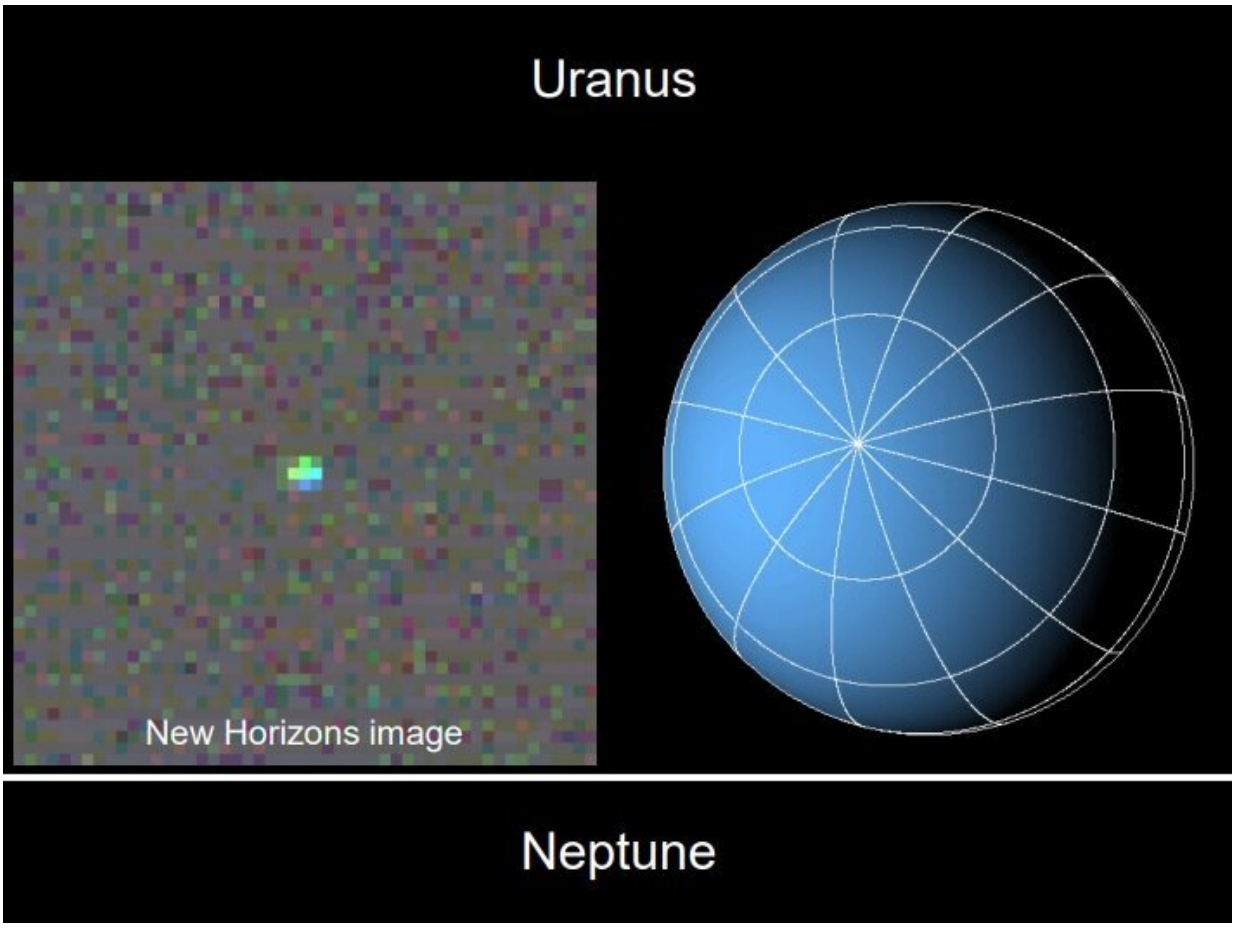
few meters tall, but on Pluto, these are hundreds of meters tall and form from methane deposits."

Mishra and his colleagues found that the properties associated with the bladed terrain imaged in detail by New Horizons during closest approach—for example, methane absorption and surface roughness—were also present in wider areas on Pluto's "far side."

"It seems like bladed terrain might be one of the most common landforms on Pluto," Mishra said.

Coming attractions

In the months and years ahead, New Horizons' science team plans to look back at Uranus and Neptune—and look ahead into the wide expanse beyond our solar system and our Milky Way galaxy. "We've got a lot of interesting observations coming up soon, starting in August, and they extend into astrophysics and heliophysics as well as planetary science," said Will Grundy, a New Horizons co-investigator from Lowell Observatory in Arizona.



“Pale Blue Dot” images could track cloud patterns on Uranus and Neptune. Credit: Grundy et al. / Lowell Observatory / NASA / JHUAPL / SwRI

New Horizons will capture long-range imagery of Uranus and Neptune from an unusual angle. "We're seeing light scattered in a direction that you could not possibly see from Earth or the inner solar system," Grundy said. "We're going to take pictures as the planets rotate, so that we can see their evolving cloud structures coming onto the part that's lit … and rotating out as the atmosphere evolves."

The Hubble Space Telescope will be observing Uranus and Neptune in parallel with New Horizons' "Pale Blue Dot" campaign. "The advantage

of this is that what Hubble will see is what the cloud patterns are doing that day, and at the same time as New Horizons is seeing them vary as they rotate," Grundy said.

Stern said the science team will be scanning farther-out skies for New Horizons' next potential flyby target, plus other Kuiper Belt objects in the distance.

The probe will also study the characteristics of the outer heliosphere. "This is the sun's cocoon of influence, before we get out into the interstellar medium where the Voyager [probes] are, and no spacecraft except Voyager and the Pioneers have ever been this way," Stern said. "New Horizons carries capabilities that those much older spacecraft either didn't have the technology for, or simply didn't have the instrumentation for."

Stern noted that New Horizons has moved beyond the faint, hazy glow of sunlight scattered by interplanetary dust—the so-called zodiacal light. "That dust scattering in the inner solar system is like a fog that prevents you from seeing the very faintest emissions from the universe," he said.

New Horizons can use its far-out vantage point to map the cosmic background in optical and ultraviolet wavelengths, producing data that can't be collected from the inner solar system.

"We're going to be doing maps of the entire sky in the ultraviolet, and we're going to be looking at selected regions in the optical, to try to understand those two background signals, which are already telling us from precursor observations that there's at least one source of unknown light coming from extragalactic space or cosmologically," Stern said. "And then, finally, we're going to be also mapping the local interstellar medium in hydrogen light, to understand the cloud structures and other structures that have never been mapped before."

Becky McCauley Rench, a program scientist in the Planetary Science Division at NASA Headquarters, suggested that New Horizons won't be running out of horizons anytime soon.

"The Planetary Science Division and the Heliophysics Science Division are coordinating on the future of New Horizons' mission," she said. "As part of that, Heliophysics plans to put out an RFI [request for information] in the near future to understand the potential for the science to be achieved."

Provided by Universe Today