STRATIGRAPHY OF THE ROLLING-PRINTED GROOVE-FIELDS ON DAWN IMAGES IN ORDER TO RECONSTRUCT PALEOAXES OF 4 VESTA.

A. Horváth[1], Sz. Bérczi[2], E. Illés-Almár[1], [1]Konkoly Observatory of the Hungarian Academy of Sciences, [2]Eotvos Lorand University, Institute of Physics, H-1117 Budapest, Pázmány P. s. 1/a. Hungary, (bercziszani@ludens.elte.hu)

Introduction: The images by Dawn space probe revealed the groove-scattered surface of asteroid Vesta. If we accept that the equatoral groove system is the result of surface prints of reimpacting ejecta boulders – thrown away by a huge impact – we can use it to identify the actual rotational axis of the asteroid. The existence of several groove belt systems, however, suggests that the rotational axis of the asteroid changed in time. Mapping the stratigraphy of the groove systems helps in identifying earlier rotational axes and their changes during the history of Vesta.

Methods: Dawn images have been analyzed with the method published in [1,2,3,4] and a stratigraphic superposition sequence of the most prominent groove systems was composed.

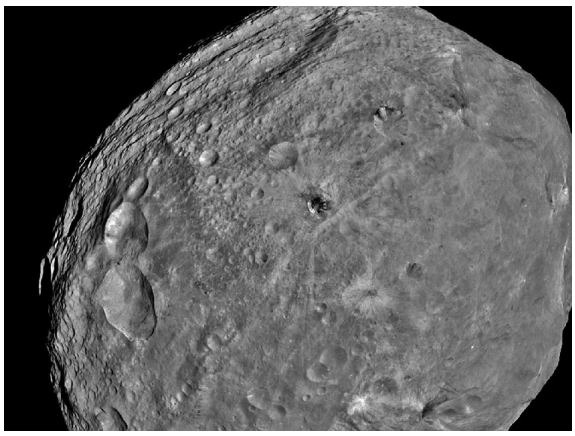

Fig. 1 A Dawn image of Vesta. The North polar groove system is conspicuous on this photo [5]

Discussion: The surface of Vesta is full with impact craters as well as with grooves. The most conspicuous groove system is containing some parallel grooves of sharp ridges (**Fig. 2**) that can be followed all around the equator. The other similarly conspicuous groove system is the one near the North Pole (**Fig. 1**) that has grooves about the same width than the equatorial system. Some other groove systems can be recognized as well, but in this preliminary investigation we concentrate on the first two ones.

If we accept after Wilson and Head [6] that also on Vesta such coherent parallel groove systems are the manifestation of the reimpacting rolling blocks – printing their pathways along the actual equatorial region of the asteroid – we can use the grooves to identify the actual rotational axis of the asteroid.

As the North polar and the equatorial groove systems have different directions, this two groove systems can be explained in the framework of the above model only if the rotational axis of the body has changed in between. That is, the groove systems serve as a useful tool in identifying paleoaxes of Vesta.

As an enormous crater exists now near the present South Pole of Vesta, it is reasonable to suppose, that after the huge impact – causing an enormous deficit of mass at the impact site – the body of Vesta turned away until the deficit arrived to the rotational axis.

As the North polar parallel groove system seems to be older than the equatorial parallel groove system, on the basis of our hypothesis it can be claimed, that the impactor arrived at the ancient equatorial plane of Vesta and caused a huge deficit of mass on that hemisphere. As a consequence, Vesta's body turned away about 90 degrees with respect to the rotational axis. After this turn-away the reaccumulation of the outthrown material continued already around a new equator.

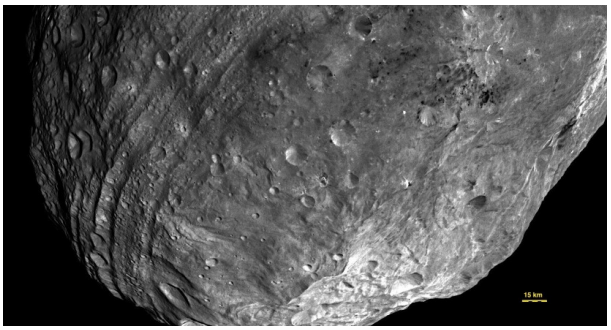

Fig. 2. A photo of Vesta [5] with the prominent equatorial groove system (to the left).

