MAGNETIC ANOMALIES WITHIN THE ELLIPTICAL BOREALIS BASIN OF MARS. K. F. Sprenke[1], [1]Department of Geological Sciences, University of Idaho, Moscow, Idaho 83844. ksprenke@uidaho.edu.

Introduction: The single impact hypothesis for the formation of the Martian hemispheric dichotomy boundary has recently been revived with the advent of hydrodynamic simulations that show that the planet could sustain such an event [1, 2]. For additional evidence, it has been proposed that the shape of dichotomy boundary is elliptical [3]. This proposed boundary shape is based on carefully chosen martian gravity anomalies and topographic trends that outline an ancient Borealis basin. The elliptical shape suggests formation by a single oblique impact. It has further been proposed that the decline in magnetic field intensity antipodal to the impact is also evidence for a single impact [2]. One issue with this series of hypotheses is that weak but nonetheless significant magnetic anomalies exist within the elliptical Borealis basin itself [4]. These anomalies raise questions about the actual shape of the Borealis basin as well as timing of the core field relative to the purported single impact.

Martian Magnetic Anomalies: The most reliable map of martian crustal magnetic anomalies produced to date is the ΔBr map [4]. This map, representing the mean change of the radial component of the field with latitude, is an excellent proxy for the Bϕ component at MGS mapping altitude. The ΔBr is thought to be largely free of the effects of external field and allows unprecedented detail of the magnetic anomalies, particularly in areas of Mars where the field is relatively weak

Magnetic Anomaly Pattern within the ellipse: The magnetic anomalies of the Borealis basin are most concentrated south of Elysium Mons and south of Chryse (Fig. 1) at the ends of the major axis of the proposed ellipse. The anomalies appear to be completely similar in intensity and pattern to those immediately outside the ellipse. If the major axis of the ellipse were shortened to exclude most of these anomalies, the shape would be circular, not elliptical. Although redrawing the dichotomy boundary in this manner would not rule out a single impact origin for the dichotomy, it takes away the argument that an impact is the simplest explanation for the shape of the basin.

The source of the spatial variation in magnetic field intensity on Mars is an ongoing topic of debate. The simplest explanation is a combination of spatially inhomogeneous crustal magnetization on early Mars with subsequent demagnetization in discrete areas by large impacts or rising plumes. Within the proposed ellipse, this explains the magnetization present as well as the magnetic voids associated with Tharsis, Elysium, Utopia basin, Acidalia basin, Chryse basin, and the lava plains north of Alba Patera.

Timing of the core field: Certainly, magnetization within the Borealis basin could not have survived a mega-impact. Hence, the remanence within the Borealis basin had to have been acquired after the impact. This is in direct contrast to the floors of the large impact basins formed during Late Heavy Bombardment which are demagnetized. However, the decline in magnetic field intensity antipodal to the Borealis basin, if the decline is in fact related to the mega-impact, requires that the global field had to have existed before the impact. Thus a core field had to have existed before and after the mega-impact if these hypotheses are both correct. However, a single impact the size of Utopia would be sufficient to halt a core dynamo [5]. One exotic solution to this dilemma is a single hemisphere dynamo generated by the mega-impact itself [6] which might generate strong magnetization in the lower mid-latitudes, less magnetization at the south poles, and still less in the northern hemisphere.

Conclusion: In summary, the crustal magnetic field of Mars provides little support for the single impact hypothesis. The magnetic patterns within the Borealis basin appear to be consistent with those of Mars as a whole. The only difference is in intensity, which is most simply explained by spatial variations in magnetic carrier concentrations across Mars. There is no reason to presume that the crustal geology of Mars is homogeneous.

