GLOBAL LUNAR PROPERTIES FROM SURFACE MAGNETOMETER MEASUREMENTS,
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Data from the Apollo 12, 15, and 16 magnetometer network have been used to calculate the internal electrical conductivity profile and magnetic permeability of the moon. Model calculations have been carried out to determine the effect of a lunar ionosphere on permeability results. A thermoelectric current model for the ancient source of the remanent magnetic fields has also been examined.

Lunar electrical conductivity results have been determined using a new analytical technique. A superposition of electromagnetic transient events, each in three orthogonal axes, is obtained from two-hour sets of simultaneous Apollo and Explorer magnetometer data. The total data set is ten times larger than previously used and allows deeper sounding of the lunar interior. This new technique yields an improved profile and permits the size and conductivity of model lunar cores to be studied.

A new technique has also been developed for calculating the relative magnetic permeability and iron abundance of the moon which involves the use of simultaneous surface magnetometer measurements only, and does not depend upon orbital data. The high resolution of the Apollo surface instruments, their proximity to the permeable lunar globe, and the simultaneous use of three orthogonal vector components permit a more accurate determination of the interior iron abundance. A model for the lunar ionosphere in the geomagnetic tail has been examined for effects on the lunar permeability determination. This model assumes that upon entering the geomagnetic tail the moon quickly loses its lighter atmospheric constituents by thermal escape, leaving principally argon and neon to be photoionized. Consideration of the ionization process suggests that argon and neon are ionized and exist at approximately 300 K, and the electrons are at a temperature of 20 eV. It is these energetic electrons which dominate the ionospheric dynamics and are responsible for a rapid thermal loss of both ions and electrons. A lower limit of 0.9 is calculated for the permeability of this diamagnetic ionosphere.

Thermoelectric currents have been used in a model of the ancient source of the remanent fields measured by Apollo 12, 14, 15, and 16 magnetometers. In this model thermal gradients in cooling mare lavas produce Thomson thermoelectromotive forces which drive currents through the mare. The solar wind plasma, highly conducting along magnetic field lines, conducts the electrical current from the top surface of the lava to the lunar surface outside the mare; the lunar interior completes the circuit. Preliminary calculations show that under certain conditions, field strengths up to 500 gammas are possible.