FURTHER ANALYSES OF THE 433EROS GLOBAL LINEAMENT MAP. D.L. Buczkowski[1], O.S. Barnouin-Jha[1], D. Wyrick[2] and L.M. Prockter[1], [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, [2]Southwest Research Institute, San Antonio TX, contact: Debra.Buczkowski@jhuapl.edu.

Introduction: The observed presence of grooves on Eros can be interpreted as being solely due to faulting resulting from the transmission of impact shock waves [1]. However, early studies found two large-scale lineations on Eros (Callisto Fossae and Rahe Dorsum) to be coplanar with a large flat region (the southern "facet") on one end of the asteroid [2]. This CF-RD-SF plane was interpreted as indicative of a pre-existing structure throughout most of the asteroid, consistent with a fabric inherited from a parent body.

A global database of all Eros lineaments (Fig. 1) was recently constructed [3] to better understand the global distribution of these features and thus understand more about the interior structure of the asteroid. Over two thousand linear features, ranging up to tens of kilometers in length, were mapped from 180 high resolution (5-11 m/p) NEAR Multi-Spectral Imager images of Eros [3].

It is possible that those sets of linear features on Eros that formed by a common creation mechanism are either co-planar or describe a series of parallel planes. Because the linear features are mapped directly onto the Eros shape model they have a three dimensional component and can be modeled to define planes that cut through the asteroid. We determined the unit normal, or pole, of the plane described by each individual lineation [2, 3]. We compared the poles of the lineations in each set grouped by observed orientation to determine if they are in fact similarly oriented or if the visual identification was confused by the non-spherical shape of the asteroid.

The mapped lineations have been grouped into sets according to location and orientation; many different sets of lineaments were identified [3].

Radial Lineation Sets: Some of the lineations are clearly related to specific impact craters; at the time of writing lineations have been identified radial to 13 craters [3]. Given their proximity and orientation relative to the craters it seems most likely that these lineaments were formed as a direct result of the impact event.

Other Lineation Sets of Impact Origin: The most distinct set of lineations on Eros (Set 1, Fig. 2) is found aligned roughly with the prime meridian of the asteroid [3]. Several of these 143 lineations are up to 10's of kilometers long. The orientation of the lineaments is consistent with the pattern expected from fragmentation due to impact on the long side of an ellipsoid target [4]. We infer that these lineations were formed as a result of the Pysche and/or Himeros impacts.

Lineation Sets of Non-Impact Origin: A set of 55 lineations (Set 2) is identified encircling the "tail" of Eros, from ~170° to 240° longitude [3]. The preferred orientation of these lineaments does not obviously follow any predictions of models of lineation formation by impact. We therefore suspect that these lineations represent a pre-existing internal structure.

Another set of lineations (Set 3) also does not fit any impact-formation predictions. This set of 95 lineations describes a plane which may be coplanar to the CF-RD-SF plane described by [2] (Fig. 3). The pole of the set 3 plane is ~60° from the set 2 pole.

Implications: The bulk density of Eros (~2.7 g/cm^3) is lower than the measured density of comparable ordinary chondrite meteorites (~3.3 g/cm^3), indicating a high porosity [5]. However, the presence of long structural features on the surface, including the thousands of lineations mapped by [3], are indicative of a significant internal strength. Thus Eros is generally classified as a 'heavily fractured' asteroid [6].

Interpretation of the global lineation map introduces the possibility that Eros is a contact binary [3]. The set 2 lineations, although present in both the northern and southern hemispheres, are only found in a restricted longitude range. [3] noted that these linear features are not in the same plane as the planar structure suggested by [2] and occur "tailward" of Calisto Fossae; they are not in the section of Eros where [2] observed planar structure. [3] suggested that if the [2] planar fabric is indeed a remnant of structure within a parent body, then the presence of a completely different planar fabric in the Eros tail could imply that the tail has a different parent body from the rest of Eros, or that it is a piece of a larger Eros that has been "relocated" to the end of the asteroid.

However, the recent identification of the set 3 lineations may discount the contact binary theory. If the set 3 linear features are in fact a continuation of the CF-RD-SF planar set described by [2] then they would be in the same region of Eros as the set 2 lineations. Furthermore, if the two sets are in fact conjugate fractures, then they would have formed at the same time, either on a cohesive Eros or the Eros parent body.

References: [1] Prockter L. et al. (2002) *Icarus, 155*, 75-93. [2] Thomas P.C. et al. (2002) *GRL*, 10.1029/2001GL014599. [3] Buczkowski et al. (2008) *Icarus 193*, 39-52. [4] Asphaug E. et al. (1996) *Icarus, 120*, 158-184. [5] Yeomans et al. (2000) *Science*, 289, 2085-88. [6] Wilkison et al. (2002) *Icarus, 155*, 94-103.

