MESSENGER data paints new picture of Mercury's magnetic field

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A University of British Columbia geophysicist is part of a NASA mission that is analyzing the first sets of data being collected by MESSENGER as it orbits Mercury. The spacecraft is capturing new evidence that challenges many previous assumptions about our innermost planet.

Analyses of new data from the spacecraft reveals a host of firsts: evidence of widespread flood volcanism on the planet's surface, close-up views of Mercury's crater-like depressions, direct measurements of the chemical composition of its surface, and observations of the planet's global magnetic field.

The results are reported in a set of seven papers published in a special section of *Science* magazine on September 30, 2011.

UBC's Catherine Johnson, an expert in planetary magnetic and gravity fields, is part of the MESSENGER Mission's geophysics group.

Johnson, along with colleagues at Johns Hopkins University's Applied Physics Lab, Goddard Space Flight Centre, University of Michigan and the Carnegie Institution, analyzed the data collected by the spacecraft's magnetometer to detect Mercury's magnetic equator and paint a never-before-seen picture of Mercury's magnetic field.

Mercury is the only other planet in the inner solar system besides Earth whose global magnetic field has an internal origin.

"The MESSENGER data has allowed us to establish the large-scale structure of Mercury's magnetic field," says Johnson. "Mercury's field is weak compared to Earth's. But until now, figuring out exactly how much weaker has been a challenge."

"Knowing more about the planet's field geometry might allow us to explain why Mercury's field differs so much from ours. The magnetometer's observations allow us to separate the internal and external magnetic field contributions so we can properly estimate the strength of Mercury's internal dipole field."

The strength, position and orientation of the dipole field determine how the solar wind interacts with the planet. A stronger magnetic field holds the solar wind at bay. Mercury's weak magnetic field allows solar wind to reach the planet's surface, creating a 'sputter' effect--an ejection of atoms of individual mineral crystals--that are then carried away from the planet's surface.

"Because Mercury has no atmosphere, the solar wind can reach the planet's surface at high northern and southern latitudes, causing that 'sputtering' effect, which creates a very tenuous exosphere."

"In contrast, the solar wind doesn't reach Earth's surface," explains Johnson. "Instead, it interacts with our upper atmosphere, causing what we know as the Northern Lights."

Mercury, the solar system's smallest and densest planet, is in many ways is the most extreme.

"The weak magnetic field makes for a very dynamic environment. We want to know what affect that has on Mercury's interactions with solar wind. The data being returned from MESSENGER will allow us to do that."

"MESSENGER's instruments are capturing data that can be obtained only from orbit," says MESSENGER Principal Investigator Sean Solomon, of the Carnegie Institution of Washington. "We have imaged many areas of the surface at unprecedented resolution, we have viewed the polar regions clearly for the first time, we have built up global coverage with our images and other data sets, we are mapping the elemental composition of Mercury's surface, we are conducting a continuous inventory of the planet's neutral and ionized exosphere, and we are sorting out the geometry of Mercury's magnetic field and magnetosphere. And we've only just begun. Mercury has many more surprises in store for us as our mission progresses."

MESSENGER's primary mission is to collect data on the composition and structure of Mercury's crust, topography and geologic history, thin atmosphere and active magnetosphere, and makeup of core and polar materials.

Provided by University of British Columbia