THE WAVELENGTH DEPENDENCE OF MARTIAN ATMOSPHERIC DUST RADIATIVE PROPERTIES. J. B. Pollack[1], M. E. Ockert-Bell[2], R. Arvidson[3], and M. Shepard[3], [1]NASA Ames Research Center, Moffett Field CA 94035-1000, USA, [2]San Jose State University, San Jose CA 95172-0130, USA, [3]Washington University, St. Louis MO 63130-4899, USA.

Motivation: One of the key radiative agents in the atmosphere of Mars is the suspended dust particles. We are carrying out a new analysis of two datasets of the martian atmosphere in order to better evaluate the radiative properties of the atmospheric dust particles. The properties of interest are the size distribution information, the optical constants, and other radiative properties, such as the single-scattering albedo and phase function. Of prime importance in this research is the wavelength dependence of these radiative properties throughout the visible and near-infrared wavelengths. Understanding the wavelength dependence of absorption and scattering characteristics will provide a good definition of the influence that the atmospheric dust has on heating of the atmosphere.

Data: The first dataset that we are analyzing is a set of Viking 1 and 2 Lander images. Our present work represents a significant improvement over our past analyses [1,2]. Color and IR images and a survey image have been calibrated and a correction for vignetting was added. The vignetting correction reconstructed the saturation near the top of the images and allowed us to use data closer to the Sun, which in turn gives a better definition of the diffraction peak and, thus, the size distribution of the particles. The second dataset is visible and near-infrared data from Bell and Mustard [3] and Mustard and Bell [4]. The dataset, taken in 1988 and 1989, covers a wide range of wavelengths (0.4–3.0 μm).

Analysis: The examination of the Viking Lander images involves modeling the reflectance data using radiative transfer calculations based on the doubling method [5]. A semi-empirical method is used to model the scattering by nonspherical particles [6]. Hapke [7,8] theory is used to model the photometric properties of the surface.

We used an iterative method to fit the parameters of interest to the observed data: small phase angles were used to find the size distribution information, phase angles of about 50° were used to determine the imaginary index, and the data at larger phase angles determined the shape of the particles. We calculate the intensity expected in a given range due to variation of one parameter and do a chi-squared fit to the variance to find the best fit of the parameter in question. The resulting best fit is used as a set parameter while another is varied, etc.

From the information obtained in the examination of the Viking Lander images, we have defined the particle size distribution using a log-normal distribution, and we have defined the wavelength dependence of the imaginary index of refraction and radiative properties for wavelengths between 0.5 and 0.9 μm.

For the investigation of the second dataset we operate under the assumption that the properties of the atmospheric dust closely mimic those of the "bright" soil on the surface. Since the optical depth of the atmospheric dust was low during the time period of the data acquisition, we can use Hapke theory [7,8] to extract the single-scattering albedo of the soil. By scaling the imaginary index of refraction of the soil to agree with the atmospheric dust in the visible, we derive the spectral dependence of the imaginary index in the entire visible and near-infrared domains.

The results of this inquiry will be presented. The particle single-scattering phase function from the Viking analysis and the wavelength dependence of the radiative properties within the visible and near-infrared wavelength regions will be given.

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EVIDENCE FOR ULTRAMAFIC LAVAS ON SYRTIS MAJOR. D. P. Reyes and P. R. Christensen, Department of Geology, Arizona State University, Tempe AZ 85287-1404, USA.

Data from the Phobos 2 Imaging Spectrometer for Mars (ISM) compiled by [1] support the existence of komatiitic lavas on the Syrtis Major plateau. Using ISM data, Mustard et al. [1] determined that the composition of the low-albedo materials covering the Syrtis Major plateau originally consisted of augite-bearing basalt containing two cogenetic pyroxenes with no appreciable amount of olivine. Additionally, Syrtis Major ISM visible and near-infrared spectra were matched to the spectra of an Apollo 12 basalt and a Shergotite meteorite to show that the ISM spectra are consistent with a mafic basalt composition [1]. In this work, pyroxene compositions from ISM data determined by [1] compared with the pyroxene compositions of Apollo 12 pigeonite basalt, Shergotite meteorite, and pyroxenitic komatiite show that the Syrtis Major volcanic materials are consistent with pyroxenitic komatiite. Pyroxenitic komatiite is significant for the Earth because it contains a large amount of MgO, implying generation under unique circumstances compared to typical basaltic compositions [e.g., 2].

Background: Komatiites are subdivided by weight percent MgO into peridotitic (>20%), pyroxenitic (12–20%), and basaltic (8–12%) varieties [3]. Pyroxenitic and basaltic komatiites may be collectively referred to as mafic komatiites. Mafic komatiites are always found with peridotitic komatiites in the Archean and are also found alone in the few Proterozoic occurrences. Peridotitic komatiites are dominated by olivine, with interstitial clinopyroxene and glass. Mafic komatiites are dominated by pyroxene (augite ± pigeonite ± bronzite), with lesser plagioclase, and rare olivine. Olivine is only present in a few mafic komatiite flows were MgO content is >12% and even then olivine only accounts for <10% of the mode [4].

The upper portion of pyroxenitic komatiite flows are often composed of skeletal magnesium pigeonite with augite exteriors in a fine augite and plagioclase groundmass. Coexisting magnesium pigeonite and augite are unusual for most lavas on the Earth, but are an important characteristic of pyroxenitic komatiites [4]. According to Campbell and Arndt [5], rapid cooling in the upper parts of some komatiite flows may cause olivine to crystallize initially. However, the rate of olivine crystallization is not sufficient to prevent continued supercooling of the liquid to a point below the temperature of the stable pyroxene liquidus. This supercooling results in the crystallization of magnesian pigeonite in a liquid that would normally produce olivine under equilibrium conditions. As the liquid temperature drops further, augite crystallizes, followed by plagioclase.