NEAR MSI MOVIES OF EROS: A NEW TOOL FOR SCIENTISTS AND EDUCATORS. E. J. Speyerer[1], M. S. Robinson[1], A. Harch[2], C. Peterson[2], M. Bell[2], J. Veverka[2], [1]Northwestern University 1847 Sheridan Rd. Evanston, IL, 60208, [2]Cornell University, Ithaca, NY 14853.

Introduction: The Near Earth Asteroid Rendezvous (NEAR) Shoemaker spacecraft was designed to spend a year orbiting the asteroid 433 Eros to investigate the surface with a suite of science instruments [**1**]. The MusltiSpectral Imager (MSI) returned ~140,000 images of Eros with a resolution range of 40 m/pixel down to 1.2 cm/pixel [**1,2**]. We have processed 100 movie sequences (32,261 MSI images) into a standard product available in QuickTime format. The digital movie format represents a powerful analysis tool, as well as a compelling education aid.

Overview of Movie Sequences: Among the many different types of imaging sequences acquired during the orbital mission, the *movies* comprise a significant percentage of the total imaging data set. In general, we came to use the term *movie* to describe an observation that acquired images in rapid succession (usually less than 1 minute separation between frames) and for which the camera pointing did not move quickly across the background of Eros' surface. The result is a sequence of frames with a large percentage of frame-to-frame overlap. Played in accelerated movie format, it gives the effect of flying over the terrain of Eros. In many cases, movie sequences were acquired over a time period of many hours, and for these the user is able to effectively watch Eros rotate beneath as if perched on the spacecraft as a silent observer.

We used the generic term *Flyover* for any of several types of movie sequences. Camera pointing for any given *Flyover* often contained commands that would alternately hold at a fixed angular position relative to Eros's center of mass, scan slowly across the terrain or along the limb, or follow a specific feature on Eros for a period of time. A special case of *Flyovers* sometimes only utilized one or two of these slewing techniques, if the last method was used exclusively the observation was called a *Feature Track*. The primary goal of a *Feature Track* was to allow viewing of a localized region of the surface over a wide range of viewing angles (emission) and solar illumination angles (incidence) as the asteroid rotated beneath the spacecraft (**Figs. 1,2**). *Feature Tracks* were often repeated at different times during the mission and provide additional solar illumination information to assist with interpretation of the morphology and to allow studies of the photometric properties of the surface.

Flyovers allow the user to observe a large portion of the asteroid, covering time periods that may represent up to or greater than one full spin period of Eros (>5 hours) over the course of just a few minutes. Just as with the *Feature Tracks*, *Flyovers* were scheduled throughout all phases of the mission, thus many cover the same swaths of territory redundantly, but with very different solar illumination as Eros progressed in its orbit about the Sun (**Fig 1.**).

Production of the Movies: Using calibration software developed for the NEAR mission, the raw MSI images were calibrated to IOF [**3,4**] and then deblurred [**5**]. Each frame was annotated with a unique MSI identifier known as mission elapsed time (MET), time of acquisition (UT), and the sub-spacecraft latitude and longitude points. These final frames were then compiled into a continuous sequence and saved in QuickTime format.

Current Education Outreach Tool: The movies represent a highly interactive method of quickly scrolling through large numbers of images, a great tool to allow scientists to become familiar with Eros. Additionally, these movies are an excellent tool for educational and outreach purposes. During the orbital mission, movies were released on the Johns Hopkins University Applied Physics Laboratory NEAR web page and were widely distributed through television and web media outlets. A greatly expanded movie resource is now available along with a preliminary user's guide — Eros Orbital Movie Manual.

http://www.earth.northwestern.edu/research/robinson/near.html

The manual devotes a page to each movie giving technical information such as the sequence name, day of year, date, MET range, orbit size (km), sequence ID, filter, number of images, calibration, and compression type. At the bottom of each page there are eight thumbnail images that display evenly spaced time-steps (**Fig. 2**), giving an overview look at the movie. The information now contained in the manual is most useful as a technical guide, but does not contain geologic information which would be most useful for teachers or their students as the basis for research projects.

Future Education Outreach Tools: In the next year, we hope to expand the content of the manual to include a description of features that are visible in the sequence along with their geologic significance. There will also be a searchable index to help teachers or students find a movie sequence(s) for a particular topic of interest (craters, landslides, ponds, boulders, dynamic lighting, etc). Additionally there are many more movie sequences that can be produced. Finally we envision

placing the movies and supporting documentation in a highly interactive web-based graphical user interface to help scientists, teachers, and students find the specific movie for a particular topic.

References: [**1**] Veverka et al. (2000), *Science*. 289, 2088-2097. [**2**] Veverka et al. (2001), *Nature*, 413, 390-393. [**3**] Murchie et al. (1999), *Icarus*, 140, 66-91. [**4**] Murchie et al. (2002), *Icarus*, in press. [**5**] Li et al. (2002), *Icarus*, in press.

