MAGNETIC, INTERIOR, CRUSTAL AND CLIMATE EVOLUTION OF EARLY MARS.

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Introduction: Thanks to a lack of plate tectonics or destructive weathering, many of the clues to the early evolution of Mars are still discernible in its topography, mineralogy, magnetic fields, and atmosphere, as well as in the Martian meteorites that have fallen to earth. So far as we know, the first several hundred million years of Martian history were characterized by crustal solidification and the formation of the global dichotomy, many cataclysmic (and smaller) impacts, the growth of Tharsis and its pervasive magmatism, volcanism and associated volatile release, the commencement and eventual demise of the magnetohydrodynamic core dynamo, the acquisition and modification of intense crustal magnetism, the formation of precipitation-fed valley networks and huge floodplains, the aqueous and subsequent acidic weathering of surface minerals and the escape of some fraction of the atmosphere to space.

While attempting to distinguish the telltale signs of these often-coupled processes, and so come up with a plausible 'history' of the early Martian evolution, is a daunting task, recent observations and modeling studies have shed substantial new light on this exciting period of solar system history, as well as created new questions and controversies.

We will present a review of early Martian history from a geophysical standpoint, concentrating on the magnetic, impact and interior evolution of Mars and the consequences for the evolution of the crust and atmosphere.

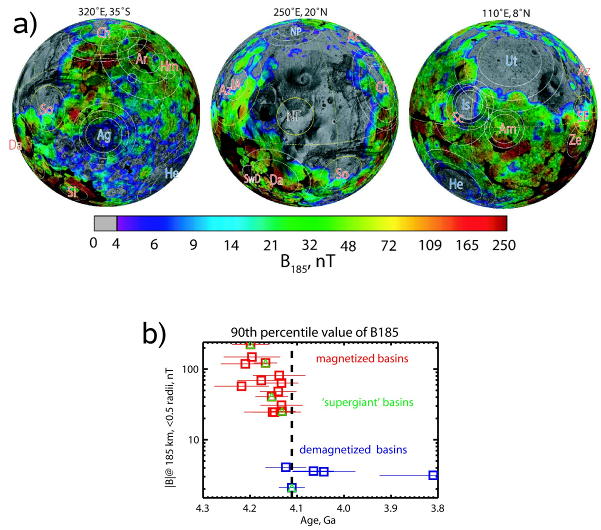

Figure 1: Orthographic maps of crustal magnetic field magnitude at 185 km altitude (denoted B185; note logarithmic scale) overlaid on shaded MOLA topography[1]. The 20 largest basins identified in topographic and crustal thickness data are shown as white and yellow circles, respectively. Each ring in multiringed basins is shown. Demagnetized and magnetized basins are identified with blue and red lettering, respectively. (b) The 90th percentile of the distribution of 0.5° x 0.5° pixels of B185 inside 0.5 basin radii is plotted against absolute model ages [Hartmann and Neukum, 2001; Frey, 2008] for all identified basins except North Tharsis (thermally demagnetized). The five largest basins are also marked with green triangles. Note that the youngest basins (i.e., North Polar, Utopia, Hellas, Argyre, and Isidis) are the least magnetized.