Transcript

Planet Mercury – Volcanism, faults and hollows

DAVID ROTHERY:

There are two kinds of volcanic features on Mercury, broadly speaking. Whenever we look at the surface, it seems to be made of vast lava flows. So we've got a few effusive volcanism, squeezing out lava which is flooding across the surface, flooding large parts of the surface and then hundreds of millions of years later, somewhere else is flooded by lava flows.

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 landform. Where we have the youngest instances of these flood basalts, the overwhelming majority of them are located beside or inside impact craters and basins.

So it's an important point to make that the eruption of the lavas is not directly due to the impact, and the reason we know this is because if it was, we would expect the lava to be the exact same age as the impact basins in which they occur. But we know the floor of that impact basin was exposed to space long enough for it to be impacted with craters, because those craters are barely visible, but visible nonetheless, by the lava that poured in later. So that tells us that some amount of geological time elapsed from the formation of the basin, to the emplacement of those later lava provinces.

DAVID ROTHERY:

That's the kind of volcanism that's well known on the moon. Dark patches on the moon are a similar source of volcanism. The difference on Mercury is, everywhere we look has been flooded by those big lava flows. But we also have some quite large explosive volcanic eruptions have gone on.

REBECCA THOMAS:

To get volcanism to be explosive, you need to have these volatile elements in it. So that when the magma rises, then that expands and it rips apart the magma as it's erupted. And it turns the magma into these tiny little droplets which will then be thrown up in a great big cascade, because there's no atmosphere on Mercury. You don't get plumes like you might get on the Earth. Instead you just get this fire fountain which lays down these amazing pyroclastic deposits.

DAVID ROTHERY:

And that was a big surprise. We suspected there would be effusive volcanic eruptions, lava flows. We thought that was the case after Mariner 10, NASA's first mission. Messenger has confirmed this, but also shown us these explosive events. And they seem to have gone on in the more recent past as well. So this was a big surprise to find these explosive volcanic eruptions, that are bigger than anything seen on the moon in explosive line.

JIM HEAD:

And it's teaching us that, in fact, the whole planet may have undergone tectonic deformation that enabled huge volumes of lava to come out onto the surface, over a very short period of time. So when we look at the moon we see some volcanism, but it's very episodic, whereas on Mercury it seems to have just come out all almost at the same time in these huge expanses. And we don't see any big shield volcanoes or other kinds of things like we see on Mars and the Earth that are typical of slow accretion of lava over long periods of time.

So this is telling us something really important about the interior of Mercury. And we really need to understand the interior to understand the overall evolution of the planet.

VALENTINA GALLUZZI:

Faults are just surface break ins that causes the rock to slide, one piece of rock over another. And on Mercury they are quite long. They are long hundreds of kilometers, and they causes [INAUDIBLE], which are high, hundreds of meters. So they are quite huge folds. And the strange thing that Mercury has only contraction of faults. On Earth we have plate tectonics. We don't have plate tectonics on Mercury. So it's important to study the faults to understand which is the model that drove these faults.

JACK WRIGHT:

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. We used to think that this was how mountains formed in the Earth. As the earth was cooling it would get-- it contracted and smaller and maybe the surface would wrinkle like on a fruit that's getting bit too ripe.

But we now know that plate tectonics is what controls mountain building on Earth. But on Mercury it seems that it is actually in global contraction.

DAVID ROTHERY:

Now mercury's rotating, spinning pretty slowly now. It takes 56 days to spin on its axis and 88 days to go around the sun. It's spinning pretty slowly, but it was probably spinning a lot faster once upon a time. And when you've got a fast spinning planet, it bulges out at the equator. It's flattened towards the poles, like the Earth is. If you slowed the Earth down it would lose but equatorial bulge and become much more spherical than it is.

And Mercury's a very spherical planet. It's lost its equatorial bulge. Now, did it slow down and lose its equatorial bulge before or during the formation of these faults? And it begins to seem that that's consistent with these faults being at least in part produced by Mercury's rotation slowing down. And that is telling us that it slowed its rotation down relatively late in it's geological history. Didn't happen four billion years ago, it happened three or even two billion years ago that some of this slowing down occurred. And that's a surprise, if that turns out to be true.

VALENTINA GALLUZZI:

There are features which were discovered on Mercury. They are called hollows, and they are bright spots, look like a small bright spots on the surface. Actually they are very mysterious features. And it's quite interesting for me to understand if they are related to fault activity, and to volcanic activity, for example.

REBECCA THOMAS:

So they show that you've got this planet that we thought might be like the moon, a little bit old and dead and just impact craters on the surface of it. Instead it's got these things that are forming even now. And the only way they could really form is by there being something which is very volatile on the surface, something that has a low boiling point. Which is just going away in the heat of the sun.

DAVID ROTHERY:

So if there's something volatile there, which in we think relatively recent times has carried the surface away. And we know it's recent because you don't see impact craters superimposed on these areas of hollowing. So it's probably active today. Didn't expect this on a place like Mercury.