Transcript

Planet Mercury – Messenger

LOUISE PROCKTER:

I work for the Johns Hopkins University Applied Physics Lab, and we built and flew the Messenger spacecraft for NASA.

MALE:

And 0 and lift off of Messenger on NASA's mission to Mercury.

SUSIE IMBER:

It was launched in 2004. It reached Mercury in 2011. So took a long time to get there. It was the first spacecraft to actually orbit the planet rather than just fly past it.

LOUISE PROCKTER:

We've discovered things about the composition, about the unusual deposits at the poles and the permanently shadowed regions of the magnetic field, just a phenomenal amount of science.

JOHANNES BENKHOFF:

They confirmed that there is ice on Mercury. And you would not expect ice on a planet where you have temperature 450 degrees. But there are some areas on the planet on the poles which never see the sunlight. And indeed it is possible that in these areas, in the deep interior of these craters, you can find water ice, and that is what Messenger did. And so water ice on a planet close to the sun, that fascinates me a lot.

DAVID ROTHERY:

Mercury is extremely hot by day and extremely cold by night. Now, we used to think, until the '60s, that it kept one face to the sun all the time. That would be permanently hot, and the dark side would be permanently very cold. That's not the case. It does rotate.

So everywhere, almost everywhere, on the globe gets baking-hot temperatures at noon. But its axis is not tilted to its orbit at all, as far as we can tell, a tiny fraction of a degree if it is. So there are craters near the poles that the sunlight can never see into. And the floors of those craters are permanently at very cold temperatures, minus 200 Celsius. Really, really cold.

So if you do get some ice inside a crater, it's going to stay there forever. Now, how can you get ice onto a planet like Mercury that's probably had pretty violent birth? Well, there's all kinds of icy bodies striking Mercury. 1/10 at least of its craters are produced by comets hitting the surface. And comets are mostly water.

Now, when that happens, most of the water is vaporized. Then those molecules will disperse, and they will strike the surface. And if they hit a hot surface, they'll bounce off and keep moving and

eventually be lost to space. But if a water molecule bounces into a shadow, it will stick because it's cold in the shadow. If it's in the shadow, which is permanent because the sunlight never gets there, that water molecule is stuck there forever.

So gradually, molecule by molecule these permanently shadowed craters build up a body of water ice in their permanently shadowed regions. That's been confirmed by several lines of evidence now. So there is water on Mercury in the right places.

EMMA BUNCE:

One of the intriguing aspects of the Messenger data is Mercury is thought to have a very large iron core. But then there's not as much iron on the surface as perhaps people had thought. I think maybe it was thought before Messenger that that would be the case, but why it's the case, I don't think we really yet understand.

Also, Messenger found a very high magnesium region on the surface that could possibly be related to an ancient impact basin, but we need more detail.

PAUL BYRNE:

The older crust, as we see it today, is volcanic and it looks like it poured out everywhere. We don't see any particular correlation with where that is and any other kinds of land form. But on the case of Mercury, where we have the youngest instances of these flood basalts, the overwhelming majority of them are located beside or inside impact craters and basins. That suggests or at least makes us think there might be some link between the impact process and the eruption of these flood basalts.

DAVID ROTHERY:

Messenger just kept giving and giving and giving in terms of interesting discoveries. But the thing that sticks most in my mind is the moth-eaten patches of surface, the hollows, just areas which are patches of surface where hundreds of meters across and 10 or so meters deep, the surface material is just gone. It's been removed somehow.

GABRIELE CREMONESE:

But the Messenger didn't have enough special resolution to cover all the surface to look for these specific features. What does it mean? Maybe these features are associated to some volatiles.

DAVID ROTHERY:

It must have been vaporized, volatilized, and gone away into space somewhere. There's no wind to blow it away. It's not falling into underground caverns. The morphology is all wrong. It's the top surface being volatilized and escaping to space.

JACK WRIGHT:

Messenger has shown us that there is an extensive array of geological faults on the surface of Mercury, and these are faults that appear on Earth also. But the faults on Mercury are all showing that the planet's surface, its crust, is shortening and shortening everywhere, horizontally getting shorter and shorter. And this means that the planet may be in some form of global contraction. That planet is physically getting smaller.

DOMINIQUE DELCOURT:

Messenger was a planetology mission. It was dedicated to the analysis of the composition, surface, and so on. But it's only the beginning of the story. There with MMO, we will have a view of the Mercury environment that was not provided by Messenger.