GLOBAL ABUNDANCE OF FeO ON THE MOON: IMPROVED ESTIMATES FROM MULTISPECTRAL IMAGING AND COMPARISONS WITH THE LUNAR METEORITES. Paul G. Lucey[1] , G. Jeffery Taylor[1] , and Erick Malaret[2], [1]Hawai'i Institute of Geophysics and Planetology, 2525 Correa Rd., Honolulu HI 96822, [2]Applied Coherent Technology Corp., Herndon, VA 22070.

Lucey et al. 1995[1] presented estimates of the global abundance of Fe based on a new technique for deriving iron contents from spectral data on lunar materials. They suggested that the average iron content of the lunar surface was significantly lower than previously estimated, a conclusion apparently at odds with the composition of lunar meteorites[2]. The Lucey et al. method was based on a calibration using laboratory spectra of lunar soils obtained by John Adams' group which used a photometric system (directional hemispherical reflectance) which is not identical to that used in spacecraft observations (bidirectional reflectance). The two are related, but in a nonlinear way [3]. While the method employed reproduced landing site averages reasonably well, much of the Moon showed Fe contents lower than that of any of the landing sites and lunar soils. This required extrapolation to the lower values FeO areas observed. This extrapolation, coupled with the known nonlinearities in the calibration, makes the absolute calibration below FeO contents of Apollo 16 site averages suspect.

To improve these estimates we constructed a calibration curve based solely on the average compositions of the Luna and Apollo landing sites using full resolution Clementine data. We then checked the calibration at low FeO contents using locations on the nearside which have been shown by near-IR spectroscopy to be composed of anorthosite with less than 3wt% pyroxene [4] [5] and must have iron contents less than 1wt%. The new calibration yields FeO values between zero and 1 wt% for all anorthosite locations checked thus far[6]. The Lucey et al 1995 data had shown low Fe terrains at high northern latitudes and so admitted the possibility that the low values were due in part to a phase function error (Clementine data exhibit a high correlation between latitude and phase). We checked the phase correction by projecting and ratioing Galileo nearside data (taken at a narrow range of phase angles) to Clementine data (taken over almost 90 degrees of phase) and derived a phase correction assuming Galileo as "truth" as these latter data do not have a correlation of latitude and phase.

The results are shown in the form of global, farside and nearside histograms in Figure 1 . The global mode is 4.6 wt% FeO, the farside mode is 4.4 wt% FeO, and the nearside mode is 5.2 wt% FeO. These values are higher than the Lucey *et al*. estimates (global nonmare average FeO = 3.9 wt% FeO) and correspond to a global Al_2O_3 model of 27 to 29 wt%. Recently, Korotev *et al*.(2) noted that the lunar meteorites range in FeO from 4.3 to 6.1 wt% FeO. Our new calibration shows only on the order of 10% of the lunar surface has FeO values lower than the lowest lunar meteorite, though there are still very significant areas of the northern farside which show essentially zero FeO. Given the 1wt% FeO uncertainty in the multispectral FeO method, the new estimates for the iron content of the lunar crust from multispectral imaging are not in conflict with the results from the lunar meteorites.
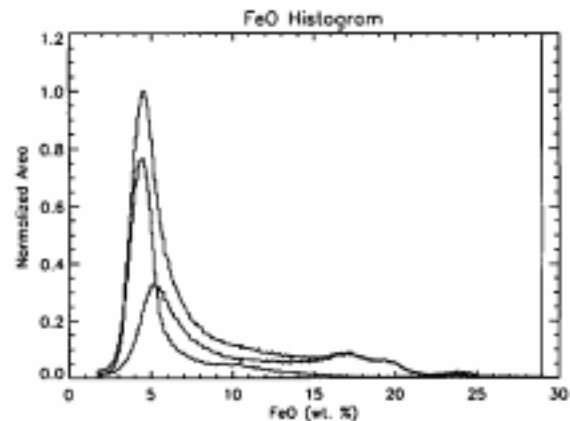

Figure 1. Histograms of global, nearside and farside FeO content. Data are in 0.1wt% bins. Global histogram is the curve that peaks at a normalized area of 1.0. The farside curve peaks at about 0.75 of normalized area. The nearside curve peaks at about 0.3 of normalized area. The bump in the farside curve near 10 wt% FeO is the South Pole-Aitken Basin. The second mode at higher FeO in the nearside curve are the mare basalts.

[1] Lucey, P.G., G.J. Taylor, and Erick Malaret, *Science* **268** pp1150-1153, 1995.
[2] Korotev, R.L., B.L. Jolliff and K.M. Rockow, *Meteorites and Planetary Science* **31**, pp909-924, 1996.
[3] Hapke, B., **JGR 86**, pp3039-3054, 1981.
[4] Pieters, C.M. in Remote Geochemical Analysis, Cambridge University Press, pp309-339, 1993.
[5] Peterson, C.A., *et al.*, **EOS 77**, p. F488, 1996..
[6] Peterson, C.A., *et al.*, **GRL 22**, pp3055-3058, 1995.