REGIONAL ELECTROMAGNETIC INDUCTION AT THE APOLLO 15 SITE, B.F. Smith*, G. Schubert**, C.P. Sonett***, D.S. Colburn*, K. Schwartz†, *NASA Ames Research Center, Moffett Field, Calif. 94035, **Dept. of Planetary & Space Science, Univ. of Calif., L.A. 90024, ***Dept. of Planetary Sciences & Lunar & Planetary Lab., Univ. of Arizona, Tucson 85721, †5160 Camino Floral, Santa Barbara, Calif. 93111.

For frequencies f $\gtrsim$ 5 mHz, time-dependent magnetic fields recorded by the Lunar Surface Magnetometer (LSM) at the Apollo 15 (A15) site show a linear polarization which suggests a regional inductive influence of the nearby mascon basins (1). A15 LSM time series show a marked mirror-image symmetry in the components B_y and B_z, eastward and northward, respectively, in the plane locally tangent to the lunar surface. This mirror-imaging results from the resolution of NW-SE linearly polarized field fluctuations into the N-S and E-W directions. The driving field fluctuations show no such linear polarization. The lunar response to the driving interplanetary magnetic field monitored by the Ames Magnetometer on the Explorer 35 (Ex 35) lunar orbiter, has been investigated for the first three lunations following A15 LSM deployment. We have analyzed 24 one and two hour intervals in lunar daylight and an additional 25 cases on the night side for the first lunation. An additional 14 eight to ten hour intervals also in the first lunation have been used to determine the lower frequency lunar response.

Figure 1 shows the distributions of the directions of maximum power in the local tangential plane for day side LSM and Ex 35 data. Northwest is at $\alpha=135^\circ$. At the lowest frequency shown, the directional properties of the LSM and Ex 35 powers are nearly the same. At such low f the LSM power reflects the global lunar response to the driving field (2,3). At f $\gtrsim$ 5 mHz there is a preferred direction of maximum LSM response independent of the direction of Ex 35 maximum power. For the two highest frequencies shown, the direction of maximum LSM power is always between 40° and 70° W of N while the directions of the maxima for the Ex 35 data vary widely. For f $\gtrsim$ 5 mHz the field fluctuations at A15 are strongly polarized in the NW-SE direction independent of the properties of the interplanetary magnetic field. This linear polarization is also observed in the night side data, although the distribution of maximum power is not nearly as strongly peaked as in the sunlit cases, and it is also present in the data for other A15 lunations.

The local remanent field at A15 (26.1°N, 3.7°E) is small and bears no relationship to the direction of observed polarization. The source of this polarization cannot be global induction in an asymmetric plasma environment (4-7). The proximity of the A15 LSM to Imbrium and Serenitatis and the coincidence of the direction of polarization with the approximate direction to the center of Mare Imbrium and the approximate direction circumferential to Mare Serenitatis suggest that regional inductive effects are responsible for the observations (1).

The polarization phenomenon at A15 may be similar to a much less distinctive directional asymmetry in the A12 LSM data. The power at A12 tends to a maximum roughly 10° -30°W of N (Fig. 2) at the higher f while the corresponding Ex 35 power has a slight preference for N-S. As in the A15 data, the directional asymmetry is apparent for f $\gtrsim$ 5 mHz. The local remanent field at A12 (3.2°S, 23.4°W) is oriented in roughly the same direction as the maximum in the LSM power and we had previously interpreted the asymmetry as a plasma modulation of the local steady field which introduced a noise source in addition to the inductive response signal (2,3). However, even on the lunar night side, the asymmetry in the A12 data persists (8), though plasma modulation of a local field cannot be important. The similar nature of the directional asymmetries at both sites suggests a common physical source, though a combination of regional induction and plasma noise may be important for the A12 data.

Finally, we have investigated the low frequency (10^{-4}Hz $\leq f \leq 10^{-3}$ Hz) A15 LSM magnetic field transfer functions which show good agreement with those of A12 (3). The agreement indicates that the regional inductive response is not important at the lower f and thus, that both instruments measure the low frequency global electromagnetic response. This supports our previously determined electrical conductivity models for the lunar interior (2).

(1) SCHUBERT G., SMITH B.F., SONETT C.P., COLBURN D.S. and SCHWARTZ K. (1974) Polarized Magnetic Field Fluctuations at the Site of Apollo 15: Possible Regional Influence on Lunar Induction, Science, in press.

(2) SONETT C.P., SMITH B.F., COLBURN D.S., SCHUBERT G. and SCHWARTZ K. (1972) The Induced Magnetic Field of the Moon: Conductivity profiles and Inferred Temperature, Proc. Third Lunar Science Conf., Vol. 3, pages 2309-2336, M.I.T. Press.

(3) SMITH B.F., SCHUBERT G., COLBURN D.S., SONETT C.P. and SCHWARTZ K. (1973) Corroborative Apollo 15 and 12 Lunar Surface Magnetometer Measurements, in Lunar Science IV, ed. J.W. Chamberlain and C. Watkins (Houston: Lunar Science Inst.).

(4) SCHUBERT G., SONETT C.P., SCHWARTZ K. and LEE H.J. (1973) The Induced Magnetosphere of the Moon I. Theory, J. Geophys. Res., 78, 2094-2110.

