LOCAL-SCALE SPECTRAL VARIABILITY OF THE SOUTH POLE-AITKEN BASIN. J. A. Arnold[1], T. D. Glotch[1], J. L. Bandfield[2], B. T. Greenhagen[3], P. G. Lucey[4], M. Wyatt[5], D. Paige[6]; [1]Department of Geosciences, Stony Brook University, Stony Brook, NY 11794-2100, jaarnold@ic.sunysb.edu, [2]Department of Earth and Space Sciences, University of Washington, [3]Jet Propulsion Laboratory, [4]Hawaii Institute of Geophysics and Planetology, University of Hawaii, [5]Department of Geological Sciences, Brown University [6]Department of Earth and Space Sciences, UCLA.

Introduction: We are using emissivity spectra derived from Diviner Lunar Radiometer Experiment (Diviner) data to characterize the mineralogy of the South Pole-Aitken (SPA) basin. We placed particular emphasis on characterizing the distribution of the most mafic components.

Diviner is equipped to study variations in silicate mineralogy. Of Diviner's nine spectral channels, two measure broadband solar reflectance (Ch 1 & 2) and seven measure emitted infrared radiation (Ch 3-9). Three of the infrared channels, located at 7.80 µm (Ch 3), 8.25 µm (Ch 4), and 8.55 µm (Ch 5), are specifically dedicated to distinguishing the Christiansen frequency (CF) of the most abundant lunar materials [1]. The Christiansen frequency varies with degree of SiO_2 polymerization; more mafic materials have Christiansen frequencies at longer wavelengths [e.g. 2].

Background: The SPA basin, at ~2500 km in diameter is the largest known impact basin in the solar system and is pre-Nectarian in age [3]. It is situated on the far side of the moon centered at roughly 60°S, 180°W. Unlike the impact basins on the nearside, it does not have an extensive covering of mare material. This is thought to be due to crustal differences between the near and far sides of the moon [4,5].

Heavily cratered surfaces interior to the SPA basin are characterized by a lower albedo and an enhanced mafic signature [6] as well as an increased abundance of TiO_2 [7] compared to typical highlands exterior to the basin. Possible explanations for this contrast can be placed in three general categories: (1) An extensive mare was produced by the initial basin forming impact. This was partially covered and mixed with other materials by subsequent impact events [8]. (2) Materials from the lower crust and/or upper mantle were excavated upon impact [8,9]. (3) The SPA basin composition may be due to mixing of anorthositic highland material, foreign material and the underlying crust by impact-generated melt [9,10].

The silicate mineral composition of the SPA basin, especially the presence or absence of olivine, can provide a clear indication of whether any of these processes have brought mantle material to the surface. Previous studies attempting to address the question of how much mantle material could be on the floor of SPA had widely varying results and interpretations [6,8]. At first, it was thought that the mantle component of the SPA basin could be as much as 50% based on the FeO and TiO_2, content [6]. However, studies focused on detecting olivine with Clementine UV-VIS and near-IR data yielded a small upper limit on the amount of olivine, which seems to suggest that only crustal materials have been excavated [9]. Because Diviner operates in a different wavelength range and is more sensitive to bulk composition, it may be able to provide a check on previously derived upper limits for olivine.

Methods: We established an index to highlight olivine. The first criteria is that the CF be within the range of olivine (>8.41µm). While the CF ranges of olivine and pyroxene have some overlap, their Diviner spectral shapes are distinct. A parameter c, measures the difference in slope change from channels 3 to 5. A line is defined by the measured Ch3 and 5 emissivities. The interpolated emissivity value at Ch 4 is then subtracted from the measured value to obtain c. Pyroxene tends to have a high value of this index, indicating a strongly concave down spectral feature, while olivine has a low value (Fig. 1).

Diviner data were selected with surface temperatures ranging between 330 and 380K and time of day between 10AM and 2PM. Surface emission angles were limited to <5°. We binned the data at 16 pixels/degree for regional analysis. Emissivity spectra were obtained by dividing the measured radiance of each channel by the black body radiance of the maximum brightness temperature of all the channels for each pixel.

Preliminary Results: Initial mapping indicates no large regions of olivine-rich material within SPA. The small-scale regions highlighted by this index are relatively evenly distributed between mare and highlands (Fig. 4). We are currently investigating the high olivine-index pixels to confirm the presence of olivine.

References: [1] Paige D. A. et al. (2009) *SSR.* [2] Logan et al. (1973) *JGR, 78,* 4983-5003. [3] Spudis P. D. et al. (1994) *Science, 266,* 1848-1851. [4] Toksöz M. N. et al. (1974) *RG, 12,* 539-567. [5] Haskin L. A. et al. (2000) *JGR,* 105:20, 403-20, 415. [6] Belton M. J. S. et al. (1992) *Science, 255,* 570-576. [7] Lucey P. G. et al. (1998) *JGR, 103(E2),* 3701–3708. [8] Head J. W. et al. (1993) *JGR, 98(E9),* 17,149–17,181. [9] Pieters C. M. (1997) *GRL, 24(15),* 1903-1906. [10] Petro N. E. and Pieters C. M. (2004), *JGR, 109(E06004).*

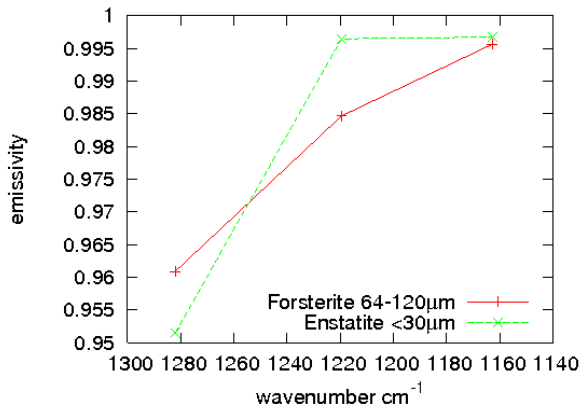

Figure 1: Laboratory spectra convolved to Diviner resolution demonstrating the difference between a pyroxene (solid line), with a high c-index, and an olivine (dashed line), with a low c-index.