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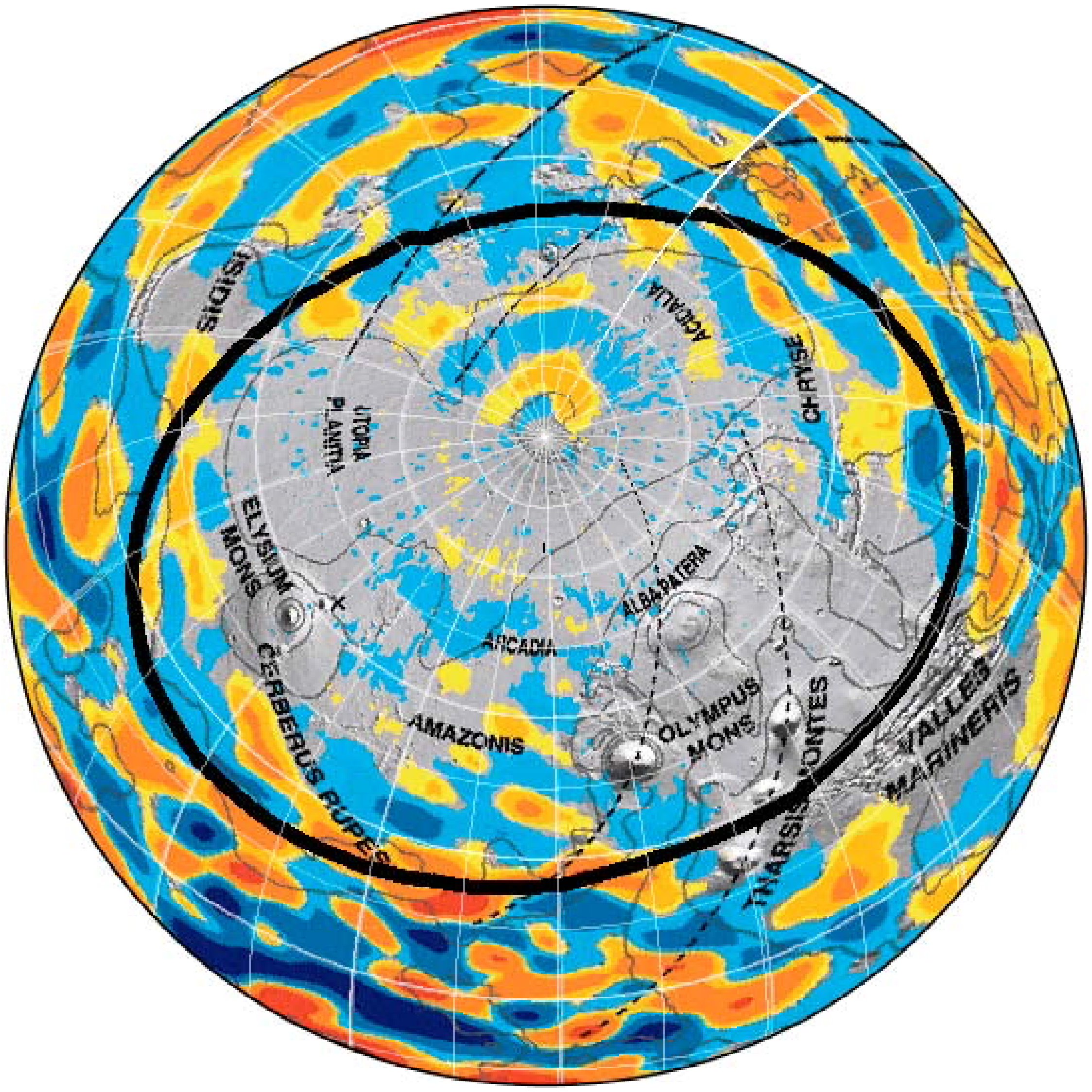

Figure 1. Equidistant azimuthal projection centered at 67N, 208E of the ΔBr magnetic field of Mars [4] observed by the MGS satellite at a nominal 400-km altitude. In areas with no significant magnetic field, topographic features are shown in gray scale. Colors are assigned in 12 steps spanning two orders of magnitude variation. The ellipse shows the boundary of the proposed Borealis basin [3]. The map was projected using ***G.Projector*** by Robert B. Schmunk, Nasa Goddard Institute for Space Studies.