CANDIDATE SOURCE REGIONS FOR THE LUNAR METEORITES.
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Introduction: The lunar meteorites provide a sampling of the Moon's surface unlike any provided by the Apollo or Luna missions. While these latter samples are from known locations, the lunar meteorites appear to randomly sample the Moon. To date, no studies have concluded that lunar meteorites are preferentially ejected from any *specific* regions on the Moon [1], though [2] have recently suggested that Dhofar 961 is connected to the South Pole Aitken (SPA) Basin and [3] have traced SaU 169 to a thorium hotspot south of Imbrium. Given this random sampling, lunar meteorites can reveal much about the geochemistry and origin of the regions from where these meteorites were excavated, as well as linking the ages of the rocks to their source regions, providing important constraints on the timing of recent impacts into the lunar surface and the age of the lunar surface. Here, we present candidate source regions for most of the lunar meteorites.

Methods: Using Lunar Prospector Gamma Ray Spectrometer (LP-GRS) data optimized by [4], we have simultaneously matched nine major and trace elements (Si, Ti, Al, Fe, Mg, Ca, Th, U, and K) to the compositions of most of the lunar meteorites. Two matching algorithms are used in this process. In the first, a range is defined around the compositional value of a LP-GRS pixel based on a prescribed tolerance, while the second is based on a sum of errors between the meteorite compositions and the LP-GRS pixel values. The top matches are plotted onto a lunar surface map in order to identify clustering within candidate source regions for each meteorite. Where possible, the compositions of paired meteorites are also cross-compared to test the method. These procedures allow the identification of source regions with compositional affinities to the meteorites, and to infer such properties as nearside vs. farside provenance (feldspathic meteorites) and possible source mare (basaltic meteorites).

Sample Results/Discussion: Yamato 983885 (Y98) and Calcalong Creek (CC) may be samples from the SPA basin floor, a high priority target for lunar exploration by a sample return mission. Like Dhofar 961 [2], these meteorites are basalt-bearing feldspathic regolith breccias, and their candidate source locations are driven by high Si (Y98, CC), Ca and K (Y98) and low Mg (CC) concentrations in the rocks. Our most likely source region for SaU 169, a KREEP-rich, mafic impact-melt regolith breccia is near the source site determined by [3] driven by high Th, as well as U. Our determination of Mare Serenitatis as the source region for NEA 003, a high Ca/Mg mare basalt with basaltic impact melt breccia, compares well with the work of [5].

Although a simultaneous match of nine elements and the clustering of the top matches lend confidence to our determinations, the Moon is known to be heterogeneous on scales smaller than the LP-GRS resolution. Thus, our determinations are non-unique, and *candidate* locations have been prioritized for future analysis. This effort sets the stage to identify source craters for nearly all lunar meteorites.

References: [1] Korotev R. 2005, *Chemie der Erde* 65, 297. [2] Jolliff B. et al. 2009, Abstract #2555. 40th LPSC. [3] Gnos et al., 2004, *Science* 305, 657. [4] Prettyman et al., 2006 *JGR* 111, E002656. [5] Haloda et al., 2007, Abstract #1768. 38th LPSC.