NEAR MSI MOSAICS OF 433 EROS, M.S. Robinson[1], D.B.J. Bussey[1], J. Edmonds[1], J. Lutsey[1], A. Milne[1], K. Moore[1], L. Prockter[2], B. Wilcox[2], , [1]Northwestern University, Dept. of Geological Sciences, 1847 Sheridan Rd., Evanston, IL, 60208, [2]Applied Physics Laboratory, Johns Hopkins University, Laurel MD.

Eros is a highly irregular object, approximately 33 × 11 × 11 km, with a period of rotation of 5.27 hours and an obliquity of 88°. During its 1.76 year journey around the Sun, periapsis is at 1.13 AU, and apoapsis at 1.73 AU. The NEAR Shoemaker spacecraft entered orbit around Eros on February 14th 2000. By February 12th 2001 it had completed a successful global mapping campaign utilizing the Multispectral Imager (MSI) with both single filter and multi-filter (color) sequences. NEAR Shoemaker orbited Eros 230 times acquiring more than 140,000 images of the surface. The spacecraft initially orbited at an altitude of 200 km, providing regional coverage (typical resolution = 19 m/pixel) of the then illuminated northern hemisphere of the asteroid. From February to July of 2000 the orbit radius was decreased in discrete steps down to 35 km before being stepped back up to 200 km by November, allowing synoptic imaging of the then illuminated southern hemisphere. While the higher altitude data provide regional coverage, the lower orbits yielded high resolution images (≤ 3 m/pixel) showing the nature of the surface in great detail. The irregular shape of Eros often results in large variations in the resolution of images during an orbit. The 180° end of Eros has a radius as great as 17.7 km while the minimum radius to the middle of Psyche crater is only 3.1 km, a difference in range to the spacecraft of nearly 15 km. In a 35 km orbit, this corresponds to a difference of resolution of almost a factor of two, 3.1 m/pixel versus 1.7 m/pixel. In addition to orbiting the asteroid in low eccentricity ellipses, the NEAR Shoemaker spacecraft conducted a Low Altitude Flyby in October 2000 where it passed within 6 km of the surface, collecting images at better than 1 m/pixel. A further set of low altitude flybys were conducted in late January 2001, with the spacecraft descending to within 3 km of the surface. These maneuvers collected approximately 1000 images with sub-meter resolution. At the end of the mission the spacecraft descended to the surface, using several de-orbit burn maneuvers, resulting in a landing on Eros on February 12th 2001. This terminal part of the mission also allowed acquisition of many high resolution (< 1 m/pixel). Imaging of the surface has revealed many interesting features, including widespread boulders, the existence of a regolith, craters of all sizes, and grooves and ridges.

Due to Eros's irregular shape, the production of cartographic products requires specialized processing techniques based on a global shape model. This shape model, derived from over 6000 control points of latitude, longitude, and radius that define Eros's surface, permits the MSI images to be geometrically. The shape model also provides local slope information making it possible to apply photometric corrections on an individual pixel by pixel basis.

In addition to strict cartographic mosaicking hundreds of hand laid 2x2, 3x3, and larger sequences were produced during, and subsequent to mission operations to aid in mapping the surface, understanding the geography, and locating features for special imaging sequence acquisition. Resolution ranges from 20 m/pixel down to better than 10 cm / pixel. These mosaics are not strict cartographic products: they were produced by importing image sequences into Photoshop and hand placing frames. During acquisition subtle rotation of the asteroid and small changes in scale result in geographic small discontinuities from frame-to-frame. These discrepencies were minimized by erasing areas of overlap around distinct features such as craters and scarps. Many of the sequences were taken at oblique angles, thus naturak changes in scale can be extreme. However, these mosaics are a great tool for investigating the surface of Eros, and much science analysis concerning spatial relations of features on the surface can be derived with minimal user effort. These mosaics not only represent a valuable tool for scientists but are a great tool for educators to introduce the asteroid landscape into planetary science curricula. Eros exhibits extremes in shape and has a rich variety of surface features. NEAR acquired many redundant sequences of the surface, albeit at greatly different illuminations making for spectacular comparisons.

