SPECTRAL DIVERSITY AT GUSEV CRATER FROM COORDINATED MINI-TES AND PANCAM OBSERVATION. D. L. Blaney[1], James F. Bell III[2], Nathalie Cabrol[3], Phil Christensen[4], William H. Farrand[5], Doug Ming[6], Jeff Moersch[7], Steve Ruff[4], and The Athena Science Team, [1]NASA Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, MS 183-501, Pasadena Ca, 91109, email: Diana.Blaney@jpl.nasa.gov, [2]Cornell University, Ithaca NY, [3] NASA AMES, , [4]Arizona State University, Tempe Az, [5]Space Science Institute, Boulder, CO, [6]NASA Johnson's Space Center, Houston TX, [7]University of Tennessee, Knoxville, TN.

Introduction: During the last year the Spirit rover has explored Gusev crater with the Athena payload. Two remote sensing instruments collected spectral information at visible (Pancam) and at thermal infrared (Mini-TES) wavelengths. Observations for these instruments were coordinated and targeted to determine the mineralogical diversity and identify specific lithologies / end members for detailed investigations with the rest of the payload. Initial results were reported last spring [1,2]. A wide range of materials have been measured including outcrops, rocks, and soils. Both natural and brushed/ratted rocks and natural and disturbed soils have also been measured permitting investigations of coating and soil structure. As of Jan 9, 2005, over 400 coordinated observations have been made.

Pancam: Pancam contains two separate cameras with discrete filter wheels. For mineralogical purposes 13 filters between 400 and 1000 nm are typically used with left and right eyes overlapping at 430 and 750 nm. The spectra at these wavelengths are dominated by Fe^{3+} and Fe^{2+} absorptions in minerals. Spatial resolution is 0.28 mrad IFOV.

Mini-TES: Mini-TES is a Michelson interferometer with a spectral resolution of 10 cm^{-1} that covers the wavelength range of 5-29 µm. Two spatial resolutions are available- 8 mrad and 20 mrad. These results focus on 20 mrad observations. The mid-infrared contains strong fundamental vibrational bands that permit mineralogy to be determined remotely, ensuring that new and unique endmenbers are not overlooked as Spirit travels through Gusev Crater.

Rocks: Rocks fall into three broad classes: Gusev Plains rocks which occur from the landing site to the Columbia Hills; West Spur rocks; and the rocks of the lower Husband Hill area. Figure 1 shows false color composite of example rocks in each class.

These representative rocks for spectral examples were identified using imaging showing relatively dark natural surfaces in Pancam images and flat spectral characteristics between 6 and 8 µm in Mini-TES spectra indicating relatively dust free surfaces.

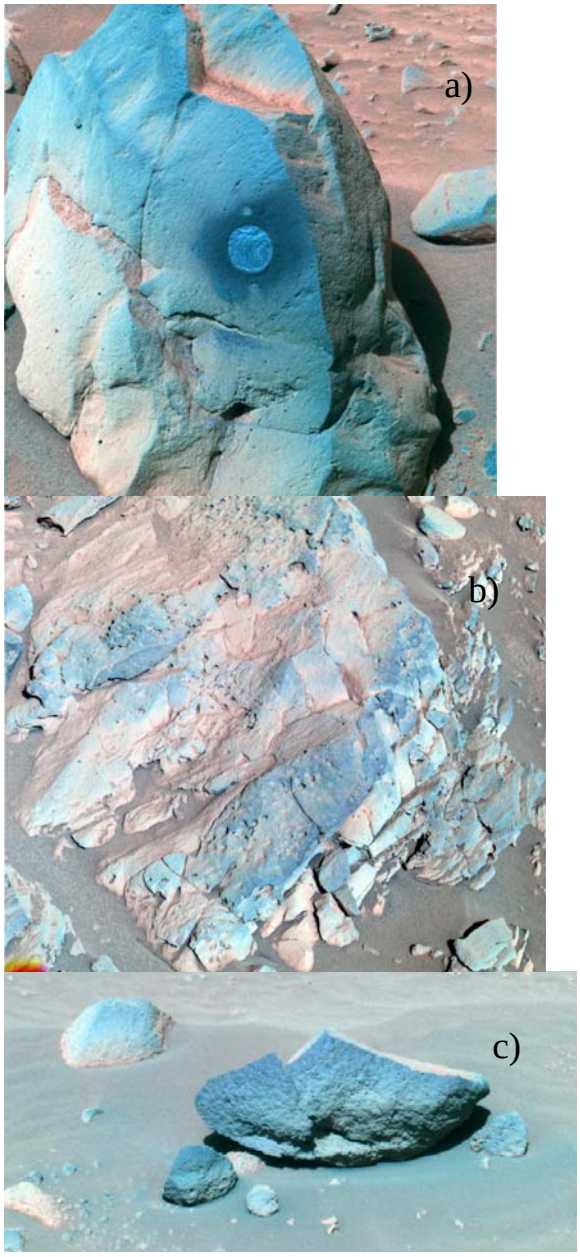

Figure 1. False color (430 nm, 601 nm and 753 nm) images of typical rock class examples: a) Humphries- Gusev Plains class; b) Palenque West Spur- class and c) Wishstone- Lower Husband Hill class.