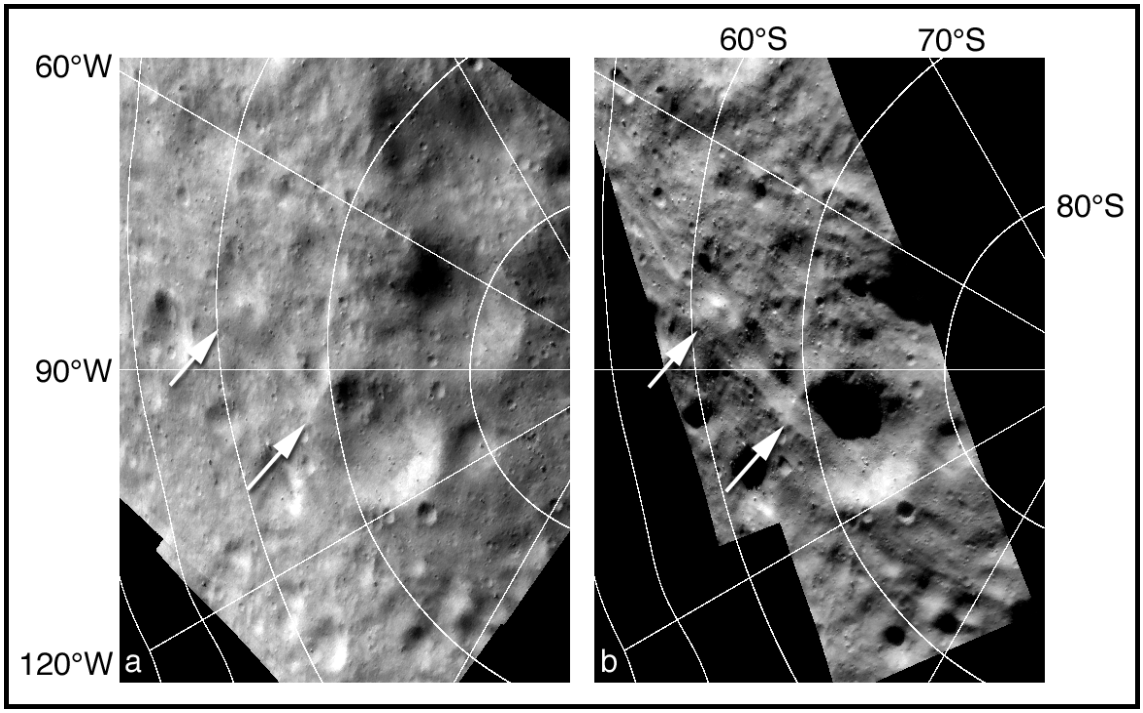

Fig. 1. Two mosaics covering same area on Eros acquired under very different lighting conditions. Arrows in both mosaics key on identical features. Note that the structural feature clearly seen (arrows) in the right mosaic (Aug. 4, 2000) is not easily discernable in the left mosaic (July 21 and 29, 2000). The MSI Eros movies in many cases allow viewing as lighting conditions change, thus allowing more confident interpretations of surface features.

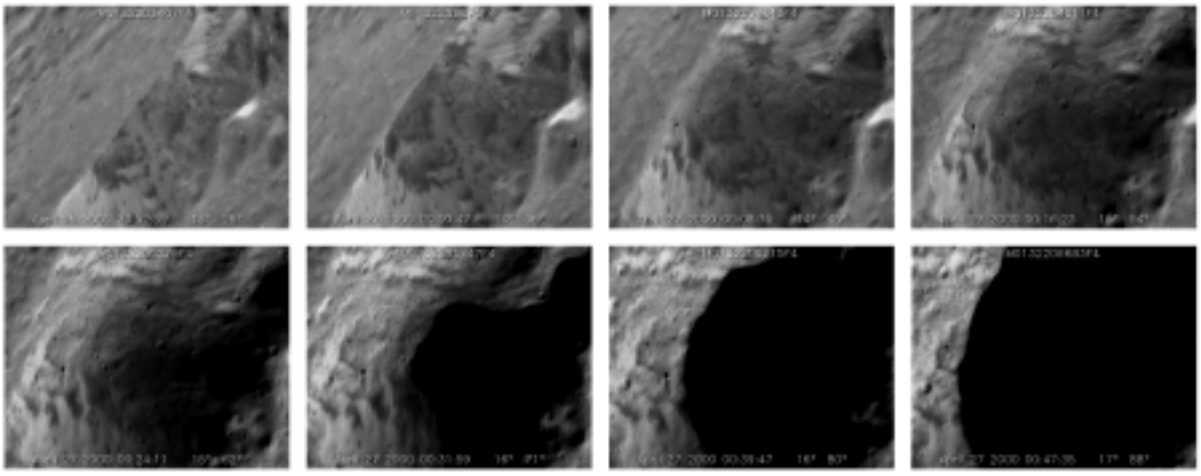

Fig. 2. Thumbnail summary of movie MSI_FeatureTrack_117 showing sunset over Psyche crater, from page 25 of Eros Orbital Movie Manual.