THE APOLLO DIGITAL IMAGE ARCHIVE: PROJECT STATUS. K. N. Paris[1], M. S. Robinson[1], S. J. Lawrence[1], J. Danton[1], E. Bowman-Cisneros[1], A. Licht[1], W. Close[2], and R. Ingram[2] [1]School of Earth and Space Exploration, Arizona State Univ., Tempe, AZ,, [2]Johnson Space Center, Houston, TX.

Introduction: Photographs acquired by the Apollo astronauts comprise not only a detailed record of the surface of the Moon, but also serve as historical documentation of humans' first venture off the Earth. The processed Apollo flight films are carefully stored and archived at Johnson Space Center (JSC). Due to the delicate nature of the film and their historical significance, only duplicate (second or third generation) film products were available for study. To allow permanent archive and full accessibility, the original flight films are being scanned and archived in a web accessible format [**1**]. The original flight film is scanned at JSC and digital copies are sent to the Arizona State University (ASU) School of Earth and Space Exploration (SESE) for processing and web archiving. The scanned images are available online along with details of the scanning process [**Fig. 1**; http://apollo.sese.asu.edu].

Status: Currently, all of the Metric frames are scanned and received at ASU, with 75% of the frames available via the public website. Scanning of Nikon 35 mm, Apollo Lunar Surface Closeup Camera and Stellar film is also complete and received by ASU and the frames are undergoing systematic processing before subsequent release. Scanning of the Panoramic film is in progress at JSC, with all of the Apollo 15 and 10% of the Apollo 16 Panoramic frames thus far scanned and received at ASU. The received scans are currently being processed and released at a rate of 100 per week.

Critical support ephemeris (state vectors) associated with Apollo Metric and Panoramic observations were originally computed and recorded to paper, and later recorded to microfilm. To our knowledge no paper or digital versions were archived. The National Space Science Data Center scanned the microfilm records to Tagged Image File Format (TIFF) files. Due to the poor state of preservation of the state vectors on the original paper, some of the records were unable to be converted to microfilm. The new digital scans of the microfilm were received at ASU and a custom Optical Character Recognition algorithm converted the raster image of the microfilm frames to text format. Automated and manual methods were used to interpolate values that were unrecoverable. Navigation and Ancillary Information Facility (NAIF) [**2**] SPICE kernels were then produced from the recovered state vectors and will be released after review by the NAIF group.

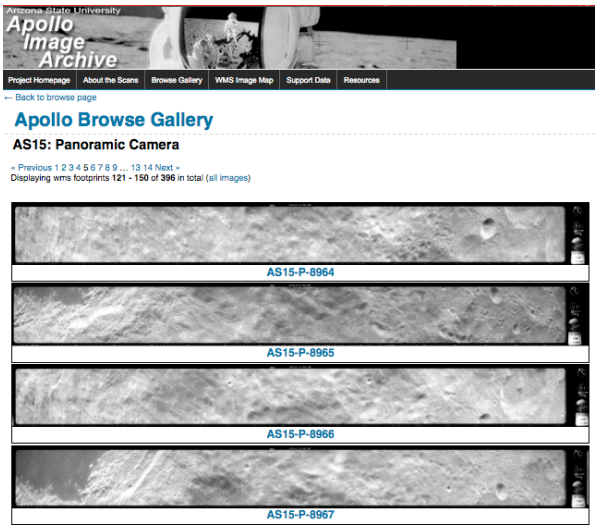

Figure 1: *Web-based interface for the Panoramic frames in the Apollo Digital Image Archive.*

The Panoramic Camera: The Apollo Panoramic (or Pan) camera was carried aboard the service modules of the final three Apollo missions, during which ~4700 frames were acquired. The Pan camera was an optical bar camera, meaning that the frame was continuously, rather than instantaneously, exposed during image acquisition. The camera assembly was comprised of a roller cage that allowed the film to slide over a variable slit while it was being exposed across the orbit track to obtain images that were about 1-2 meters in resolution at the center of the frame. The camera imaged in a 108-degree wide arc, which translates to about 45 inches in film. The roller cage was attached to a gimbal assembly, which allowed for movement of the camera along the flight path in the forward and aft directions, thus providing stereo coverage of the lunar surface [**3, 4**].

Processing Panoramic Frame Scans: Similar to the Metric scanning, the Panoramic film is scanned using a Leica Geosystems DSW 700 photogrammetric scanner. Because the scan bed can only "see" 10 inches x 10 inches, and each Pan image is 45 inches long on film, the frames must be scanned in sections (or tiles), resulting in 8 tiles per frame [**Fig. 2**].

