PALEOMAGNETIC POLE POSITIONS OF MARS. N. C. Richmond, L. L. Hood, *Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721, USA (nic@lpl.arizona.edu).*

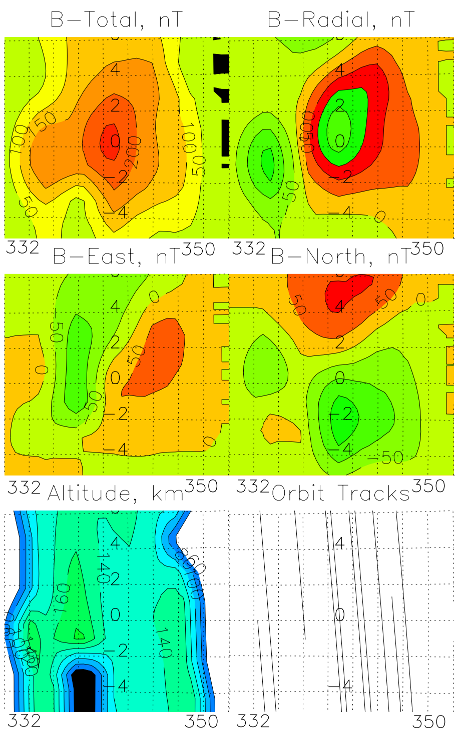

Figure 1: Regional field map of an anomaly centered at approximately 0°N, 340°E. The contour interval on the field maps is 50 nT; the contour interval on the altitude map is 20 km.

Introduction. The Mars Global Surveyor magnetometer experiment has obtained nearly uniform global measurements of the Martian crustal magnetic field at mapping orbit altitudes (∼370-440 km) since March 1999 (1). Lower altitude, partial coverage aerobraking data (∼80-200 km) has also been obtained, primarily over the southern hemisphere. In this paper, we report mapping of these data using methods introduced earlier by Hood and Zakharian (2). Results will be summarised and new model results from aerobraking data presented. The main goal is to use these data to calculate paleopole positions for relatively isolated anomaly sources.

Mapping Method. For the mapping and aerobraking phase data a vector field map is produced on a variable surface defined by the spacecraft altitude. The mapping procedure consists of (i) ordering of selected orbit segments according to location; (ii) visual examination of the segments to eliminate intervals with significant external field disturbances; and (iii) two-dimensional filtering of individual orbit data to produce an equally spaced array of measurements which can be used to generate the maps.

Figure 1 is a contour plot of an anomaly located at approximately 0°N, 340°E. Data coverage over this anomaly is not ideal, with only 10 orbits within a ∼20° longitude sector. However, due to the limited number of aerobraking phase orbits with altitude below 200 km over this location, it is the best coverage available.

Modeling Method. We assume that the sources of individual, isolated anomalies consist of a uniformly magnetized, circular plate located at the Martian surface with an unknown thickness and radius. An iterative forward modeling procedure (2) is applied to estimate the location of the plate, the radius of the plate, the intensity of magnetization per unit area and the bulk direction of magnetization within the plate. If necessary more than one plate can be used to model an anomaly.

This method assumes that the intensity and direction of magnetization is constant across the plate. In reality there could be significant variations across the source. Similarly the source is unlikely to be exactly circular and there could be variations in thickness. However, if the anomaly is dominantly dipolar it is possible to obtain an estimate of the bulk direction of magnetization using this method.

Modeling Results. Several studies have been carried out recently using the method described here (2,3,4). The model parameters are summarised in Table 1. The direction of magnetization is described by the angles α and β, where α is the angle between the local radial direction and the moment vector and β is the azimuth of the surface projection of the moment vector measured from the local eastward direction counterclockwise (looking down) about the radial direction.

Anomalies **D** and **E** were modeled using two plates, indicated by the subscripts a and b in Table 1.

Table 1. Model Parameters

	Location		**R (km)**	**DM**	**Mag Dir**	
	°N	**°E**			α	β
A	83	32	400±60	4.2±2.0e4	160±20	100±20
B	65	27	360±70	9.2±1.4e4	115±20	100±20
C	-14	194	390±60	19±5e4	25±20	270±20
$\mathbf{D}_a$	-27	165	325±40	20±5e4	55±30	135±30
$\mathbf{D}_b$	-18	156	110±20	58±5e4	75±30	60±30
$\mathbf{E}_a$	-25	229	200±40	21±5e4	235±20	35±20
$\mathbf{E}_b$	-33	232	200±40	21±5e4	245±20	35±20
F	-4	215	290±40	13±2e4	305±30	85±30
G	0	341	180±50	21±3e4	75±30	20±30

DM is the dipole moment per unit area. **A** northern anomaly (2), **B** southern anomaly (2) **C** ref. (3), **D**-**F** ref. (4).

