New theory for magnetic stripes on Mars

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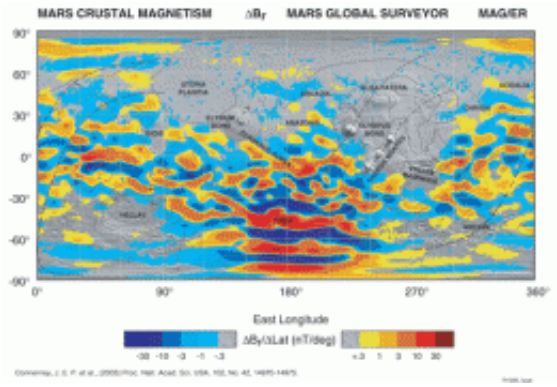

This global map uses colors to represent the strength and direction of the magnetic field caused by crustal magnetization. Credit: NASA

(PhysOrg.com) -- A controversial new theory has been proposed to explain a series of stripes of permanently magnetized minerals containing iron in the Martian crust. The magnetized stripes, which have alternating orientations, have intrigued scientists since their discovery in 1997.

The Mars Global Surveyor (MGS) began orbiting almost 400 km above the surface of Mars in 1997, and its magnetometer began sending signals back to Earth, which revealed the presence of the magnetized stripes. The latest research, led by Ken Sprenke and Daisuke Kobayashi of the University of Idaho in Moscow, Idaho, theorizes the stripes were created as a result of ancient hotspots beneath the planet's crust.

The theory, published in *Icarus*, is that sub-surface hotspots caused material to rise to the surface from the interior, and the mineral was then magnetized with the field present at the time. Sprenke noted that on Earth the Hawaiian Islands were probably created by hotspots moving slowly below the hard crust, leaving parallel magnetized tracks. He said there could have been dozens of hotspots in the first few hundred million years of Mars's existence, when the molten iron in the planet's core was probably acting as a dynamo.

The stripes form parallel arcs and are of two different types with distinctive pairs of poles, and Sprenke believes these magnetic poles, with "polar wandering" between them, represent the axis of the planet's spin at the time. In order to explain how the crust was dragged over the hotspots, Sprenke suggests Mars may have captured some satellites early in its history, and these could have exerted a gravitational tide that would have reduced the speed of the crust relative to the hotspots beneath. As evidence for this hypothesis, Sprenke pointed out that seven of the 15 impact basins on the planet were found unexpectedly to fall along equators of the two poles fixed by the magnetic stripes.

One problem with the new theory is that there is no surface topography corresponding to the proposed hotspots. Planetary scientist John Connerney at the NASA Goddard Space Flight Center in Greenbelt, Maryland, pointed out that on Earth hotspots are associated with chains of islands or mountains, but the same thing is not seen on Mars. Sprenke suggests this may be because later volcanic activity on Mars could have eliminated the surface topography after the dynamo activity had stopped.

Connerney worked on the MGS project and has his own theory for the stripes - that the stripes were a result of ancient spreading of the sea floor - but his theory has also been criticized by planetary scientists. Detection in the 1960s of alternating magnetic stripes of rock at the bottom of the Atlantic led to theories of sea floor spreading on Earth,

which in turn led to the theories of plate tectonics.

The stripes on Earth were detected by ships and were not noticed from satellites, which suggests the mystery might only be resolved when higher resolution data becomes available. This may be in 2013 when the Mars Atmosphere and Volatile EvolutioN (MAVEN) reaches Mars, carrying two magnetometers. MAVEN will gather data for several years and may fly at only 150 km above the surface for at least some of the time. If it does, the quality of data on the magnetized surface would be much improved.

More information: Lithospheric Drift on Early Mars: Evidence in the Magnetic Field, Daisuke Kobayashi et al., *Icarus*, Article in Press, doi:10.1016/j.icarus.2010.06.015