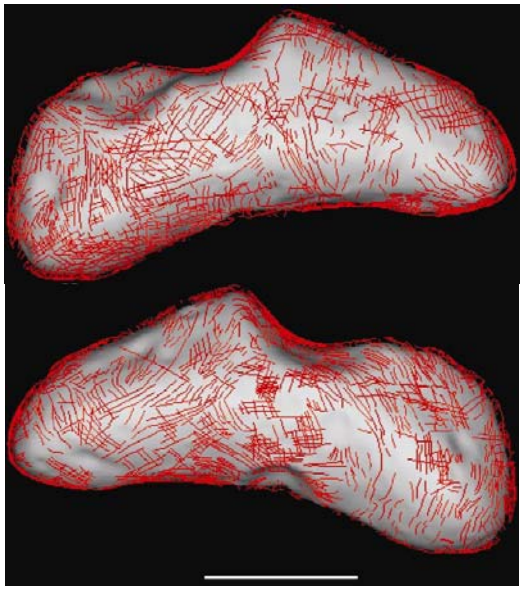

Figure 1. Southern (top) and northern (bottom) hemispheres of the Eros lineation map.

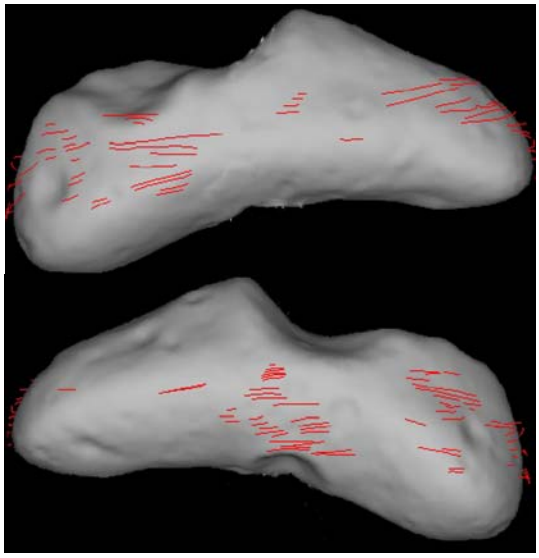

Figure 2. Example of a lineation set on the southern (top) and northern hemispheres of Eros. Set 1 lineations.

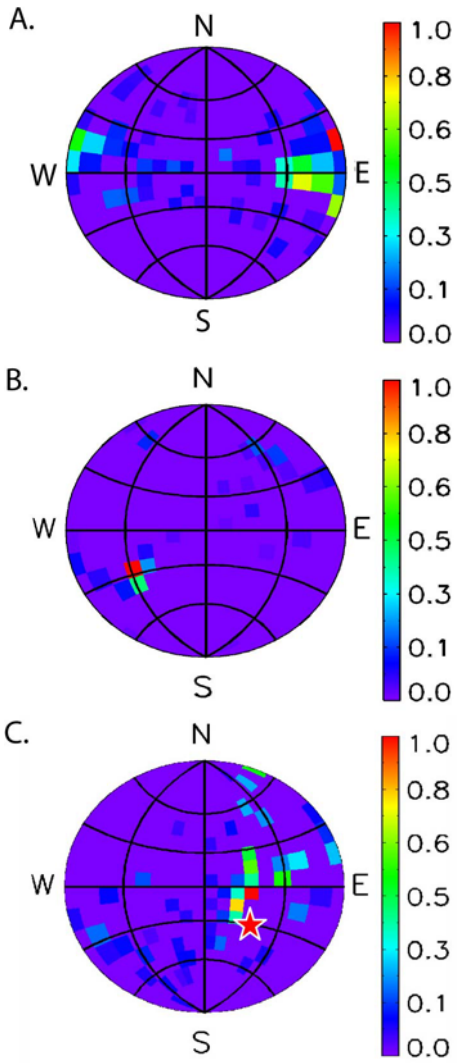

Figure 3. Stereonet plots of the poles of the planes described by a set's lineations relative to the equatorial plane of Eros. Clustering of poles indicates that the planes are parallel. A) Set 1 lineations. Poles clustered at 0° indicates that set 1 planes are perpendicular to the equatorial plane. B) Set 2 lineations. C) Set 3 lineations. Red star indicates pole of the CF-RD-SF plane, as described by [2]. The similarity between the two poles indicates that the two lineation sets may be co-planar. Also, the set 2 and set 3 poles are separated by 60°, which implies that they may represent a conjugate fracture set.