Iron 'snow' helps maintain Mercury's magnetic field, scientists say

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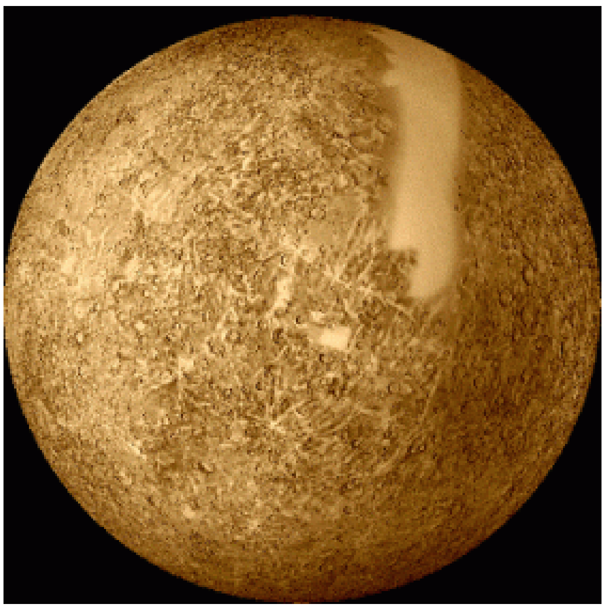

Mercury surface taken by Mariner 10. Credit: NASA

New scientific evidence suggests that deep inside the planet Mercury, iron "snow" forms and falls toward the center of the planet, much like snowflakes form in Earth's atmosphere and fall to the ground.

The movement of this iron snow could be responsible for Mercury's mysterious magnetic field, say researchers from the University of Illinois and Case Western Reserve University. In a paper published in the April issue of the journal *Geophysical Research Letters*, the scientists describe laboratory measurements and models that mimic conditions believed to exist within Mercury's core.

"Mercury's snowing core opens up new scenarios where convection may originate and generate global magnetic fields," said U. of I. geology professor Jie (Jackie) Li. "Our findings have direct implications for understanding the nature and evolution of Mercury's core, and those of other planets and moons."

Mercury is the innermost planet in our solar system and, other than Earth, the only terrestrial planet that possesses a global magnetic field. Discovered in the 1970s by NASA's Mariner 10 spacecraft, Mercury's magnetic field is about 100 times weaker than Earth's. Most models cannot account for such a weak magnetic field.

Made mostly of iron, Mercury's core is also thought to contain sulfur, which lowers the melting point of iron and plays an important role in producing the planet's magnetic field.

"Recent Earth-based radar measurements of Mercury's rotation revealed a slight rocking motion that implied the planet's core is at least partially molten," said Illinois graduate student Bin Chen, the paper's lead author. "But, in the absence of seismological data from the planet, we know very little about its core."

To better understand the physical state of Mercury's core, the researchers used a multi-anvil apparatus to study the melting behavior of an iron-sulfur mixture at high pressures and high temperatures.

In each experiment, an iron-sulfur sample was compressed to a specific pressure and heated to a specific temperature. The sample was then quenched, cut in two, and analyzed with a scanning electron microscope and an electron probe microanalyzer.

“Rapid quenching preserves the sample’s texture, which reveals the separation of the solid and liquid phases, and the sulfur content in each phase,” Chen said. “Based on our experimental results, we can infer what is going on in Mercury’s core.”

As the molten, iron-sulfur mixture in the outer core slowly cools, iron atoms condense into cubic “flakes” that fall toward the planet’s center, Chen said. As the iron snow sinks and the lighter, sulfur-rich liquid rises, convection currents are created that power the dynamo and produce the planet’s weak magnetic field.

Mercury’s core is most likely precipitating iron snow in two distinct zones, the researchers report. This double-snow state may be unique among the terrestrial planets and terrestrial-like moons in our solar system.

“Our findings provide a new context into which forthcoming observational data from NASA’s MESSENGER spacecraft can be placed,” Li said. “We can now connect the physical state of our innermost planet with the formation and evolution of terrestrial planets in general.”

Source: University of Illinois at Urbana-Champaign

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