**REGIONAL CRUSTAL THICKNESS VARIATIONS ON MARS.** H. V. Frey and B. G. Bills (Goddard Space Flight Center, Greenbelt MD), S. N. Lyons (Texas A&M Un., College Station, TX), and J. H. Roark (Science Systems Applications, Inc., Lanham, MD)

## INTRODUCTION

We generated models of crustal thickness for Mars [1] using both Mars50c [2] and GMM-1 [3] based on the assumption that gravity anomalies are due only to variations in surface and crust/mantle topography and crust and mantle densities are laterally constant [4], for a range of crust and mantle densities, and assumed average crustal thickness. Here we discuss regional variations in crustal thickness for one such model, with average thickness of 65 km and crust/mantle density contrast 0.5 (crust 3.0, mantle 3.5) gm/cc. Crustal thickness ranges from 140 km below Olympus Mons to less than 10 km below the Hellas and Isidis basins. Crust below Argyre is five times thicker than below Hellas, while that in Elysium is 85 km thick. Most (but not all) heavily cratered terrain is thicker than the crustal average, while most lowlying plains are only 25-45 km thick. Across the crustal dichotomy boundary zone the crustal thickness changes by 25 to 35 km over less than 500 km in some (but not all) places.

## CRUSTAL THICKNESS MODEL

Because thicker average crusts produce short wavelength thickness oscillations and thinner models yield negative crustal thicknesses, we favor models with average thickness 55±10 km [1]. If 0.5 gm/cc is a reasonable density contrast and 3.5 gm/cc a reasonable density for Mars, then an average crustal thickness of 65 km may be appropriate [1]. Such a model is one of many that satisfies the weak "constraint" on crustal thickness from the possible detection of a marsquake by Viking Lander II [5]. Figure 1 shows crustal thickness contours (interval 20 km) for this model on a map of simplified terrain age. Four profiles shown at identical scale illustrate the regional comparisons described below.

## REGIONAL VARIATIONS IN CRUSTAL THICKNESS

The thickest crust in this model lies below Olympus and Ascreaus Montes, with roots 120 to 140 km thick, if the observed gravity anomalies are due to such roots. The Elysium Mons crust is 85 km thick (profile DD'), roughly the same as for the Tharsis region as a whole (profile AA'). Because both the underlying assumption of this crustal model probably fails for Tharsis and the gravity anomalies for this region may be underestimated [2,6,7], we confine the discussion below to other portions of Mars.

The thinnest crust (< 10 km) is in the Hellas and Isidis basins. Despite their different size, both basins show roughly the same relative thinning, being flanked by cratered terrain approximately 70-80 km thick. The crust within the Argyre basin (roughly the same size as Isidis) is five times thicker, even though the surrounding crust is also about 80 km thick.

Heavily cratered terrain is generally thicker than the 65 km average, mostly 75-85 km thick. Values in excess of 100 km occur in Memnonia, in the fractured terrain of southern Thaumasia, and SE of Argyre (SW of Hellas) near longitude 0 at 80S. There is one extensive area of unusually thin heavily cratered terrain: a broad, lowlying region of western Arabia which grades downhill toward the Chryse basin and the Noachian-age crust thins to ~45 km (see Figure 1b in [1]; also profile BB'). By contrast, the lowlying portions of the Tempe Terra cratered terrain are 65-75 km thick (profile BB').

Knobby terrain which makes up the Phlegra Montes east of Elysium has about average crustal thickness (profile DD'), like that along many parts of the crustal dichotomy boundary (profiles CC', DD').

Lowland plains are everywhere thinner than the crustal average, usually 25-45 km thick. Crust in central Utopia thins to less than 20 km as it does in Elysium SW of the VL II landing site.

Across the crustal dichotomy boundary zone the crust changes thickness by 25-35 km over a short distances (< 500 km) only east of 240W (profile DD'), near longitude 330W, and across the Tempe-Western Acidalia and Tempe-Chryse boundary zone (profile BB'). Elsewhere, e.g., in Memnonia and west of Isidis, the thinning is more gradual even if sometimes more extensive (compare profile CC').

REFERENCES: [1] Lyons, S. N. et al., LPSC XXVII (this volume), 1996. [2] Konopliv, A. S. and W. L. Sjogren, JPL Pub. 95-5, 1995. [3] Smith, D. E. et al., JGR 98, 20871-20890, 1993. [4] Bills, B. G. and A. J.Ferrari, JGR 83, 3497-3508, 1978. [5] Anderson, D. L. et al., JGR m82, 4524-4546, 1977. [6] Bills, B. G. and R. S. Nerem, GRL, in press, 1995. [7] Frey, H. et al., JGR, submitted, 1995.

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**Figure 1.** A crustal thickness model based on the Mars50c gravity model [2]. Average crustal thickness is 65 km. Density contrast is 0.5 (crust 3.0, mantle 3.5) gm/cc. Contoured crustal thickness (contour interval 20 km) shown over simplified terrain age (top). Crustal thickness profiles are shown, as indicated on the terrain map. Both true and 10x true topography (thin black line) included in the profile.