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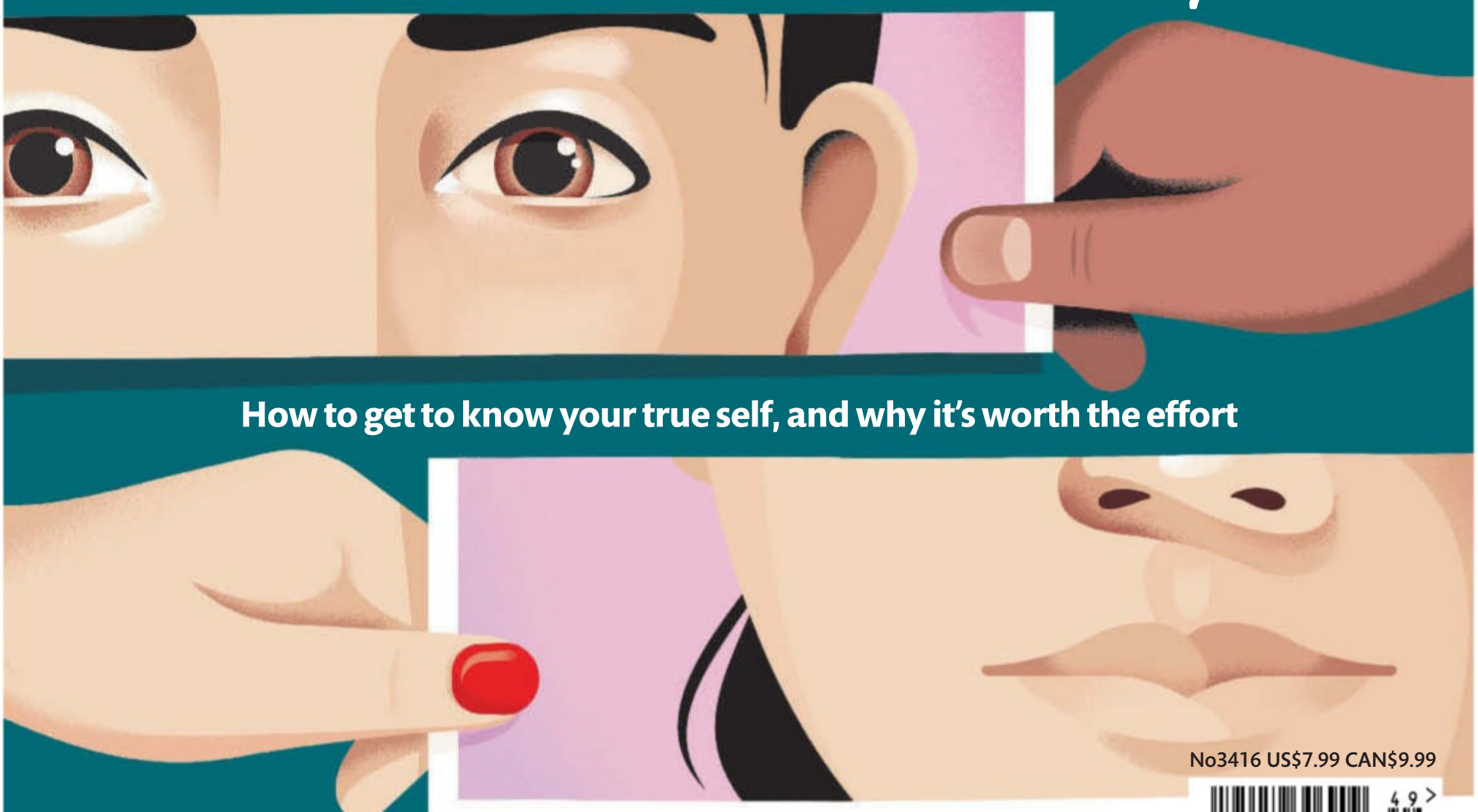

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Solar system

Huge plume of rising hot rocks may be shaking Mars...

Leah Crane

A STRANGE system of trenches on Mars may be hiding an enormous plume of hot rock rising from the planet's core. This could upend our ideas of Mars as a mostly geologically static world and explain why so many marsquakes start near these fissures, in an area known as Cerberus Fossae.

Mars doesn't have plate tectonics, and after a long period of volcanic activity 3 billion to 4 billion years ago, things have largely been calm there. But recent studies, particularly measurements of marsquakes by NASA's InSight lander, have indicated that something strange might be going on at Cerberus Fossae, which is in a region called Elysium Planitia.

Nearly all of the major quakes InSight has measured originated there, and it has felt a low, constant rumble of seismic activity that seems to come from nearby. Other observations have also suggested that the area might have been volcanically active just tens of thousands of years ago, far more recently than anywhere else on Mars.

Adrien Broquet and Jeffrey Andrews-Hanna at the University of Arizona hypothesised that this could all be explained by a phenomenon called a mantle plume, in which hot material from near the planet's core begins to rise through the mantle of the planet, causing shaking and volcanic activity as it goes. "If you were to touch a mantle rock at its mantle temperature and pressure, it would definitively feel solid. But on a million years timescale, it will flow," says Broquet.

