QUANTITATIVE COMPARISON OF LUNAR PROSPECTOR MAGNETOMETER AND ELECTRON REFLECTOMETER DATA. R. A. Carley[1], M. E. Purucker[2], J. S. Halekas[3], and K. A. Whaler[1]. [1]School of GeoSciences, University of Edinburgh (Grant Institute of Earth Science, West Mains Road, Edinburgh, EH9 3JW, Scotland, r.a.carley@sms.ed.ac.uk) [2]Raytheon at Planetary Geodynamics Lab, GSFC (Code 698, GSFC/NASA, Greenbelt, MD 20771, purucker@geomag.gsfc.nasa.gov) [3]Space Sciences Laboratory, University of California, Berkeley, CA (jazzman@ssl.berkeley.edu).

Introduction: Recent processing of the low altitude (11-66 km) Lunar Prospector Magnetometer (LP-MAG) data has made possible direct comparison of the LP-MAG and LP Electron Reflectometer (ER) data. The LP-MAG directly measured three orthogonal components of the lunar magnetic field at satellite altitude, while the ER indirectly determined the surface field intensity [1]. A preliminary global model of the internal magnetic field of the Moon developed from MAG data [2] was used to reproduce the vector components and magnitude of the magnetic field at the lunar surface. These fields were then compared with the LP-ER estimates of the surface field inferred using electrons reflected from local surface magnetic fields. These data sets show pleasing similarities despite their differing sensitivities and resolutions.

A combined MAG/ER data set is useful for the production of constrained crustal magnetization models for the Moon which can reveal the magnitude, direction and extent of magnetization for regions of the lunar crust.

Data: The data used for this comparison are the surface magnetic field estimates from ER data at all altitudes [3, 4] and the surface magnetic field reproduced from a 90 degree spherical harmonic model of the internal magnetic field of the Moon, developed from the low altitude LP-MAG data [2]. Both of these data sets are from magnetically quiet periods when the Moon was in the Earth's magnetic tail, or when LP was in the lunar wake (lunar night).

LP-MAG surface reproduction The spherical harmonic model used in this comparison was produced from a map of MAG data developed using internal dipoles as basis functions to represent the correlative parts of three adjacent satellite passes after subtraction of a simple model of the external magnetic field. Data from the lunar wake and magnetic tail were supplemented by data taken when the Moon was in the solar wind to give the global coverage required for such spherical harmonic analysis.

The spherical harmonic model was used to reproduce the scalar and vector components of the surface magnetic field on a 5×5 and 1×1 degree grid, consistent with the ER data sets (1° of longitude ~ 30 km). Field reproductions at altitude are in good agreement with independently processed LP-MAG data [5].

LP-ER data The LP-ER data estimates of the surface magnetic field intensity used in this comparison are average field estimates for 5×5 degree and 1×1 degree bins 'boxcar smoothed' over 3×3 degree areas. Electron Reflectometry provides a lower bound scalar estimate of the magnetic field, located by linear extrapolation of the magnetic field vector measured at the spacecraft with the magnetometer to the surface. As a result, the ER data set is sparse at the poles where the spacecraft is not 'magnetically connected' to the surface, and may be subject to some location errors (of the

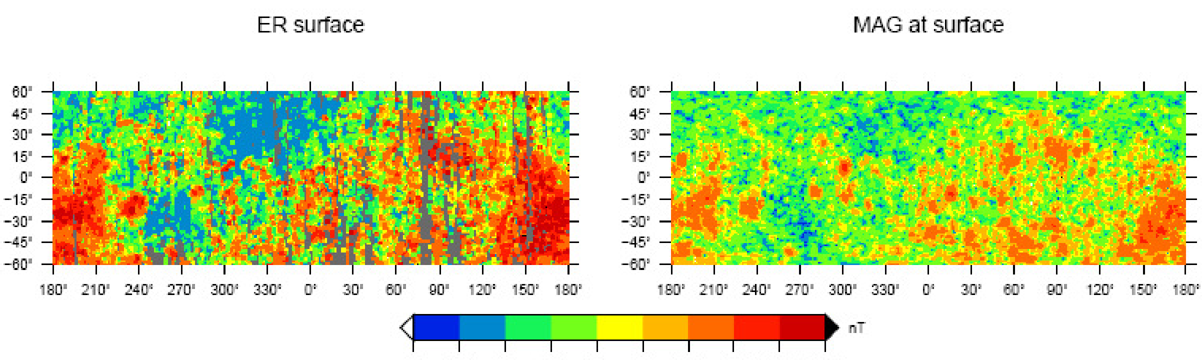

Figure 1: A comparison of the 1×1 degree binned surface field magnitude estimates from LP-ER data versus the surface field magnitude reproduced on a 1×1 degree grid from a preliminary global model of the internal magnetic field of the Moon developed from LP-MAG data. Magnetic field strength is indicated by color, as shown in the scale bar. Polar latitudes are not shown due to low coverage, and missing data is shown in greyscale.

order of the satellite altitude) over larger magnitude regions where there may be significant curvature of the magnetic field lines.

Comparison: Qualitatively, the ER and MAG surface fields are in remarkable agreement in terms of location of fields and relative magnetic field magnitude (figure 1). The largest differences between the data sets occur in the regions of very strong or very weak magnetic field. This is expected as the ER surface field magnitudes are most reliable for moderate fields (a few nT to tens of nT).

Both data sets show the now familiar concentrations of strong magnetic fields antipodal to the youngest impact basins [6], along with several small areas of strong anomalies such as Reiner Gamma and Rima Sirsalis. As expected, the ER data give the highest surface magnitudes with strengths of up to hundreds of nT. The spherical harmonic model of the internal magnetic field, being produced from MAG data at satellite altitude, is not sensitive to localized incoherent sources that are detectable by Electron Reflectometry. However, the ER data are not consistently higher than the MAG data.

In areas of high surface field, such as the strongly magnetized South Pole Aitken basin, the ER magnitude estimates are indeed higher than the spherical harmonic model field reproduction, in some areas by over 100 nT. However, in the weakly (< 0.2 nT) magnetized basins such as Imbrium and Orientale, it is the MAG data that give the larger amplitude fields, if only by a few nT. This could be the result of the ER data being a lower limit to the surface field (particularly in weaker field areas), or could result from the amplification of noise in the MAG data at altitude when reproducing the field at the surface from the spherical harmonic model.

The raw MAG and ER data have different spatial resolutions. MAG data generally have a resolution of tens of km, depending on the orbiting altitude of the satellite and disturbances in the ambient magnetic plasma. ER data have a higher intrinsic spatial resolution of several km, being determined by the gyro-radius of the reflected electrons. Sparse coverage at this sub-degree resolution requires the ER data to be binned. These different resolutions cause the differences between the MAG and ER data sets to vary with resolution, with more variation for the 1×1 degree data.

Regional studies: Local comparisons of the ER and MAG data sets allow the causes of the data differences to be investigated and allow a study of the coherence scale of the crustal fields. The high field regions of Reiner Gamma and Rima Sirsalis will be studied and preliminary magnetization models presented.

Magnetization models: The combined MAG and ER data sets will be used with an equivalent source dipole technique and conjugate gradient approach [7] to produce preliminary magnetization models for the Reiner Gamma and Rima Sirsalis regions. Estimates for the magnitude and direction of magnetization models which can account for both the magnetic fields at altitude and at the surface place constraints on magnetization models produced from MAG data alone (e.g [8, 9]) and will contribute to the resolution of some of the issues surrounding lunar magnetism.

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