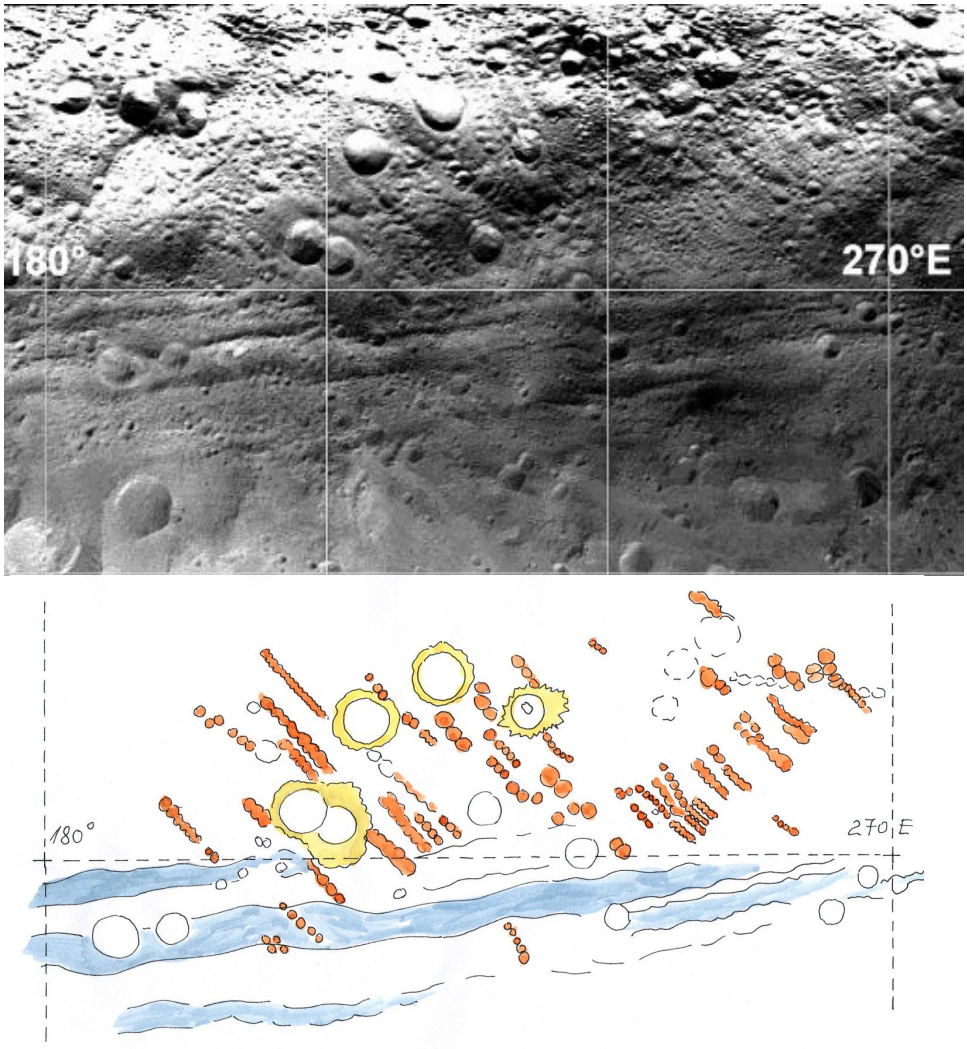

Fig. 3. Between 180 and 270 longitudes the crossing region of two groove fields can be identified [5]. The average inclination angle between the two systems is about 30-40 degrees.

Conclusion: In this preliminary study at least one older groove system could be identified. Supposing that the different parallel groove systems belong to different directions of the rotational axis of Vesta the stratigraphical sequence of the rolling printed groove-field features serves as a method to decipher earlier paleoaxes. In other words, we could find a method in determining earlier paleoaxes of the asteroid and, as a consequence, the corresponding impact events can be reconstructed.

In the opinion of one of us (E.I-A), however, in the case of the equatorial groove system the freshness and sharpness of the grooves – and their circumferential position in connection with the impact – hints at a conclusion that its origin is rather a rapture as a consequence of the huge impact. On the contrary, according to A.H., the North polar parallel groove system may be the surface manyfestation of volcanic layering of the parent body of Vesta [1,2,3,4,7].

References: [1] E. Illés, A. Horváth, F. Horváth, A. Gesztesi (1985) In Situ Measurements to Determine if Phobos is Layered, *Acta Astronautica* **12.** (6), 455-464. [2] A. Horváth, I. Almár, E. Illés-Almár, A. Szabó (1994) Comparison of the Surface Grooves on Gaspra, Ida and Phobos, XXX. COSPAR Meeting in Hamburg, July 1994, Paper B.4 – 015. [3] Horváth, A.; Illés-Almár, E. (2011): Grooves on 21 Lutetia Indicate a Layered Structure. 42nd LPSC, The Woodlands, Texas, #1366, LPI Houston CD ROM; [4] Bérczi, Sz.; Horváth, A.; Illés, E. (2003): Comparison of the Cracking and Fracturing Systems of Phobos and Europa. 6th International Conference on Mars, July 20-25 2003, Pasadena, California, #3198; [5] http://dawn.jpl.nasa.gov/; [6] Wilson, L.; Head, J. W., III (2005): Dynamics of Groove Formation on Phobos by Ejecta from Stickney Crater: Predictions and Tests. 36th LPSC, #1186, LPI Houston CD RON; [7] Bagrov, A. (INOSAN, Akad. Nauk Russia). Personal com.