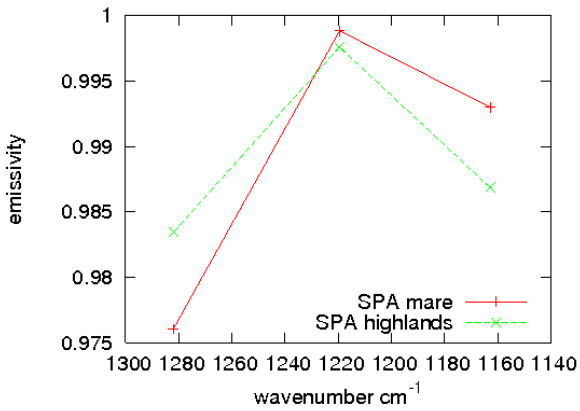

Figure 2: Averaged emissivity of SPA mare and highlands samples.

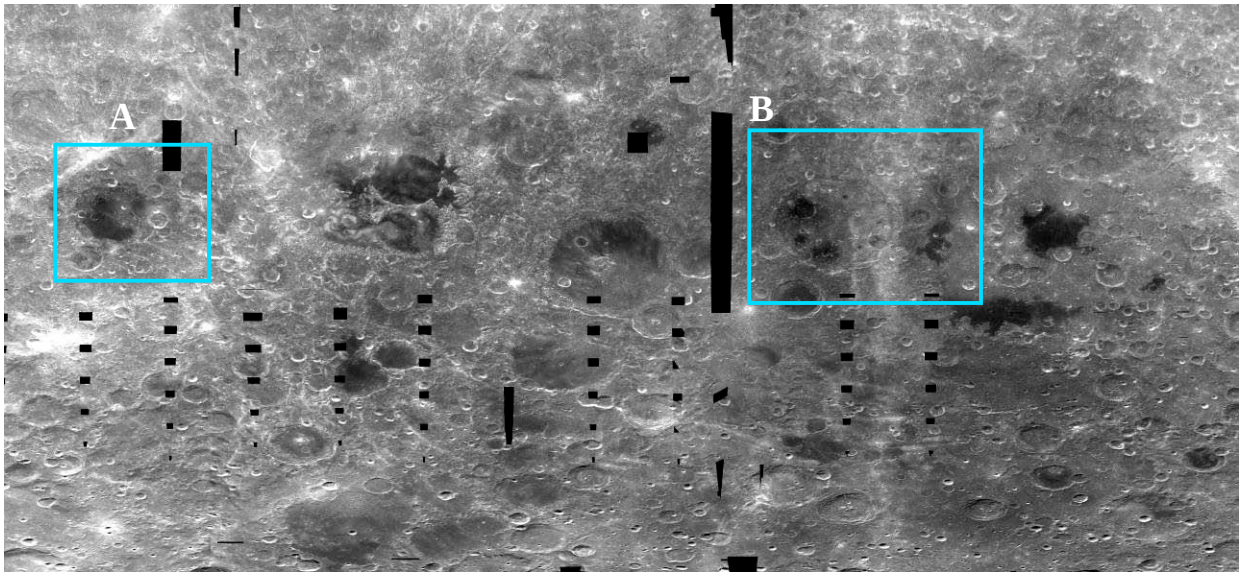

Figure 3: Clementine 750nm reflectance map of area studied. The latitude/longitude range is:-60°s to -20°N and 140°E to 220° W. Boxes 'A' and 'B' indicate the areas shown in figures 4a and b, below.

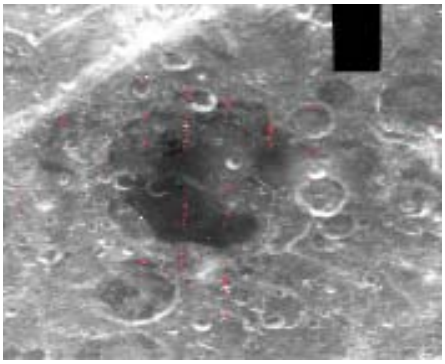

Figure 4a: Clementine 750 nm reflectance with overlay showing all pixels with positive olivine index in red.

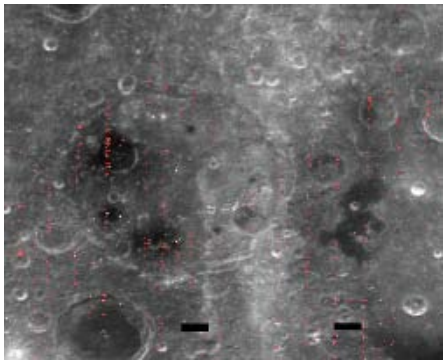

Figure 4b: Clementine 750 nm reflectance with overlay showing all pixels with positive olivine index in red.