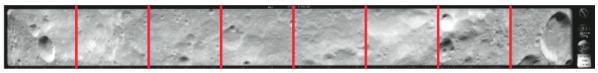

Figure 2: *Stretched JPEG2000 image of Panoramic frame AS15-P-8911 . The red lines indicate where the center of the seams are between tiles.*

The frames are received by ASU in several formats: raw scan tiles as 16-bit TIFF files, several down-sampled versions of the original tiles, which are also 16-bit TIFF files (each tile is down-sampled by a factor of two in eleven steps, resulting in each raw tile having 12 files, each with half the pixel scale of the one preceding it), and reconstructed, 16-bit JPEG2000 mosaics of each frame generated from the original, full resolution scans. Each individual tile is about 2 GBytes and the reconstructed JPEG2000 file is about 6 GBytes. Between two raw scan tiles there is a 28% overlap with the adjacent tiles [**Fig. 3].**

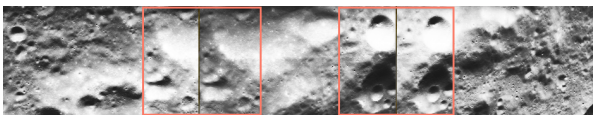

Figure 3: *Tiles 2, 3, and 4 (from right to left) of AS15-P-8911. The two areas bounded by the red boxes are the areas of overlap between the adjacent tiles.*

Reduced image products are produced at ASU from the JPEG2000 full frame file. A linear stretch is applied to the JPEG2000 mosaic and it is down-sampled four times (each time by a factor of 4) to generate large, medium, small, and thumbnail 8-bit Portable Network Graphic (PNG) browse products. The center 50% of the stretched JPEG2000 mosaic is down-sampled by a factor of two and also made available as an 8-bit PNG, along with the original full-resolution raw scan tiles.

Continuing Work: Work continues to complete the Metric products and completion is slated for May of 2012. Panoramic frames are being released weekly until scanning is complete. The state vector ephemeris data is being refined and progress is being made to make the original scans, converted state vectors (in ascii tables), and derived SPICE kernels available via the Apollo Digital Image Archive website.

References: [1] Robinson M. S. et al. (2008) *LPSC XXXIX,* Abstract #1515. [2] http://naif.jpl.nasa.gov/naif. [3] Masursky H., Colton G. W., El-Baz, F. (1978) *Apollo Over the Moon: A View From Orbit*, NASA SP-362. [4] McEwen, M. C. (1972) *Apollo 15 Index of Mapping Camera and Panoramic Camera Photographs,* NASA.

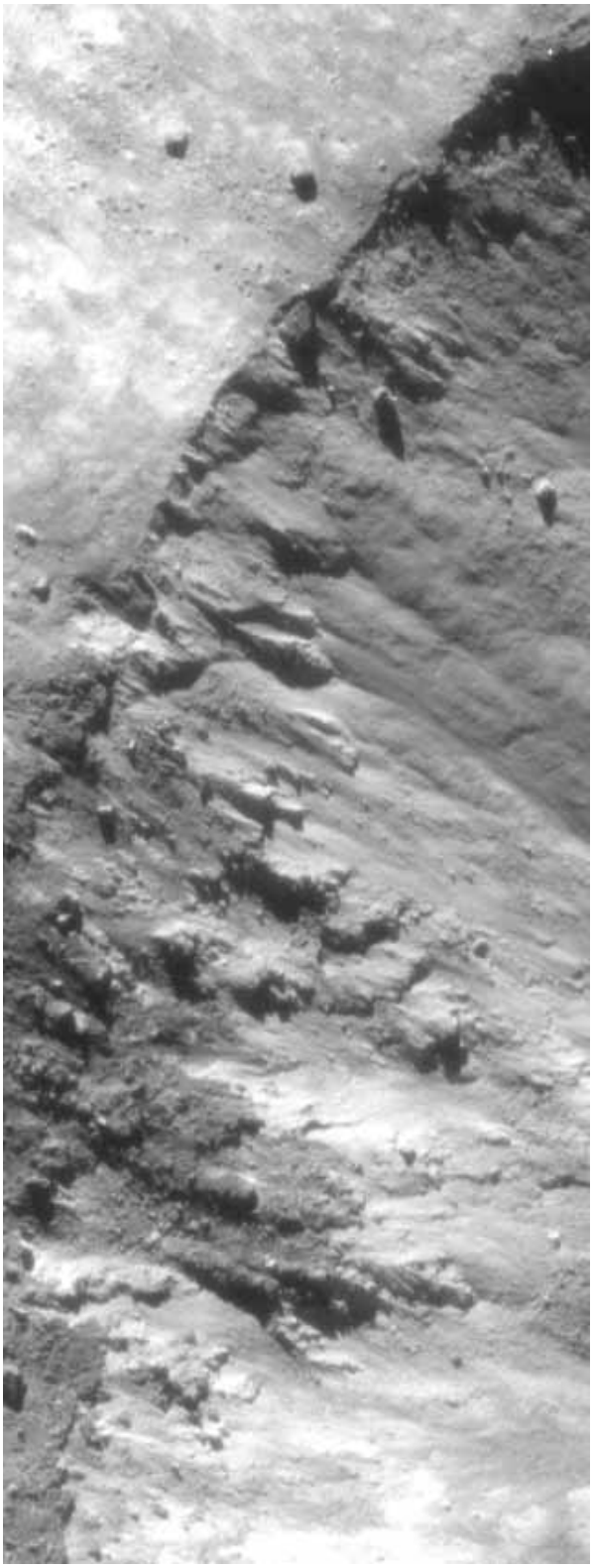

Figure 4: *The wall of Gagarin crater. From Panoramic frame AS15-P-8936.*