AN INVESTIGATION OF POLARIMETRIC CHARACTERISTICS OF LUNAR PYROCLASTIC DEPOSITS TO BE CONDUCTED WITH KPLO POLCAM. W. H. Farrand[1]. [1]Space Science Institute, Boulder, CO, farrand@spacescience.org.

Introduction: The Korea Pathfinder Lunar Orbiter (KPLO) will be launched in August 2022 with mapping of the lunar surface scheduled to begin in early 2023. Included in the KPLO suite of instruments is its Polarimetry Camera or PolCam [1]. PolCam is a multispectral instrument with filters centered at 320, 430, and 750 nm. The 430 nm band has polarization filters for 0°, 60°, and 120°. The 750 nm band has polarization filters for 0° and 90°. From the nominal orbit of 100 km, PolCam will have a swath width of 35 km with a spatial resolution of 70 m/pixel.

Lunar Pyroclastic Deposits: Lunar pyroclastic deposits (LPDs) have traditionally been divided into the larger (> 2500 km^2 in area) regional LPDs and smaller (< 2500 km^2 in area) localized LPDs [2]. The former include glass-rich deposits such as that to the NW of Aristarchus crater and devitrified "black bead" deposits such as Rima Bode. The regional deposits are thought to have formed through large scale Hawaiian style fire-fountaining events. The latter consist of smaller deposits in a variety of settings including floor-fractured craters and likely formed through Vulcanian eruptions. A likely subset of the latter include deposits mantling domes and along rilles [3]. Multiple previously unrecognized localized LPDs were detected with LROC Narrow Angle Camera (NAC) imagery [4] and the use of a new remote sensing approach in the form of orbital polarimetry holds the potential for the discovery of even more as well as better characterization of previously recognized LPDs.

Polarization Character of the Lunar Surface: PolCam will be the first lunar orbital instrument to characterize the polarization character of the lunar surface. Polarization is an optical property of the lunar surface that has previously been characterized only from Earth-based telescopic studies. Shkuratov et al. [5] used telescopic imagery to collect polarization data in spectral bands centered at 420 and 650 nm. For the portions of the lunar nearside that were observed, polarization degree was measured as a function of phase angle in order to derive parameters associated with polarization including P_{max} (the maximum degree of polarization) and the phase angle at which it occurs. P_{max} is generally inversely related to albedo (a relation known as Umov's law).

A parameter related to deviations from Umov's law is $(P_{max})^a A$ where A is the albedo and *a* is a constant. As will be discussed below, this parameter is potentially useful in the characterization of lunar pyroclastic deposits (LPDs).

Also derivable from the polarization data to be returned by PolCam is a characterization of the grain size of the lunar regolith. Based on laboratory work by [6] grain size, symbolized by <d>, is derivable by:

$$\langle d \rangle = 0.03 \exp[2.9(\log A + c \log P_{max})]$$

where *c* is a wavelength dependent constant.

Spectropolarimetry from PolCam: By collecting polarimetric information from both the 430 and 750 nm channels, spectropolarimetric data will be obtained. In telescopic studies conducted by both [5] and [7], the parallel and perpendicular components of polarization were examined. In particular, from [7] a ratio of the parallel component at 750 nm divided by the parallel component at 350 nm highlighted LPDs at Aristarchus and SW Mare Humorum (**Fig. 1**). This type of response will be sought using the orbital PolCam data from the 430 and 750 nm bands.

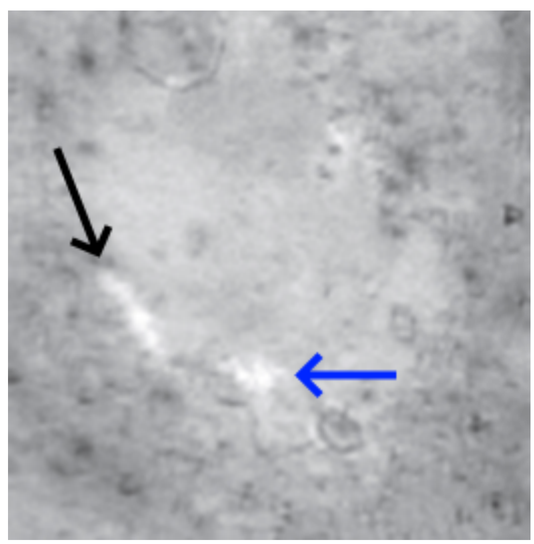

Fig. 1. From supplementary data of [7] the ratio of parallel polarization components of telescopic bands at 750 and 350 nm showing bright areas (indicated by arrows) in Mare Humorum corresponding to the SW Humorum (black arrow) and Dopplemayer crater (blue arrow) LPDs.

Multispectral Analyses from PolCam: Collecting imagery from the 430 and 320 nm wavelengths will allow for an independent mapping of TiO_2 content similar to that done with Clementine [8] and LROC WAC data [9] through an examination, for PolCam data, of the 320/430 nm ratio. The TiO_2 contents of lunar glasses returned by Apollo astronauts spanned a range from 0.26 to 16.4 wt. % [10] and is not necessarily a characteristic indicator of LPDs. However, pyroclastic deposits can have TiO_2 contents distinct from those of background materials as shown in this conference [3] and for the example shown in **Fig. 2**.

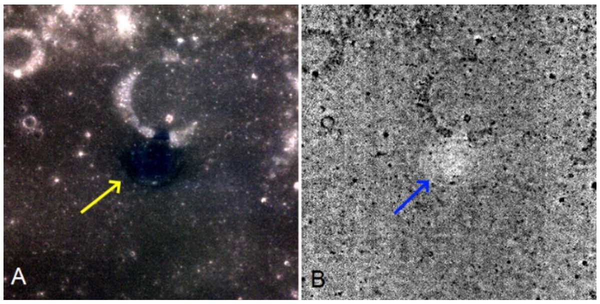

Fig. 2. A. LROC WAC composite of 689, 566, and 415 nm bands of scene M155213603 over Yangel-1 small LPD [11] indicated by arrow. **B**. 321/415 nm ratio showing enrichment of TiO_2 in Yangel-1 LPD relative to the surroundings.

Conclusions: Orbital multispectral polarimetric data shows great promise for use in better characterization of known LPDs and for the potential discovery of previously unrecognized LPDs. The KPLO PolCam instrument will be instrumental in validating the utility of orbital polarimetric data for the characterization of LPDs and other lunar geologic terrains.

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