If there is a mantle plume, it ought to press up on the crust above it, creating a large hill and fracturing the ground. Cerberus Fossae has exactly those characteristics, and computer models of how the area would evolve over time with a mantle plume pressing upwards were an exact match. The models suggested that the plume measures more than 3500 kilometres across and is up to 285 degrees hotter than the surrounding area (*Nature Astronomy*, doi.org/jpn2).

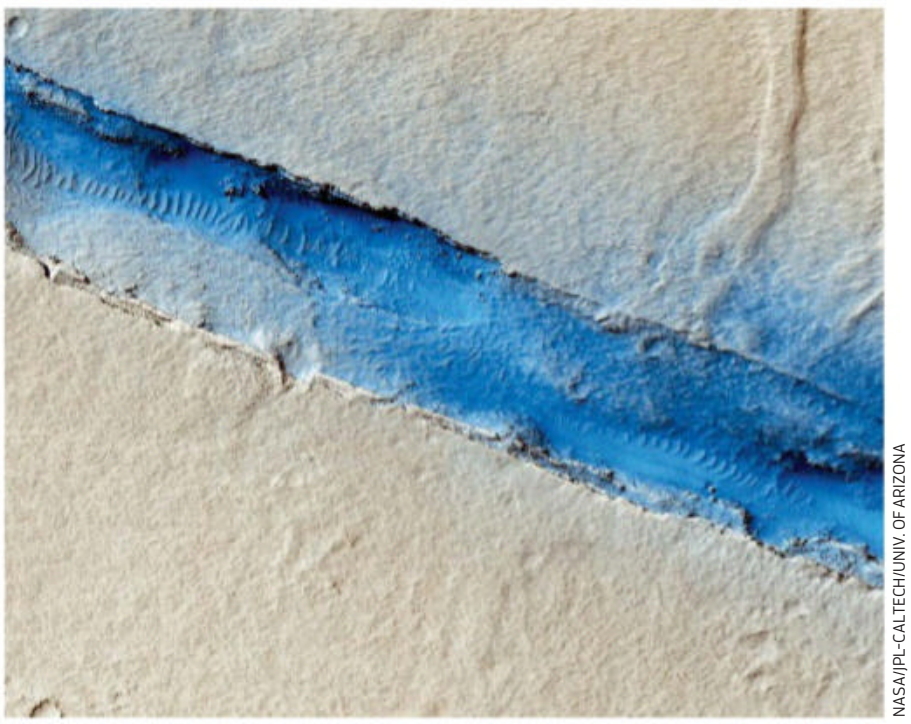
285
Difference in degrees between the plume and surrounding area

"This work provides an important crack in our understanding of Mars as a geodynamically dead planet," says Sue Smrekar at NASA's Jet Propulsion Laboratory in California. "It makes a compelling case for a stealthy but active mantle plume beneath Elysium Planitia."

Not only would that explain why there are so many quakes there, it would also solve the long-standing mystery of how the strange landscape of Cerberus Fossae formed. "Having a mantle plume there is the only way to create the fissures that make up Cerberus Fossae," says Broquet. "If not for this, the region should be in compression as the planet cools and shrinks."

The heat from a plume would also melt some of the material above it, creating magma that may eventually seep out onto the surface. In fact, the seismic activity detected by InSight is probably related to magma rising through the ground, Broquet says.

That warmth could also be a boon for the potential of life on Mars. "The plume may also provide the heat to melt water underground, and I don't want to be too optimistic, but on Earth this is an environment where microbes flourish," says Broquet. ▮



NASA/JPL-CALTECH/UNIV. OF ARIZONA

Fissures on Mars in an area known as Cereberus Fossae

...while impact crater that caused Martian megatsunami traced

ABOUT 3.4 billion years ago, a colossal tsunami swept over the face of Mars after an asteroid slammed into one of the planet's oceans. Now, researchers think they have found the crater where this megatsunami began. The size of the crater hints that the impact was similar to that of the Chicxulub asteroid on Earth, which is thought to have killed off the dinosaurs.

Alexis Rodriguez at the Planetary Science Institute in Arizona and his team combined data from several Mars orbiters to undertake a search for the impact site of the asteroid that caused this megatsunami. They found a crater 110 kilometres wide called Pohl in the northern lowlands of Mars that seems just right. It sits atop channels that probably formed as the area first flooded, creating a huge ocean, but there are deposits thought to have come from a later tsunami on top of it. That means it almost definitely formed in the right time period, before Mars dried out.

The researchers found that the asteroid that created the crater was either about 9 kilometres across or 3 kilometres across, depending on the properties of the ground it hit. Either way, it probably generated a megatsunami with 250-metre-tall waves reaching as far as 1500 kilometres from the impact site (*Scientific Reports*, doi.org/jn8q).

"You would have seen this massive wall of turbulent, reddish water, with some of it flying upwards and falling back into the wave along with rocks and soil," says Rodriguez. Mars has lower gravity than Earth, so the water and debris would fall more slowly than it does on Earth. The impact would have generated a seismic wave that propagated hundreds of kilometres, throwing dirt and rocks into the air and creating a catastrophic flow of debris along with the wave. "Very terrifying, definitely nothing to surf on," says Rodriguez. ▮ LC