LUNAR MAGNETIZATION CONCENTRATIONS (MAGCONS) ANTIPODAL TO YOUNG LARGE IMPACT BASINS, R. P. Lin, and K. A. Anderson,* Space Sciences Laboratory, University of California, Berkeley, CA 94720, L. L. Hood, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85711

Electron reflection measurements from the Apollo 15 and 16 subsatellites show that patches of strong surface magnetic fields ranging in size from less than ~7 km, the resolution limit of the observations, to greater than 500 km, are distributed over the surface of the Moon (1, 2). With the exception of a few regions — Rima Sirsalis (3) and Reiner Gamma (4) — no obvious association to surface geology has been found. In the ±35° latitude band covered by the electron reflection measurements, the largest concentration of surface magnetic fields extend in a chain from ~E160 S30 east and south to ~W115 S20 (Figure 1). In the north a large magcon is located at ~N10-25 E85-110. The southern chain includes the intense magnetic region near Van de Graaff initially found from Apollo subsatellite magnetometer measurements (5). The orbiting magnetometer also observed the anomaly centered at ~W125 S23, at the northeastern end of the southern chain (6). We have previously noted that these large regions are approximately antipodal, i.e. located diametrically opposite, to large circular impact basins (7). The southern chain appears to be composed of three regions corresponding to the antipodes of the Imbrium, Serenitatis and Crisium basins. The large northern magnetized region is antipodal to Orientale.

We have examined the antipodes of the 23 ringed impact basins identified by Wilhelms (8) for which electron reflection measurements are available. Measurements (in 1¼° × 1¼° pixels) located within an antipodal region equal in diameter to the basin itself were used to form distributions of the surface magnetic fields for each basin (Figure 2). The median surface magnetic field for each basin antipode is plotted in Figure 3, where the basins are arranged in order of increasing age. Strong magnetic fields are obtained for antipodes of the young ringed impact basins, but significantly weaker fields are found for older basins. Strong median magnetic fields are obtained at the antipodes of three young ringed impact basins, Orientale, Imbrium and Serenitatis. The median magnetic field at the antipodes of 20 other ringed basins are significantly weaker. With one possible exception, all these basins are older than the three young basins just referred to.

Large impacts could produce significant modification of the antipodal region either by focusing of impact generated seismic waves (9) or by clustering of secondary ejecta. Seismic waves may produce and enhance deep fractures in the antipode region. If an underlying layer of the lunar crust was uniformly magnetized over a very large region, possibly over the entire Moon, then the surface field from such a layer will be small except at the edges of the region. Deep fractures produced at the antipodes of impact basins will result in discontinuities in the magnetized layer, which would result in strong surface magnetic fields.

Alternatively, antipodal magnetic anomalies could mean that the basin-related secondary ejecta may have become highly magnetized, possibly in a strong ambient or impact generated magnetic field.

The apparent temporal variation of the magnetic fields for the basin antipodes may reflect real variations in the lunar magnetic field. Paleomagnetic data (10) suggest that a lunar "magnetic epoch" of strong fields occurred approximately at the time of formation of the youngest impact basins. However, the lack of strong antipodal fields for older basins may also be the result of more extensive gardening which has removed any strong magnetization signature.

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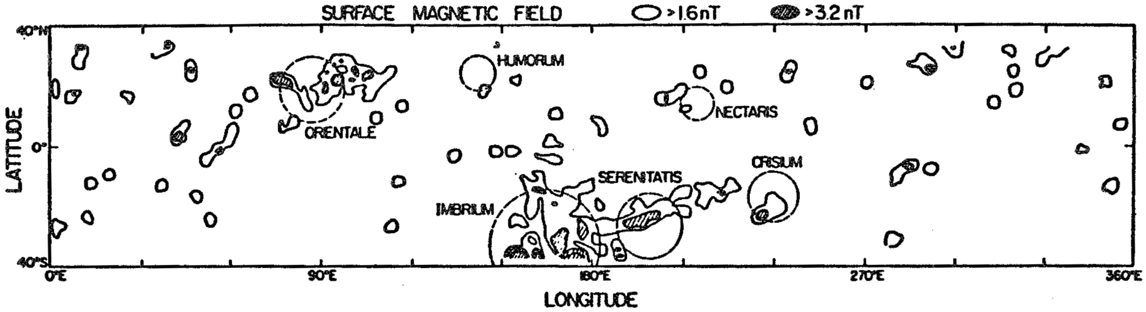

Figure 1 (above). A contour map of the strongest surface magnetic fields measured by the electron reflection method. The circles indicate the antipodes of large impact basins.

