STRESS AND FLEXURAL MODELING OF ALBA PATERA, MARS. E.P. Turtle and H.J. Melosh. Lunar and Planetary Lab, University of Arizona, Tucson, AZ 85721.

Surface fracture patterns are indicative of the regional stress level and of the thickness of the elastic layer in which they are active. The terrain surrounding Alba Patera, one of the shield volcanoes in the Tharsis region of Mars, as well as the flanks of the volcano itself, is cut by numerous graben which are diverted outward around the volcanic cone (Fig. 1, [1]). Wise [2] demonstrated that this deflection could be caused by the interaction of an extensional regional stress with the stresses associated with the load of the volcano on the lithosphere. However, the regional stresses which produced a stress field matching the observed faulting were quite low. This is probably a result of his use of an elastic half-space to represent the Martian lithosphere. Here we present results of a similar study in which we represented Mars as having an elastic lithosphere of finite thickness overlying a fluid interior. This improvement in the model has enabled us to derive not only a better estimate for the amount of stress in this region, but also a value for the thickness of the lithosphere in the vicinity of Alba Patera.

Alba Patera rises about 2km above the Tharsis plateau and has a diameter of about 700km at its base. The surrounding graben cut across volcanic flows from Alba. Drainage from the slopes is not diverted into the faults, indicating that they formed after the growth of the volcano. The graben are thus the result of extensional stress imposed on the region after the formation of the volcano. Wise modeled Alba as a cone 500km in diameter and 5km high with a density of $2900 kg/m^3$, equal to that of the crust. The stress field from this load on an elastic half-space along with a superimposed regional stress between 5 and 20 bars produced a stress pattern that matched the trajectories of the graben around Alba. This value of stress is quite low compared to stresses thought to be necessary to initiate faulting, probably due the use of the elastic half-space in his model.

We have applied a model which incorporates an elastic lithosphere over a fluid mantle. The same type of model proved successful in describing a variety of fracture patterns associated with coronae on Venus [3]. We assumed a load with a gaussian shape for Alba. First we calculated the flexure of the lithosphere under such a load by varying three parameters: lithospheric thickness, load radius, and load height. The resulting profiles were compared to the most recent Martian topography [4]. The best fit was obtained for a lithospheric thickness of 100±25 km, volcano radius (at base) of 350±25km, and volcano height of 4.0±0.5km. There was little variation of load radius among the group of models which produced good fits. The expected tradeoff between lithospheric thickness and load height was apparent, but parameters were chosen to be in the middle of the range for each variable. Regional gravity has not yet been used to confirm the results of the topographic modeling. It should be possible to compute the gravity associated with the modeled volcanic load and resultant lithospheric flexure. A comparison of this with the observed gravity of the region will serve as a check on the validity of the model. This has not yet been implemented, however, and could lead to some changes in the model parameters.

Stresses due to a combination of the modeled volcanic load and a superimposed regional stress field were calculated out to a distance of three volcano radii for various values of regional stress. The pattern which best fits the observed graben trajectories (Fig. 2) corresponds to a extensional regional stress of 1.4±0.2kbar, significantly higher than the value obtained by Wise. The surface fracture pattern observed around Alba Patera is indicative of an extensional regional stress of 1.4±0.2 kbar acting in an elastic layer about 100±25 km thick.

[1] Scott, D.H. *et al.* (1986-87) Geologic Map of the Western Equatorial Region of Mars, USGS Map I-1802-A.
[2] Wise, D.U. (1975) *International Colloq. of Planetary Geology, Proceedings*, pp. 430-433.
[3] Cyr, K.E. and Melosh, H.J. (1992) *Icarus*, **102**, pp. 175-184.
[4] Zuber, M.T. personal communication

TECTONIC MODELING OF ALBA PATERA, MARS: Turtle, E.P. and Melosh, H.J

Figure 1 (right): Sketch of graben surrounding Alba Patera 90°-120°W and 25°-50°N (from [1]). Same scale as Figure 2.

Figure 2 (below): Model results for a lithospheric thickness of 100km, gaussian load with 700km diameter and 4km thickness, and regional stress of 1.4kbar. Left hand side of figure shows the resultant principal stresses: hourglass shape indicates compression and bars denote tension. Sizes are proportional to the magnitude of the stress. Regional stresses act in the x direction. Orientation of resultant graben are sketched on the right.