CHAOTIC TERRAINS AS INDICATORS OF CRUSTAL THICKNESS OF EUROPA. A. Kereszturi (Department of Physical and Historical Geology, Pázmány sétány 1/C, Budapest, H-1088, Hungary, E-mail: krub@freemail.hu)

Introduction: In the last years there were observations suggest there is a thick water ocean below the ice crust of Europa where the ice crust "drifts" on the top of the ocean. Important question is the thickness of this ice crust because it influences the future cryobotic missions and the tectonic structure of the crust. Because the most active crust cracking and rotation happens at the chatotic terrains we analysed these regions as indicators of the structure and thickness of the ice crust. Based on the Galileo spacecraft's images we estimated the relative height of the "icebergs" based on their shadows and Airy isostasy models. With this we can approach the relative thickness and thickness variations on Europa which could be an interesting infromation among the other thickness estimations.

Working method: We used images of Europa made by the Galileo spacecraft with higher than 40 m resolution. On the images we marked the width of the shadows of certain positive topographic structures according to the lighting direction, measuring the physical distances of the pairs of pixels (the beginning and end of the shadow parallel to the lighting direction). With simple trigonometric transformation we were given the height of the surface structure relative to the surrounding terrain. We used three basic statements in our approach: 1. The ice crust and blocks are in isostatic equilibrium. 2. The ice is homogene and has density of 0.9175 g/cm^3. 3. Beside the isostatic situation the internal plasticity and deformation does not influenced the drift of the rafts. Above this effect at certain cases the "ice drifts inside ice" situation have to be analyzed too when the surrounding plastic ice can act as a second fluid-like medium in the isostatic drifting of smaller ice fragments. The estimated errors in the measurements are below of 20%.

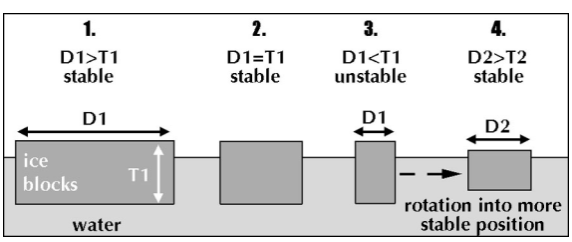

Fig. 1. Theory of rotation of "taller than wider" blocks

Results: We measured the size and relative height above the surrounding terrain of the blocks inside an 48x38 km part of the famous Conamara Chaos. On Fig. 1. the theoretical approach is visible: during breaking that blocks which height are greater than their width, the shape is "tall" which cause rotation into more stable drifting position. If we find blocks which height are lower than of that blocks which has larger diameter we find the isometric shaped blocks and in that case the isometric block's diameter is equal to the thickness.

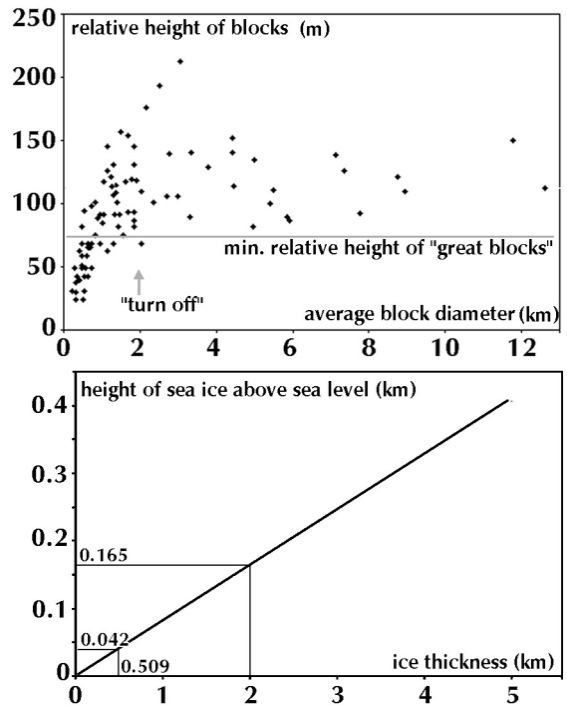

Fig. 2.: The diameter/height distribution (top) and the proposed thickness (bottom)

On the upper part of Fig. 2. the shadow based average relative heigth of certain blocks relative to the low level matrix versus the blocks' maximal diameter is visible. It is obvious that there is a maximal relative height which in this case is about 200 m, it this case the blocks which has double ridge pairs on their surface probably represent the original crust. The relative height distribution turs down around 75 m height and 2000 m diamater. Based on the theoretical approach in this case using the isostatic drifting we can determine the absolute ice thickness of the original blocks

and of the ice matrix make up the lowest part of the chaotic terrain's surface. If we take the 2 km value for the great block's thickness, the matrix thickness is about 0.5 km. If we take some other values (because the uncertain determination of the turn over point), we find at 1,8 km original thickness

Conclusion: Based on the "block rotation method" the thickness of the original ice crust is about 2 km and in the case of the low level matrix 0,5 km. The results can be interpreted in two ways as it is visible on Fig. 3.: the 2 km can be equal to the original thickness (case B), or smaller than the original thickness (C).

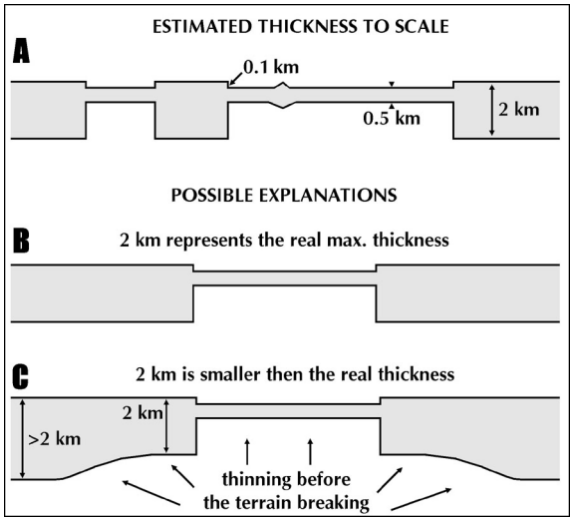

Fig. 3.: On the top (A) the proposed thickness values are visible to scale, at B and C two possible explanations are visible

Future work: Now we are working on a method which use the lighting conditions to generate row photometric based "slope angle" maps (for one lighting direction). With a graphic filter from this map we generate a quasi topographic gray-scale map in which the relative height variation is corrected with the observed values mentioned in this article. Our method can be used for several research areas: 1. Crustal thickness variations on different parts of Europa, 2. Heat escape variations according to different crustal thickness, 3. Slope angle estimation, 4. Analysis of geologic process on Europa based on the crustal differences at superimposed tectonic structures.

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References: [1] R. Greenberg at al. (1998) Icarus 135, 64-78. [2] G. V. Hoppa et al. (2001) Icarus 151. 181-189.