Magnetic Anomalies Near Apollinaris Patera and Lucus Planum, Mars; L. L. Hood[1,*], H. P. Gunnlaugsson[2], and B. Langlais[3]. [1]LPL, University of Arizona, [2]Aarhus University, Aarhus C, Denmark, [3]Université de Nantes, Nantes, France.

Mars Global Surveyor magnetometer measurements were obtained over limited areas during the aerobraking phase of the mission at $\sim$ 90 - 200 km altitude and globally during the mapping phase at $\sim$ 360 - 420 km altitude. A correlation of one martian crustal field anomaly with an early Hesperian-aged volcanic construct, Apollinaris Patera (A.P.), has previously been reported [Langlais and Purucker, Planet. Space Sci., 2007]. Here, we report more detailed mapping and modeling of the available MGS data over this construct and nearby volcanic units along the hemispheric dichotomy boundary. We also suggest an origin for the source materials of the anomalies based on Mössbauer spectroscopy of basaltic rocks within the nearby Gusev crater.

First, the existence of a magnetic anomaly directly over A.P. is confirmed by comparing anomalies detected on closely adjacent low-altitude passes near the construct. Although sparseness of data precludes construction of a continuous map at low altitudes, maps at the mapping altitude contain a broad total field anomaly that correlates approximately with a large-scale volcanic plateau that adjoins the A.P. construct on its southwestern side. The volcanic plateau is mapped as part of the Medusae Fossae Formation (Lucus Planum) and may consist of pyroclastic flow deposits up to 3 km thick originating at one or more now-buried vents. It has a Hesperian age according to recent assessments [Kerber and Head, LPSC, 2009]. Modeling of the A.P. anomaly using a near-surface disk source indicates that the horizontal scale size of the source is about twice as large as the surface diameter of the construct. A strong gravity anomaly also exists over A.P. with a similar scale size. On this basis, it is suggested that the most probable source of both the magnetic and gravity anomalies is the extinct A.P. magma chamber. Modeling of the Lucus Planum anomaly assuming that the flow deposit is the source yields an estimated mean magnetization intensity of 60 - 80 Amp/m.

Mössbauer spectroscopy of basaltic rocks in the nearby Gusev crater, whose floor materials have estimated ages similar to Apollinaris Patera flank deposits, indicates a high amount of olivine. Laboratory studies of terrestrial mid-ocean ridge olivine basalts have previously shown that such basalts can undergo high-temperature oxidation to single domain magnetite, producing magnetization intensities comparable to those inferred above for Lucus Planum [Gunnlaugsson et al., PEPI, 2006]. Strong magnetic anomalies in the martian highlands are broadly correlated with the distributions of valley networks and phyllosilicate exposures suggesting that most strong sources formed in the presence of liquid crustal water. Since water is the main crustal oxidant, an oxidizing environment is implied. Solidified olivine basalt magmatic intrusions, formed in presence of crustal water, may therefore be the most likely anomaly sources.

These results also have possible implications for the history of the martian dynamo. Analyses of basin impact demagnetization signatures suggest that the dynamo ended during the Noachian. However, the evidence discussed here for magnetic sources associated with Hesperian-aged volcanic constructs (Apollinaris Patera and Lucus Planum) suggests that a dynamo operated during the Hesperian.