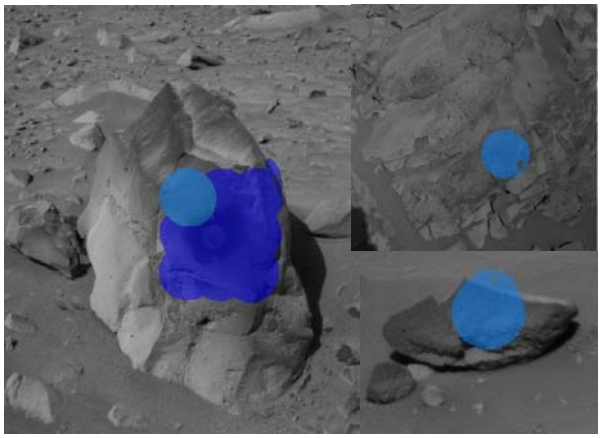

Figure 2: Locations of Mini-TES spectra for a) Humphries, b) Palenque, and c) Wishstone.

Pancam spectra were extracted by hand using the following approach. Locations of Mini-TES spectra on the targeted rock were identified by overlaying the Mini-TES footprint on Navcam frames as shown in Figure 2. Spectra were extracted by individually mapping out the area covered by the Mini-TES footprint in the Pancam image. Mini-TES and Pancam spectra are shown in Figure 3.

Spectrally the three classes of rocks are distinct at Mini-TES wavelengths and have different mineralogies [3,4]. Gusev plains rocks (Humphries) are distinguished by the olivine doublet in the long wavelength part of the spectrum. West spur rocks (Palenque) are highly altered. Lower Husband Hill rocks (Wishstone) are dominated spectrally by intermediate plagioclase feldspar.

At visible wavelengths the rocks have more subtle spectral characteristics. Since these spectra have not been photometrically corrected, care must be used in interpreting these shapes. Additionally, dust and coatings that are optically thin at the thermal infrared wavelengths seen by Mini-TES may be thick enough to influence the spectrum. However, the following trends emerge. In general even "dark" West spur rocks such as Palenque tend to have higher reflectance than plains and Lower husband hills rocks consistent with their more altered nature. Gusev plains (Humphries) and lower Husband Hill rocks (Wishstone) have a negative slope in the near infrared indicative of some type of Fe^{2+} absorption.

All targeted rock observations at Gusev can be assigned to one of these three spectral classes. Variations within classes tend to be related to dust and thin coatings. However, as shown by these examples, it is possible to find rocks where dust /coating effects do not obscure the underlying mineralogy. Comparisons between brushed and unbrushed rocks show little difference at Mini-TES wavelengths. At Pancam wavelengths brushed rocks on the Gusev plains have a lower reflectance, indicating that some bright material was removed. Rocks of a given spectral type have sharp geographic boundaries. No Palenque and or Wishstone type rocks have been identified to in the Gusev Plains and only a single Gusev Plains class rock has been identified in the Columbia Hills to date (West Spur and Lower Husband Hills).

Other observations: In addition to these rock observations the differences between natural and brushed / ratted rocks and between soils both natural and disturbed will also be presented. Finally the linkage to other Athena payload measurements to the spectral classes will also be synthesized and the implications discussed.

References: [1]] Bell J.F. III et al. (2004) *Science, 306,* 1703-1709. [2] Christensen et al. (2004), *Science*, 305, 837-842. [3] Christensen et al. *LPSC 2005*. 345. [4] Ruff et al. *LPSC 2005*.

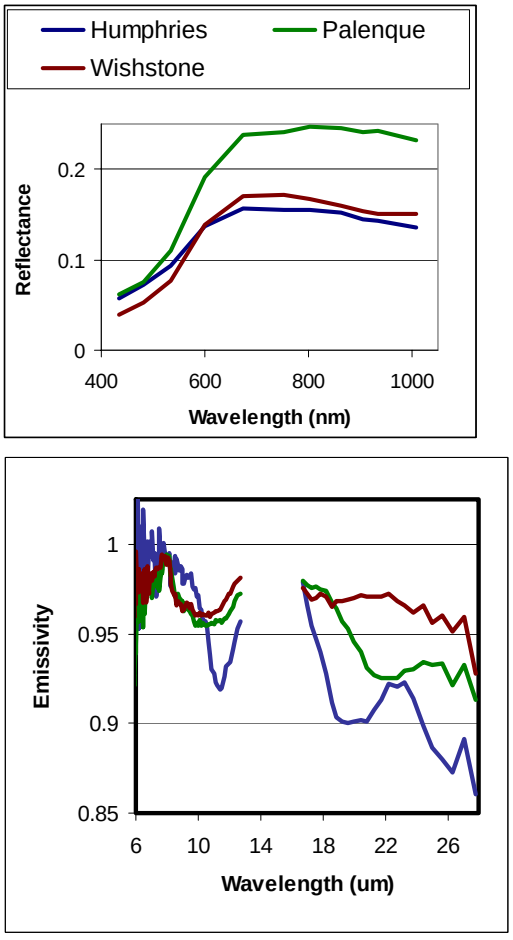

Figure 3: Spectra for the three rock spectral classes from: a) Pancam and b) Mini-TES.

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