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Joint inversion of magnetic and gravity anomalies west of the Isidis Basin, Mars and implications for Martian Dichotomy evolution and Mars' magnetic field history

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We have applied joint inversion techniques utilizing Bayesian inference to examine the relationship between gravity and magnetic anomalies near the Martian dichotomy boundary, whose geologic structure and evolution has been previously investigated. The goals of the study are to test for correlations between the gravity and magnetic signatures mapped by the Mars Global Surveyor, and to understand their implications for the origin and evolution of the dichotomy boundary, as well as the history of the ancient magnetic dynamo on Mars. The magnetic field of Mars reflects strong crustal magnetism resulting from an ancient internal field. The crustal anomaly pattern parallels the geologic dichotomy in that most of the anomalies detected by the Mars Global Surveyor are located within the presumably older southern highlands while the northern lowlands has weak or no magnetic signature at satellite altitudes. We have analyzed a section of the dichotomy boundary between 50 and 80 degrees east longitude (Ismenius quadrangle) to test for correlation between gravity and magnetic anomalies and to determine the regional distribution of magnetic sources. The study area contains some of the strongest magnetic anomalies observed outside the area of high-amplitude anomalies found within the Terrae Cimmeria and Sirenum sector of the southern highlands. Several strong magnetic and gravity anomalies in the area of the Ismenius quadrangle are associated with a mapped normal fault, but the magnetic and gravity peaks and troughs are out of phase. The isostatic gravity anomalies indicate higher density bodies flanking the mapped normal fault. Previous forward modeling of profiles suggested that the gravity and magnetic sources were anti-correlated, which we interpreted to be the result of late stage magmatic intrusions into the magnetized crust that caused it to demagnetize. Here we use a 3-D joint inversion code in

which the subsurface is represented as a series of rectangular prisms to test that hypothesis. The inversion can solve for remanent magnetization, paleopole inclination and declination, density, and depths to the top and bottom of the prisms. The initial results show that for a paleopole of 225E, 25N, higher magnetizations are found near the buried fault that decrease towards the density anomaly, consistent with the interpretation based on the 2-D forward modeling. Complete results will be presented and discussed.