SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

Author: Dr. Sergey Aksenov
Moscow Institute of Electronics and Mathematics of National Research University Higher School of Economics (MIEM NRU HSE), Russian Federation, aksenov.s.a@gmail.com

Prof. Eugene Chumachenko
Moscow Institute of Electronics and Mathematics of National Research University Higher School of Economics (MIEM NRU HSE), Russian Federation, mmkaf@miem.edu.ru
Prof. Ravil Nazirov
Space Research Institute (IKI), RAS, Russian Federation, rnazirov@cosmos.ru
Mr. Stanislav Bober
Moscow Institute of Electronics and Mathematics of National Research University Higher School of Economics (MIEM NRU HSE), Russian Federation, sbober@hse.ru
Mr. Anton Butenko
Moscow Institute of Electronics and Mathematics of National Research University Higher School of Economics (MIEM NRU HSE), Russian Federation, abutenko@hse.u

THEORETICAL AND COMPUTER INVESTIGATION OF CRACK FORMATION ON EUROPA'S SURFACE

Abstract

The paper deals with an investigation of relief formation in Europa's surface. Jupiter's satellite Europa is close in size to the Moon. Its surface is covered with a layer of ice crust of thickness 10-30 km. Europa's surface is of large interest, because under the ice crust there is an ocean of liquid water creating conditions for life. The entire ice surface of the satellite is covered with the system of bands, valleys, and ridges. These structures are explained by the fact, that the ice surface is rather mobile and it was repeatedly broken from internal stresses and large-scale tectonic processes. The analysis performed showed that compressing, extending, shearing and bending stresses can influence some arbitrarily separated section of Europe's ice surface. The computer simulation with finite element method (FEM) was performed to see, what types of defects could arise from such effects. The heterogeneity of planet's ice cover in thickness, density and temperature was taking into account during the simulation. The calculations, carried out for the cross-section of a thawed ice structure's area, have shown that, the most dangerous, from the crack formation viewpoint, is the shear stress at loading application angles of 90°. Using locally homogeneous models of thawed ice patches in the distributed field of temperatures, the effect of mechanical gravitation-tidal forces on the formation of surface defects on a Europe was studied. It is shown that fractures and cracks can have various forms depending on the stress-strained state arising in their vicinity. The formation of such defects is caused by the chaotic set of many factors, mechanic and temperature ones predominantly.