LUNAR MAGNETIC ANOMALIES. D.W. Strangway, J.C. Rylaarsdam and A.P. Annan, Dept. of Geology, University of Toronto, Toronto, Ontario

It has been clearly established that the magnetic fields detected by instruments on the lunar surface must be due to the presence of material carrying a magnetic remanence of at least $10^{-4}$ emu/gm. When this value is compared to the properties measured on the returned lunar samples, it is found that only a small class of samples carries a strong enough remanence to generate surface anomalies up to 300 gammas. This particular class of samples are breccias of medium metamorphic grade. It has therefore been hypothesized that the magnetic fields present locally on the moon are due to breccias which have settled in place from a temperature of 800°C. and that they acquired a remanence in the presence of an ancient lunar field. Orbital mapping of lunar magnetic fields has shown the presence of distinct anomalies, the most prominent of these being generally associated with the crater Van de Graaff. In our hypothesis, the magnetic remanence must be carried by breccias which have not been extensively reworked since their deposition. It is therefore quite possible that the relatively undisturbed light-coloured material present in many crater floors is the source of orbital anomalies. This hypothesis has been criticized on the basis that the anomalies do not coincide closely to the crater positions.

We have therefore generated a model for calculating the field at orbital altitude on the assumption that there is a magnetized layer filling the floors of the large craters. We have used the craters, Kepler, Aitken, Van de Graaff, Thompson, and Heaviside (fig. 1a) and we have examined the effect of putting a layer of magnetized material in the floor of each crater. The magnetization direction was chosen to be the same in each case. We are testing first whether anomalies are displaced from a magnetic crater at orbital altitudes and second whether a model can be made to fit the observation which has the same direction of magnetization in each case. If an ancient lunar field controlled the remanence acquired on cooling, one would expect the orientations to be random. Figures 1 b, c, d show the three components of magnetic field calculated for the case when the magnetization in each crater is oriented east-west.

These calculations are to be compared with the corresponding results observed and reported by Russell et al. (4) and shown in figure 2. Although we have not duplicated every aspect of the observed data with our model, there is a striking similarity in the two sets of data. It is immediately seen that the location of all components of the anomalies do not coincide with the craters but are offset. Although it can not yet be made a positive conclusion it appears that the same direction of magnetization in each crater can give a relatively good agreement between model and observations. Taken at face value this implies that there was an overall controlling field at the time that the breccias were emplaced in the floors of each of these craters.
FIGURE 1: Calculated magnetic anomalies due to filling in Aitken, Kepler, Van de Graaf, Thompson and Heaviside on the assumption that they are all magnetized in an east-west sense. Flying height 67 km.
A location of magnetized crater fillings  
B. east-west component of field 
C north-south component of field  
D. vertical component of field
LUNAR MAGNETIC ANOMALIES

Strangway, D.W. et al

References


2) M. Fuller, 1974, Revs. Geophys. Space Physics, 12, 23-70


FIGURE 2: Observed magnetic field data from lunar orbit, contour interval, \( \frac{1}{2} \) gamma, dashed line represents limit of coverage available.
A. crater locations  B. east-west component.
C. north-south component  D. vertical component