http://www.earth.nwu.edu/people/robinson

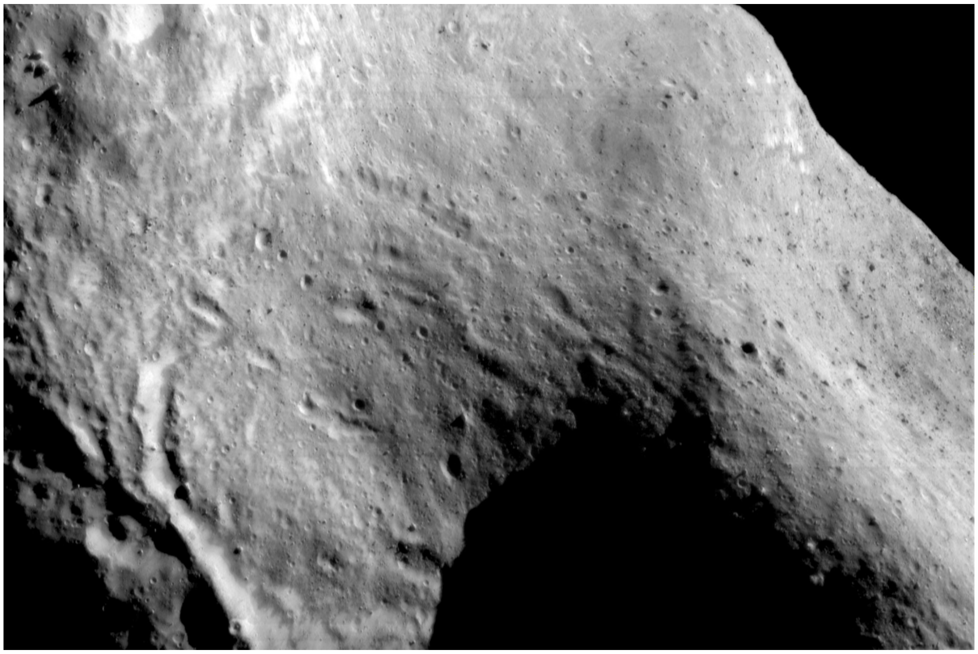

Fig 1. Hand laid mosaic showing detail of inside of Himeros crater (left foreground) and Shoemaker crater (right background). Image acquired day of year 292, 2001.

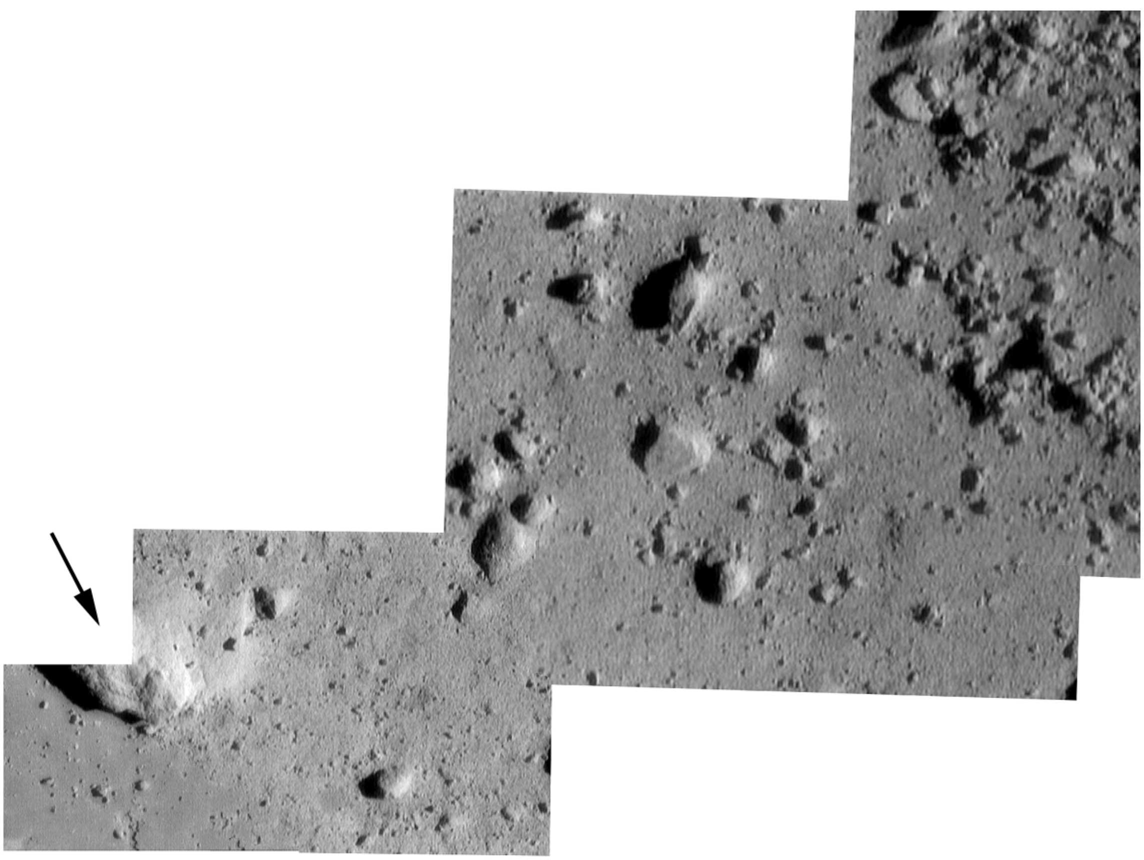

Fig. 2. Handlaid mosaic of last four frames acquired by NEAR just before touching down on the surface. Boulder in lower left indicated with arrow is ~2m across.