

A REVISIT TO APOLLO MAGNETIC FIELD RECORDS FOR SOUNDING OF THE LUNAR INTERIOR.

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Introduction: Between 1969 and 1975 three Apollo missions collected a unique set of magnetic field records measured on the surface of the Moon and in orbit at about 100 km above the surface. One of the important uses of these magnetic field records is to detect the lunar interior, such as a metallic core, by electromagnetic sounding methods. The popular approach is the use of an orbiting Apollo sub-satellite and a Lunar Surface Magnetometer (LSM) to measure respectively the input to the Moon and the sum of the input and the response [1,2]. Studies using this approach suggest either no evidence of a core with an upper limit of about 360 km [3] or a paramagnetic Moon [4]. Another approach probes the deep interior of the Moon using a low-altitude orbiting sub-satellite magnetometer to measure the induced dipole moment of the Moon in the magnetotail lobes [5,6]. The Apollo sub-satellite measurements detected an induced magnetic field of $-4.2 \pm 0.6 \times 10^{22}$ Gauss-cm³ per Gauss of applied field, suggesting an electrically conducting core with a radius of slightly more than 400 km [7]. The two approaches did not necessarily yield the same result.

Revisit to Apollo Magnetic Field Data: The two-instrument studies depend crucially on the accurate intercalibration of the magnetometers, and some of these earlier studies might have suffered from the differences in the gain of the magnetometers [8] that worth re-analysis with a careful calibration across different instruments. For over two decades, the format of the Apollo magnetic data had become obsolete, and the data were difficult to study. Only until recently are we able to restore the Apollo sub-satellite magnetometer data and a small portion of the LSM data. We selected a few intervals in 1971 where both Apollo 15 sub-satellite and LSM were operational, and we compared the two measurements in the solar wind, in the magnetosheath, and in the magnetotail for the intercalibration of the instruments as well as the sounding of the lunar interior. The comparison between the two Apollo instruments has not been made in the past, and we will assess how the results are compared with those obtained in early studies using Explorer 35 for upstream measurements.

Looking Forward: The revisit to the Apollo magnetic field records reminds us that for more than 37 years we have not been making magnetic field meas-

urements on the surface of the Moon. Surface measurements have their unique role that cannot be replaced by orbital measurements. The resolution of Apollo magnetic observations may be coarse, and the intercalibration of the Apollo measurements made several decades ago may be more difficult today. Nevertheless, the lessons learned from revisits to the Apollo magnetic observations can provide useful references for planning future lunar surface experiments.

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