**Introduction:** Pancam multispectral visible/near-infrared images acquired during both Mars Exploration Rover traverses enabled mapping of morphology, textures, and mineralogical variations vital in constraining the geologic processes that formed and modified these field sites. We describe results from the final photometric experiments conducted by both rovers, including observations of airfall dust deposits and the effects of dusty windows on photometric model parameters.

**Background:** Previous Pancam spectrophotometric studies [1] investigated variations in light scattering properties of different materials along the rover traverses. Variations in single scattering albedo ($w$) were evident among various dusty rocks, soils, and rover tracks. “Gray” rocks and rover tracks typically exhibited forward scattering, consistent with particles with few wavelength-scale internal scatterers. Typical soil and “Red” rocks (those coated with dust or soil-like materials) were more backscattering, suggestive of surface particles with more internal scatterers.

**Data sets:** At Spirit’s final resting place (Troy) on the western side of Home Plate, a set of photometry sequences was executed on Sol 1944-1946. This data set sampled the crusted soils, as well as layered flat rocks associated with Home Plate (Fig. 1). On the northern tip of Coral York on the western rim of Endeavour crater, Opportunity acquired observations of large dust drifts and soils at Turkey Haven (“TH”, Sols 2785-2789) and rocky muds mixed with variable types of pebbles at São Gabriel crater (Sols 3012-3017) (Figs. 2-3). In all cases, images were acquired at wavelengths of 432 nm, 601 nm, 753/754 nm (stereo), 934 nm (TH), and 1009 nm covering phase angles –0-140°.

**Methods:** We followed the methods of [1,2] in which stereo image disparity maps were produced from radiometrically calibrated Pancam stereo images acquired at multiple times of day. This method enabled geometric registration of right-eye images to left-eye images and construction of incidence, emission, phase, surface normal, range, and XYZ position maps for each time of day. Regions of interest (ROIs) were selected for specific unit types (e.g., Gray/Red rocks, dust deposits, soils) at each time of day to provide sufficient phase angle coverage to model Hapke scattering parameters of each unit. Sky radiance models were used in combination with ROI facet orientations to compensate for diffuse skylight [1]. Hapke models were run at each wavelength to constrain $w$, surface roughness ($\theta$), and 1- and 2-term Henyey-Greenstein (HG) phase functions to determine asymmetry parameters ($\xi$) and scattering functions ($b,c$). Opposition effect parameters ($B_0, h$) were included when well-constrained, with error estimates provided using the methods of [1].

Dust deposition on the Pancam windows resulted in scattered light effects in high-phase angle images from the São Gabriel and Troy data sets (Figs. 1-2). Models were run with and without using affected ROIs to quantify the effect on modeled parameters.

**Results:** Troy. Gray rocks exhibited narrow forward scattering 2-term HG phase functions (Fig. 4, top) whereas red rocks and soils were more backscattering. Dark soils had slightly lower $w$ values than regular soils (Fig. 5, top) but exhibited greater $\theta$ values. Red rocks exhibited the highest $w$, $\theta$, and $h$ values, likely indicative of low porosity, rough surfaces.

Turkey Haven. The dust deposits exhibited slightly larger $w$ values compared to the grayly nearby soils (Fig. 5, bottom). Dust was slightly more forward scattering in 1-term HG models (higher $\xi$ values) than the soils (Fig. 4, bottom). Dust deposits were the smoothest of all units studied here (lowest $\theta$), and the exhibited the highest $h$ values, likely indicative of a more homogeneous grain size distribution than other units.

São Gabriel. The rubbly soils exhibited backscattering functions typical for soils and the lowest $h$ values, consistent with the least uniform grain size. Backscattering increased with wavelength in 2-term HG models, likely a result of surficial dust coatings.

Scattered light. Upon removal of ROIs affected by scattered light, more backscattering behaviors were modeled, but only small changes in $w$ values. Soils were modeled with less uniform grain size and were macroscopically smoother, whereas rock models demonstrated the opposite behaviors. These results suggest that useful modeling could be performed of the final unanalyzed Opportunity photometry data set (Sols 3863-3867, Cape Tribulation), which was also affected by scattered light in high phase angle images.

Fig 1. L247 false color mosaics (753 nm, 601 nm, 432 nm) of the Spirit Troy area ~16:30 LTST, Sol 1994. (left) East-looking, (P2384); (right) West-looking, (P2383) showing effects of scattered light in top image.

Fig 2. L247 false color mosaics (753 nm, 601 nm, 432 nm) of the Opportunity São Gabriel area ~16:15 LTST, Sol 3017, (left) East-looking; (right) West-looking, with example of scattered light in lower portion of image.

Fig 3. L247 false color mosaics (753 nm, 601 nm, 432 nm) of the Opportunity Turkey Haven area (left) East-looking on Sol 2789 at 11:16 LTST (P2577); (right) West-looking on Sol 2788 at 16:51 LTST (P2578), showing no effects from scattered light.

Fig 4. (top) 2-term HG asymmetry parameters (b) versus backscattering fraction (c) for Troy units, plotted with values derived for synthetic particles (gray) from [3]. (bottom) 1-term HG asymmetry parameter vs. w for Turkey Haven units. All error bars represent 1-σ uncertainty estimates [1].

Fig 5. Single scattering albedo (w) values from 2-term HG phase function Hapke models for (top) Troy units and (bottom) Turkey Haven units. As with Fig. 4, all model results presented here represent data for which ROIs affected by scattered light were removed.