

**FREE-AIR AND BOUGUER GRAVITY ANOMALIES AND THE MARTIAN CRUSTAL DICHOTOMY** Herbert Frey<sup>1</sup>, Bruce G. Bills<sup>1</sup>, Walter S. Kiefer<sup>1,2</sup>, R. Steven Nerem<sup>1</sup>, James H. Roark<sup>1,3</sup> and Maria T. Zuber<sup>1,4</sup>, <sup>1</sup>Laboratory for Terrestrial Physics, Goddard Space Flight Center, Greenbelt MD 20771, 301-286-5450, <sup>2</sup>Lunar and Planetary Institute, Houston, TX 77058, <sup>3</sup>Astronomy Program, University of Maryland, College Park, MD 20742, <sup>4</sup>Dept. Earth and Planetary Sciences, Johns Hopkins University, Baltimore MD 21218.

### **Introduction**

This paper compares **free-air** and **Bouguer** gravity anomalies from a 50x50 field [1], derived from re-analysis of Viking Orbiter and Mariner 9 tracking data and using a 50x50 expansion of the current Mars topography [2] and the GSFC degree 50 geoid as the equipotential reference surface, with the martian crustal dichotomy. The spherical harmonic topography used in this study has zero mean elevation, and differs from the USGS maps [2] by about 2 km. In this field the dichotomy boundary in eastern Mars lies mostly at -1 to -2 km elevation.

Figure 1 shows **Bouguer gravity anomalies** on a map of Noachian, Hesperian and Amazonian age terrains, simplified from current geologic maps [3,4]. The map is centered at 300°W to show the continuity of the dichotomy boundary. Contour interval is 100 mgals. We directly compared gravity and topography along ~40 profiles oriented parallel to the dichotomy boundary topographic gradient, to determine how the geophysical character of the boundary changes along its length and what this implies for its origin and development.

### **Crustal Dichotomy**

Most of the heavily cratered Noachian terrain near the dichotomy boundary is characterized by 100-250 mgal *negative* Bouguer anomalies, independent of the elevation at which the cratered terrain occurs [5]. Regions as low as Tempe Terra and SE Acidalia (below -2 km) have the same negative Bouguer character as regions at +3km. Most lowlying plains units have *positive* Bouguer anomalies, ranging from 250-300 mgals in Utopia, southern Elysium, Chryse and Arcadia to 100-150 mgal at higher latitudes in northern Utopia, Acidalia and Amazonis. Where it is marked by a pronounced boundary, the crustal dichotomy is characterized mostly by a change from negative over the cratered highlands to more positive (at least in a relative sense) Bouguer anomaly over the low plains. In Xanthe Terra and further north in Tempe Terra where Noachian cratered terrain changes abruptly to younger plains, the same geophysical signature is also seen (Figure 1).

The change from negative to more positive Bouguer anomaly across the dichotomy boundary appears independent of elevation. Tempe Terra (-2 to -4 km), Xanthe Terra (+1 to -2 km), SE Acidalia (-1 to -2 km), and the rest of the boundary zone between 150 and 360°W (+1 to -1 or -2 km) all show the same pattern.

### **Crustal Dichotomy Boundary**

Profiles across the dichotomy boundary zone vary in a complicated way, as does the character of the boundary itself. Generally the amplitude of the **Bouguer anomaly** is intermediate over the boundary zone by comparison with the low amplitude negatives over the cratered terrain and the positives that occur over plains to the north. The amplitude swing is of order 200 to 400 mgals. East of the Isidis Basin the amplitudes associated with the generally steeper topography of the boundary are generally higher (>300 mgals). Flatter profiles characterize the region west of Isidis, where the Bouguer signature is negative even in the lowlying plains. Despite this, the 200-300 mgal change to relatively more positive from cratered terrain to lowlying plains remains. In Xanthe Terra the profiles are similar to those east of Isidis, while Tempe Terra profiles look more like those west of Isidis.

**References:** [1] Smith, D. E. et al., *LPSC XXIV*, this issue, 1993. [2] USGS *Misc. Inv. Ser.*, Map I-2030, 1:15M, 1989. [3] Scott, D. L. and K. L. Tanaka, *USGS Misc. Inv. Ser.* Map I-1082-A, 1:15, 1986. [4] Greeley, R. and J.E. Guest, *USGS Misc. Inv. Ser.* Map I-1082-B, 1:15M, 1987. [5] Frey, H. et al., *LPSC XXIV*, this issue, 1993.

FIGURE 1.  
BOUGUER GRAVITY ANOMALIES and CRUSTAL DICHOTOMY