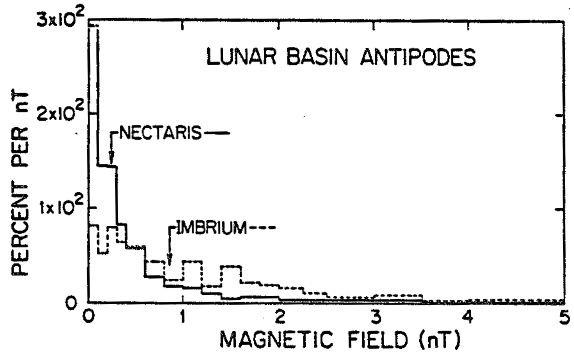

Figure 2 (left). The distribution of 1¼° x 1¼° magnetic field samples in the antipodal region for the Nectaris and Imbrium basins. The arrows indicate the median field value.

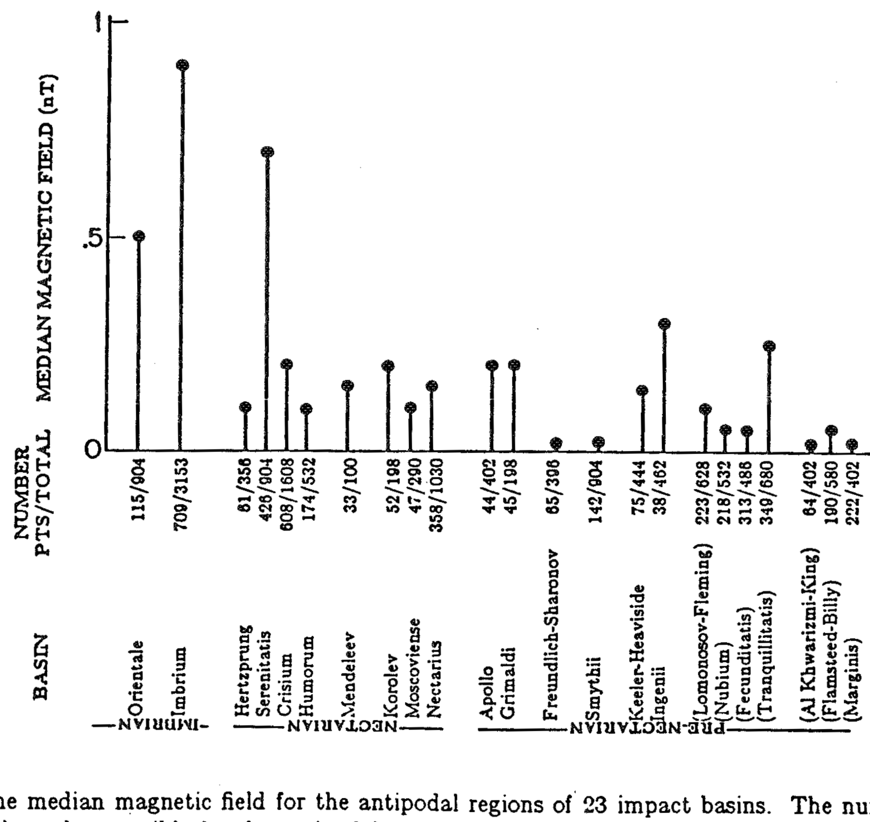

Figure 3. The median magnetic field for the antipodal regions of 23 impact basins. The number of samples and the total number possible for the antipodal region are given to provide an indication of the coverage.