

AGE DISTRIBUTION OF LUNAR SURFACE MAGNETIC FIELDS,
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We describe work on the determination of the history of the ancient lunar magnetic field. Paleointensity determinations on returned lunar samples suggest that the ancient lunar magnetic field decreased from ~ 1 to 0.05 Oe over the period 3.9 to 3.2 AE.¹ Here we obtain distributions of lunar magnetic field versus the age of formation of the surface feature using electron reflection determinations of the lunar surface remanent magnetic fields. The electron reflection data² were obtained from the ~ 14 keV electron detectors on the Apollo 15 and 16 particles and fields subsatellite. Remanent magnetic field strengths were determined for $\sim 6 \times 10^3$ $1.25^\circ \times 1.25^\circ$ surface elements between $\sim 40^\circ$ N and 40° S latitude. The surface geologic maps^{3,4,5} provide identification in six major age groupings, Copernican, Eratosthenian, Imbrian, Nectarian and pre-Nectarian. Distributions of the surface field strengths were constructed for each age category. These distributions were further subdivided where applicable into mare and highland materials because of the large difference in magnetic susceptibility. The resulting distributions show a range of surface field strengths from 0 to $> 5 \gamma$ ($1 \gamma = 10^{-5}$ Oe) in every category of material and age. Typical distributions, plotted as percent of the total number per gamma field interval, fall rapidly with increasing field strength. The median and average surface field was computed for each distribution. Because of the large range of values of the surface field we feel that the median is a better measure of the typical field strengths. The median is approximately 0.1γ for Copernican material (≤ 1 AE), and systematically becomes larger with age of the surface materials, attaining a value of approximately 0.27γ for pre-Nectarian material (≥ 4.2 AE). Median values for mare materials fall approximately 0.05γ lower than non-mare materials of the same age.

These results should be considered highly tentative because of the following qualifications:

1. the range of field values is very much larger than the difference between the median values;
2. several strong regions (such as Van de Graaff) may dominate a given distribution;
3. the sampling of the lunar surface is limited to a $\pm 40^\circ$ band around the equator;
4. we expect that boundaries between materials of different magnetization should show strong surface fields.

MAGNETIC FIELD AGE DISTRIBUTION

Lin, R. P. et al.

This age dependence would imply a stronger magnetizing field in the ancient past. Further analysis is currently underway to verify these results.

References

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