(5) SMITH B.F., COLBURN D.S., SCHUBERT G., SCHWARTZ K. and SONETT C.P. (1973) The Induced Magnetosphere of the Moon II. Experimental Results from Apollo 12 and Explorer 35, J. Geophys. Res., 78, 5437-5448.

(6) SCHWARTZ K. and SCHUBERT G. (1973) Lunar Electromagnetic Scattering I. Propagation Parallel to the Diamagnetic Cavity Axis, J. Geophys. Res., 78, 6496-6506.

(7) SCHUBERT G., SCHWARTZ K., SONETT C.P., COLBURN D.S. and SMITH B.F. (1973) Lunar Electromagnetic Scattering II. Magnetic Fields and Transfer Functions for Parallel Propagation, Proc. Fourth Lunar Science Conf., Vol. 3, M.I.T. Press, in press.

(8) SCHUBERT G., SMITH B.F., SONETT C.P., COLBURN D.S. and SCHWARTZ K. (1973) The Night Side Electromagnetic Response of the Moon, J. Geophys. Res., 78, 3688-3696.

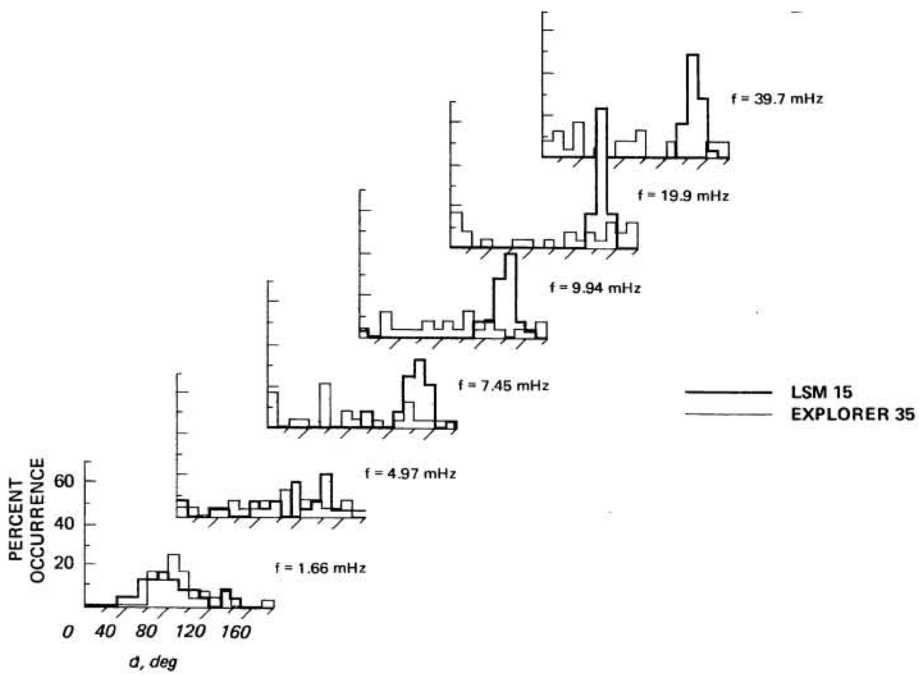

Fig. 1. Directions of maximum power for Apollo 15 sunlit data. Angle α measured from y(east) counterclockwise towards z(north).

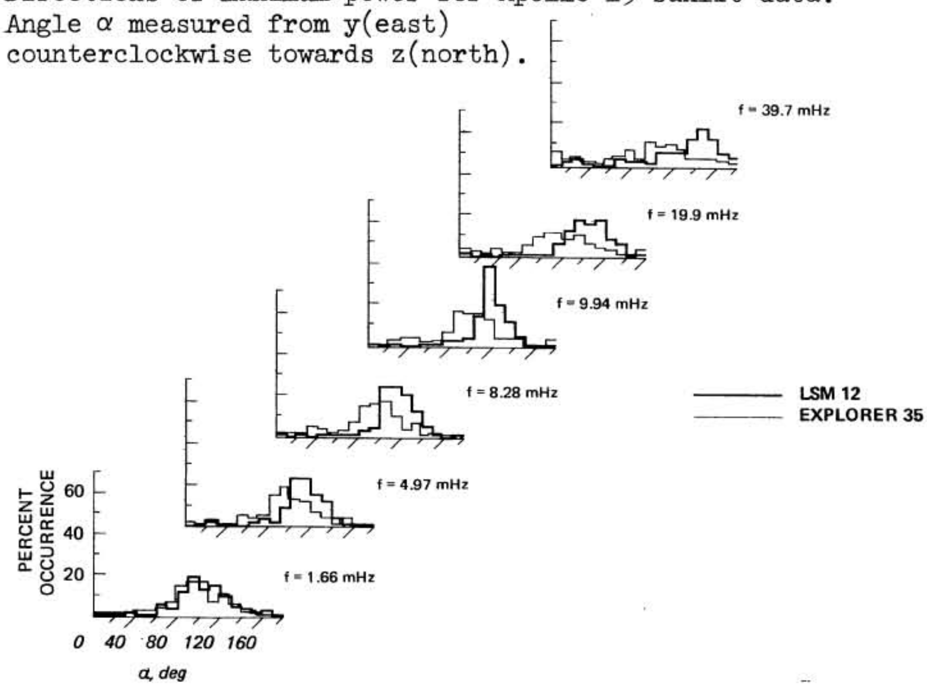

Fig. 2. Directions of maximum power for Apollo 12 sunlit data.