PREDICTIONS FOR FUTURE X-RAY FLUORESCENCE MEASUREMENTS OF MERCURY'S SURFACE FROM APOLLO ORBITAL XRF DATA. Faith Vilas[1], [1]MMT Observatory, PO Box 210065, University of Arizona, Tucson, AZ 85721, fvilas@mmto.org.

Introduction: Over thirty years after Mariner 10 first visited Mercury, the MESSENGER space probe will return to study the planet from Mercurian orbit. Its payload will include the X-Ray Spectroscopy (XRS) geochemical experiment [1], designed to probe the top 100 µm of Mercury's surface regolith for the Kα line of Al, Mg, Si, S, Ca, Ti and Fe across the 0.5 – 10 keV energy range. The European spacecraft Bepi-Colombo is planned to follow MESSENGER to Mercury in 2013 [2]. The x-ray fluorescence spectrometry technique has been used to study the elemental composition of inner Solar System bodies, including the nearside of the Moon during Apollos 15 and 16 [c.f.,3,4]. The surface coverage of the Moon afforded the Apollo observations was limited to the illuminated side of the Moon, and governed by the flight path, altitude, and orientation of the Apollo orbiters. Therefore, limited coverage of the nearside of the Moon is available from both Apollo missions [c.f. 5].

Multiple efforts were made to reduce the Apollo orbital XRF data. Two efforts endeavored to correct for the variation in the X-ray fluorescence signals caused by varying solar activity. One used the Tucker-Koren Solar Model coupled with solar flux measured by Solrad 10 during the Apollo missions [6]; the second used an empirical method measuring Al/Si and Mg/Si of lunar areas assumed to have constant chemical composition and physical state [7]. This abstract uses data reduced with the latter method, with no prejudice in choice beyond the author's familiarity with this method.

In separate efforts, ground-based telescopic spectra of the Moon and Clementine images have been analyzed to identify anorthosites on the surface [8,9,10,11], including both "pure" anorthosites (defined as having 0 – 2 wt %. FeO) and noritic anorthosite / anorthositic norite (with 2 – 4 wt% FeO). As ancillary research, lunar surface areas that were identified as having photometry indicating mature anorthositic compositions were analyzed as analogues to Mercury's surface mineralogical composition [12]. In particular, large areas on the lunar far side identified with Clementine photometry as being mature anorthosites were examined [12]. This assumption is quite reasonable, given that generally we expect the surface of Mercury to be extremely weathered, probably due to micrometeoroid impact, solar wind sputtering, or energetic cosmic and solar rays creating nanophase iron ($npFe^0$) in the surface material. The result of this weathering is to darken the surface material, decrease the depth of absorption features present in reflectance spectra, and redden the overall spectrum at wavelengths > 600 nm [13,14].

Methodology: This method of identifying areas on the Moon that are analogous to Mercury could also be effective in predicting the Al/Si and Mg/Si intensity ratios that will be observed on Mercury's surface. This abstract presents the first results of (1) a search to identify lunar surface areas having spectral data that indicate very low amounts of FeO within the region of the lunar surface covered by the Apollos 15 and 16 orbital XRF experiment, and (2) an examination of the Al/Si and Mg/Si ratios calculated from the Apollo data for those areas. Making the assumption that spectral data for the Moon serve as a reasonable analogy for spectra of the planet Mercury because the underlying terrain has a similar composition, these lunar areas should have representative elemental ratios for Mercury.

Additional constraints on the data also affected the analysis. First, the surface coverage of the Apollo XRF observations does not include areas with much pure anothosite, or low FeO anorthosites. Those areas that are identified present additional problems. The first is that many of these areas are generally smaller than the footprint of the Apollo XRF detectors (the XRF data are smoothed by a 5-channel running box average simulating the size of the detector [7]). Thus, a derived ratio would represent lunar terrain that includes the low FeO anorthosite areally mixed with different lunar terrain.

Second, many of the identified anorthosites on the Moon's surface appear to be immature. On Mercury, we expect mature, space-weathered terrain, potentially more weathered than the lunar surface. Given the limited amount of material with which to work, decisions about usable anorthositic terrain on the Moon were based on FeO content derived from the spectra or photometry of the Moon, regardless of the indication of maturity. Some support for this decision is found in [15], where laboratory samples of finely ground lunar rocks and lunar regolith were excited by SKα radiation simulating the "quiet" sun conditions that existed at the Moon during the Apollo XRF experiments. The Al/Si intensity ratios were plotted against Al_2O_3/SiO_2 concentration ratios, and Mg/Si intensity ratios were plotted against MgO/SiO_2 concentration ratios. The lunar regolith samples were of varying maturities, however, the lunar soils of basaltic and anorthositic composition were co-linear in these plots, and the concentration/intensity ratios were independent of soil maturity [15].

Finally, the scatter in the observed elemental intensity ratios increased with increasing distance from the location in the orbit where the insolation was maximum for that orbit. If data were considered at greater distances from the solar maximum, the average of the data was considered.

First Predictions: Two areas are considered here: the crater Proclus near Mare Crisium and surrounding environs, and highlands areas SE of Mare Smythii. More will be presented.

Apollo 15 Intensity Ratios Over Low FeO Terrain [7]

	Al/Si	Mg/Si
Proclus (orbits 27, 30)	1.25	0.75
Highlands SE of Mare Smythii (orbits 16, 20)	1.26	0.63

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