THE MARS PATHFINDER "SUPER PAN": A U.S.G.S. CARTOGRAPHIC PRODUCT. L. Gaddis, L. Soderblom, R. Kirk, J. Johnson, W. Ward, J. Anderson, J. Barrett, K. Becker, T. Becker, A. Bennett, J. Blue, D. Cook, E. Eliason, P. Garcia, M. Gordon, T. Hare, A. Howington-Kraus, C. Isbell, E. Lee, B. Redding, T. Rosanova, R. Sucharski, T. Sucharski, K. Thompson, J. Torson *(U.S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ 86001 USA, lgaddis@flagmail.wr.usgs.gov),* E. Dorrer *(Univ. der Bundeswehr Munchen, D-85577 Neubiberg, Germany),* P. Smith, and D. Britt *(University of Arizona, Lunar and Planetary Laboratory, Tuscon, AZ 85721 USA).*

Overview: This abstract describes acquisition and cartographic processing of the most comprehensive imaging dataset acquired by the Imager for Mars Pathfinder (IMP), the Super Panorama or "Super Pan" [1]. IMP collected 5 panoramic imaging sequences during the nominal mission (July through October, 1997) at the Sagan Memorial Station landing site in Ares Vallis on Mars [2, 3]. IMP consists of a pair of stereo cameras (15 cm baseline separation), each with a 12-position filter wheel (numbered 0 through 11). The wavelengths of the left and right filters at a given position are not often the same. Of the 24 filters, 15 are "geology" filters for IMP: 6 are for acquiring stereo images (at 3 wavelengths) and 9 are in one eye only. Monochromatic stereo and color stereo image sets are generally acquired with filter positions 0, 5, and 11.

The first four imaging sequences were designed to rapidly survey the surface of Mars, to assess the condition of the spacecraft, and to assist in the deployment of the rover. These sequences included the First Look (or Mission Success) Pan, Insurance Pan, Monster Pan, and Gallery Pan, and differed in position of the camera (i.e., deployed vertically or not), time of day, filters used, and amount of data compression (compression ratios ranged from 6:1 to 24:1). The first two pans were acquired with IMP in the low, stowed position; the second two were post-deployment sequences, acquired with IMP positioned ~0.7 m higher.

Following the successful return of the early, more conservative panoramas, in the third week after landing IMP began an intensive photographic survey of the landing site with the goal of returning the highest quality dataset possible for multispectral and topographic analyses. The plan was to acquire all 15 filters at each camera position (resulting in multispectral "super cubes"), with 3-color stereo pairs at each location, minimal compression, and increased frame-to-frame overlap relative to the earlier pans. The resulting Super Pan (Figure 1) was collected over a period of 8 weeks at various times of day, and, with more than 2000 images, was 90% complete when contact with the spacecraft was lost. To maximize data quality, red and blue stereo pairs were losslessly compressed (1.3:1) and the remaining 11 frames were compressed only 2:1. The vertical and horizontal overlap between frames was increased over earlier mosaics to facilitate automated cartographic processing and stereophotogrammetric reduction. With its inherent multispectral and stereogrammetric capabilities, the Super Pan dataset is the ideal focus of topographic and spectroscopic analyses of the Mars Pathfinder landing site.

The Super Pan Mosaic: Cartographic and stereogrammetric processing of the Super Pan is performed in several iterative stages through combined use of our Integrated Software for Imagers and Spectrometers (ISIS is available for free at http://wwwflag.wr.usgs.gov/ISIS) and commercial digital photogrammetric software, Leica Helava Systems' SOCET Set. Cartographic image processing of the Super Pan data is outlined below. Radiometric and geometric calibration efforts at the University of Arizona and SPICE and other spacecraft ancillary data from JPL are also major input elements to our processing. Stereogrammetric reduction of the Super Pan data are described in a companion abstract [1].

Cartographic processing of the IMP images is a multi-level process that is being done in several stages:

1) **Level 0:** Ingestion of raw data records and incorporation of updated SPICE data into ISIS labels.

2) **Level 1:** Radiometric correction involving shutter image, dark current, and filter-dependent flat-field corrections, removal of blemishes and readout smear, and conversion of pixel values to radiometric units (I/F).

3) **Level 2:** Establishment of Geometric Control, via selection of relative match points and connection to a ground control system (with the iterative addition of hundreds of tie points by SOCET Set); removal of camera distortions; planimetric reprojection or full 3-D transformation and registration of color filters.

4) **Level 3:** Photometric Correction, including normalization of scene brightness and removal of residual inter-image brightness (ultimately including 3-D modelling of all surfaces).

5) **Level 4:** Mosaicking of individual frames.

In the first stage, the images are reprojected (in Level 2) without taking into account the topography (shapes of rocks and other features) within the supercube scene---each is assumed to consist of a planar surface. In the second stage, following completion of photometric analysis for each supercube [1], the internal geometry is fully accounted for using a high resolution digital terrain model (DTM) for each scene. Each frame is transformed to a common view so that the 15 spectral channels are brought into spectral registration. These spectrally registered supercubes and associated DTMs will then be used to reproject all scenes in Level 2, resulting in the production of panoramic mosaics with full parallax correction. These highest quality products---spectroscopically registered supercubes and panoramas---will constitute an invaluable data product for analysis of the spectrophotometric properties of surfaces at high resolution in a rigorous 3-D framework accounting for atmospheric scattering in full generality [4].

References: [1] Kirk, R. et al., Mapping the Sagan Memorial Station with the IMP Camera, this volume; [2] Smith, P. et al., 1997, The imager for Mars Pathfinder experiment, *JGR--Planets*, 102, 4003-4025; [3] Smith, P. et al., 1997, Results from the Mars Pathfinder Camera, *Science*, 278, 1758; [4] Johnson, J.R. et al., Photometric imaging sequences and analysis at the Mars Pathfinder landing site, this volume.

Table 1: IMP Geology Filters.

Position	*Left*	*Right*	*Description*
0	440	440	"Blue Stereo"
5	670	670	"Red Stereo"
6	800	750	
7	860	diopter lens	
8	900	600	
9	930	530	
10	1000	480	
11	965	965	"IR Stereo"

Figure 1. The full Super Pan mosaic. This geometrically controlled mosaic contains 119 complete 15-band images or "super cubes" (1785 images). The inter-image brightness variations result from images acquired at different times of day (lighting was optimized in a given imaging sequence). Gaps in the full panoramic coverage represent surface areas which were not imaged at the full 15-band spectral range. Right eye view: Red=670 nm; Green=530 nm; and Blue=440 nm. Image resolution is 0.002 m/pixel.