**INTERPRETING MASCON WRINKLE RIDGES ON ISIDIS PLANITIA, MARS USING AXIAL SURFACE MAPPING TECHNIQUES: RECONSTRUCTING STRUCTURAL DEVELOPMENT AND STRESS ENVIRONMENTS.** E. M. Wolfe[1], A. Vidal[1], and K. J. Mueller[1], [1]University of Colorado, UCB 399, 2200 Colorado Ave., Boulder, CO, 80303-0399, wolfee@colorado.edu

**Introduction:** Isidis Planitia, a Noachian impact crater infilled with Hesperian aged basalts, is located on Mars on the crustal dichotomy and is antipodal to the Tharsis rise [1]. Measuring 1400 km across and 2 km deep, it is comparable in scale and age to lunar mascons. The basin contains an interesting pattern of both radial and concentric wrinkle ridges (see Figure 1), and massive graben are found outside the crater rim.

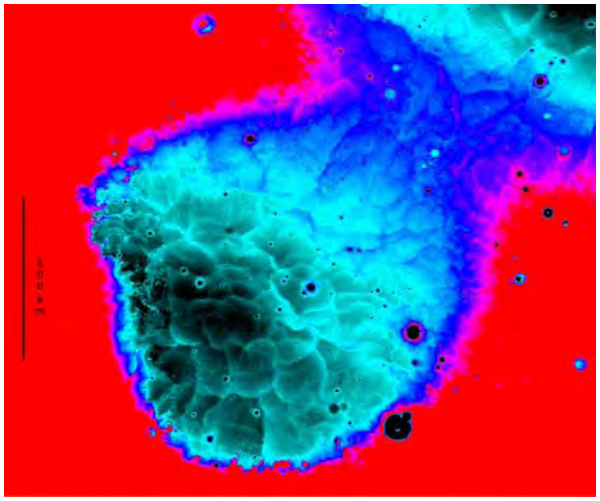

**Figure 1.** A false-color image from MOLA (Mars Orbiter Laser Altimeter) data accentuating radial and concentric wrinkle ridges in Isidis. Scalebar on left is 500 km in length.

**Mascons:** Mascon loading tectonics predict an inner compressive area surrounded by a strike slip region followed by an extentional area [2]. We observe the compressional (wrinkle ridges) and extensional (graben) structures, implying the wrinkle ridges are caused by local mascon stresses. We will also explore the possibility of far-field membrane stresses caused by Tharsis loading. Infilling of the basalt in several episodes must also be considered.

**Theories of Ridge Formation:** The ridges are approximately 50 m high by 200 km long. This low relief is a result of planetary scaling relations [3]. Using fault propagation folding theory [4] [5], we assume that the wrinkle ridges are the surficial expression of blind thrust faults at depth. By measuring the positions of the base of the forelimb, the base of the backlimb, the ridge crest, the steepest point along the ridge, and the offset (the elevation difference between the forelimb and backlimb) we predict the orientation and depth of faulting. Using fault geometry we can constrain the rheology of the mascon and compare to existing models.

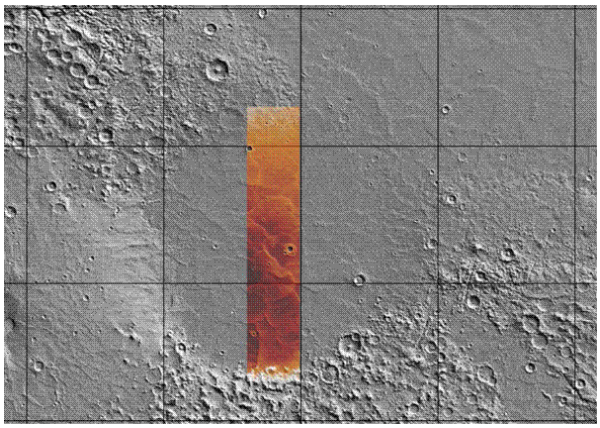

**Figure 2.** MOLA data of the Isidis region. False-colored overlay indicates region of study. Edge of one grid square measures 588 km.