In addition, results are presented for an anomaly modeled using the aerobraking phase data (Figure 1). The model field, calculated using the parameters in Table 1, is shown in Figure 2.

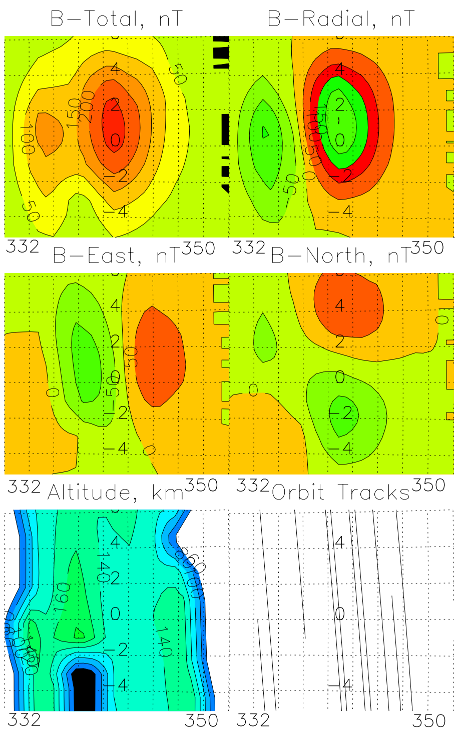

Figure 2: Same format as Figure 1 but showing the model field for the anomaly located at approximately 0°N, 340°E.

Paleopole Positions. Paleopole positions for the model parameters listed in Table 1 are presented in Table 2, calculated using the method described in (5). The north and south pole labels refer to the magnetic field poles. The error on the dipole positions are given by dp and dm, where dp is the semiaxis of the ellipse along the great circle from the source to the paleopole and dm is the semiaxis perpendicular to this great circle. It is noted that **B** and **G** have been modeled by other workers (6). Good agreement is shown for **B** (M3 in ref. 6). The agreement between the paleopole positions is not as good for anomaly **G** (M10 in ref. 6).

It has been suggested that the magnetic anomalies on Mars formed in the presence of a dominantly dipolar core dynamo field which experienced polarity reversals (2,3,6). Five of the plates in Table 2 have paleopole positions in an area centered on appromiately 30°N, 210°E. This is close to the circle of radius 30 degrees centered at 25°N, 230°E found to contain 7 out of 10 paloepoles for anomalies modeled using a different technique (6). We find north and south magnetic field poles within the same area, supporting suggestions of polarity reversals.

Table 2. Paleopole Positions

	Paleopole Position		**dp**	**dm**	
	°N	**°E**			
A	61	224	30°	34°	S
B	38	219	11°	22°	S
C	29	194	26°	32°	N
D$_a$	42	76	20°	35°	S
D$_b$	31	230	16°	31°	S
E$_a$	51	325	13°	23°	N
E$_b$	54	314	12°	21°	N
F	66	227	20°	35°	N
G	70	79	16°	31°	S

Four of the plates do not have paleopole positions consistent with a dipolar core dynamo field. Of these four, three correspond to plates that are part of a two plate model. In this case overlapping fields from the adjacent plates could be limiting the reliability of the results. Paleopole positions for other anomalies will be presented at the time of the conference.

References. (1) Connerney, J. E. P., M. H. Acuna, P. J. Wasilewski, G. Kletetschka, N. F. Ness, H. Reme, R. P. Lin and D. L. Mitchell, *Geophys. Res. Lett.*, *28*, 4015-4018, 2001; Hood, L. L. and A. Zakharian, *J. Geophys. Res.*, *206*, 14601-14619, 2001; (3) Hood, L. L. and N. C. Richmond, 33rd LPSC, 2002; (4) Richmond, N. C. and L. L. Hood, Fall AGU, 2002; (5) Butler, R. F., *Paleomagnetism: Magnetic Domains to Geologic Terranes*, 319 pp., Blackwell Sci., Malden, Mass., 1992; (6) Arkani-Hamed, J., Geophys. Res. Lett., 28, 3409-3412, 2001.