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Space exploration

Mystery of the red patches on Pluto

Red regions on the dwarf planet are defying planetary scientists' explanations

Leah Crane

WHEN NASA's New Horizons spacecraft flew past the dwarf planet Pluto in 2015, it found that huge swathes of the surface are covered in a strange red material. Planetary scientists thought they knew what this material was, but it turns out their best guess isn't a good match, leaving it a mystery.

Many assumed that these red patches were made of tholins, organic substances that form in a world's atmosphere and then drift down to the surface. Pluto's atmosphere, while extremely tenuous, has the ingredients to produce this brown or red gunk, so it was a reasonable assumption.

Now, Marie Fayolle at the Delft University of Technology in the Netherlands and her colleagues have made artificial Pluto tholins, using a laboratory set-up designed to study the tholins that are abundant in the atmosphere of Saturn's moon Titan.

The experiment works by producing a low-density cloud of molecules and then blasting them with radiation similar to what would hit a world's atmosphere in space, causing the molecules to react and condense into dust-like particles. The researchers used a mixture of carbon monoxide, nitrogen and methane to match the composition of Pluto's atmosphere as measured by New Horizons.

They then compared the tholins they made with measurements of the red material on Pluto's surface. Surprisingly, the two didn't match. "If you were to look at these two materials side by side, they might look the same – but they are not," says Fayolle. "It's quite a big problem, but at the same time quite interesting."

They tested the match by bouncing light off the artificial samples to see which parts of the spectrum they reflected or absorbed – New Horizons made similar measurements of Pluto's surface. While some parts of the resulting spectrum matched, the artificial tholins absorbed some light that the red material on Pluto didn't (*Icarus*, doi.org/gkb3hc).

"Tholins just basically means mud, it's just a bunch of goo, so it could be that they have made something similar to what's there, but there might be a bunch of effects contributing to this colour," says Mark Loeffler at Northern Arizona University.

One possibility could be the texture of Pluto's surface. Previous laboratory experiments have shown that when a material sits atop an icy surface and some of the ice sublimates, turning into gas and floating away, the porous structure left behind can affect the light spectrum of the material by limiting light absorption.

While we don't see much sublimation in Pluto's red areas, it is plausible that they could be porous. "Given that Pluto is pretty small and has weak gravity, it might be that if you're depositing very small particles in very weak gravity, you might end up with a porous surface," says Fayolle. "It might be more like a fluffy, porous snow that isn't packed down."

That is a subject for future work. For now, though, we still don't know what sort of material is painting Pluto red. "It's definitely still a mystery," says Fayolle. ∎

Pluto was photographed by the New Horizons spacecraft in 2015

NASA/JHUAPL/SWRI

Engineering

Early form of air conditioning kept Indian temple cool

AN INDIAN religious settlement built 1000 years ago had an early form of air conditioning. The settlement held Jain temples and dormitories, and was part of a small village called Artipura in what is now the southern state of Karnataka in India, a region frequently affected by droughts both now and in the past.

The predominant feature of the site was a large granite-skirted natural reservoir storing rainwater, around which temples and dormitories were strategically built. The entire settlement was situated on a hillock, where winds blew because of the elevation.

Satyajit Ghosh at the Vellore Institute of Technology in India and his colleagues used satellite data to analyse wind patterns in the region and found that they blew from south-west to north-east, meaning they would have gusted over the reservoir before reaching the temple and dormitories. The team used satellite images of the settlement along with an AI based on a watershed algorithm to determine the boundaries and the depth of the ancient reservoir. They found that as air moved over the reservoir, it would have increased evaporation, which can help reduce heat. These winds would also have cooled as they blew over the reservoir, creating an air conditioning effect (*International Journal of Biometeorology*, doi.org/gj8zpb).

Temples at the site were made with granite and brick, and dormitories with limestone and brick; both types of walls had engineered air gaps. The researchers analysed the ancient bricks and found that although they were denser than modern ones, their use in this arrangement with air gaps reduced heat transmission.

"The settlers planned their living according to what nature offered them," says Ghosh. "A large body of water, staggered buildings oriented towards the water resource and use of indigenous building [materials] with ample ventilation decreased the heat load." ∎

Deepa Padmanaban

"The settlers planned their living arrangement according to what nature offered them"