**Mapping Methodology:** Ridges were mapped in a portion of the basin (see Figure 2) using axial surface mapping techniques [6]. The method of taking the first and second derivatives of the area to map areas of highest changing slope (in order to find the base of the fore- and backlimbs) was unsuitable due to the high level of noise and the difficulty of discerning relatively low-relief ridges (~50 m) in a field of craters and a regional relief spanning 2000 m. Instead, elevation transects were taken perpendicular to the ridges, resulting in total of about 400 transects taken over 35 identifiable ridges. These transcects were analysed for their first and second derivatives in Matlab, and key points (crest, base of forelimb, ect.) were manually selected. Ridge crests, backlimbs, forelimbs, and offset were mapped in the study area (see Figure 3) [7].

**Observations and Conclusion:** Figure 3 shows that almost all of the ridges verge away from the center of the basin. True offset values can best be determined once the area has been detrended for basin concavity. The data are analyzed in the program Forced Fold [8] which uses backlimb and forelimb geometry and estimates of surface cover to model the fault geometry at depth. Using this, we will construct a cross-section of

the basin and predict the rheology and possibly depth of the basalitic infill.

**References:** [1] Head J. W. et al. (2002) *JGR Planets, 107,* doi:10.1029/2000JE001445. [2] Freed A. M., Melosh H. J. and Solomon S. C. (2001) *JGR, 106,* 20603-20620. [3] Schultz R. A., Fossen H. and Watters T. R. (2001) *LPSC XXXII,* Abstract #1832. [4] Erslev E. A. (1991) *Geology, 19,* 617-620. [5] Allmendinger R. W. (1998) *Tectonics, 17,* 640-656. [6] Shaw J. H., Hook S. C. and Suppe J. (1994) *AAPG Bulletin, 78,* 700-721. [7] Tate, A. J., Mueller K. J. and Golombeck M. P. (2002a) *LPSC XXXIII,* Abstract #1836. [8] Johnson K. M. and Johnson A. M. (2002) *J. Struct. Geol., 24,* 277-287.

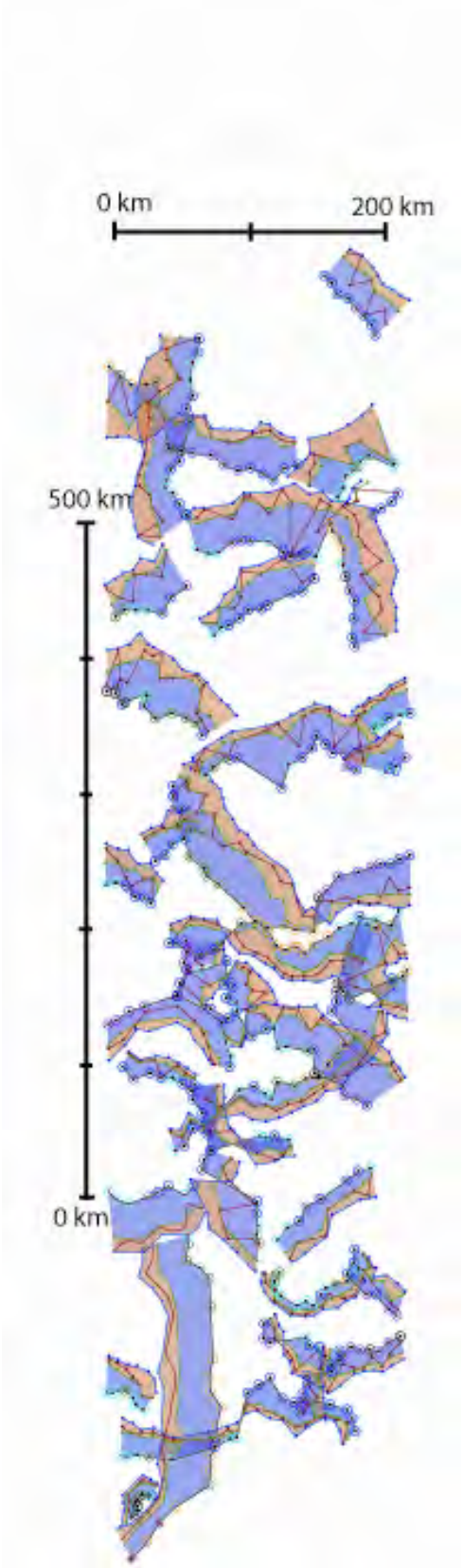


**Figure 3.** Axial surface mapping of wrinkle ridges. Black lines are the base of the backlimb, blue lines the base of the forelimb, red lines are the steepest points on the ridge, green lines are the ridge crests, colored circles indicate offset (no accurate values available), purple shading indicates the backlimb area, and orange shading indicates the forelimb area.