Effect of Isostatic Rebound on Lithosphere in the Discrete Element Method Simulation

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Mass redistribution of the lithosphere due to imposed or removed loads, so-called isostatic rebound, makes the surface to rise or sink. Loads may consist of continental shelves, ice, large lakes, thrust sheets, sediment, and volcanoes. Until the isostatic equilibrium is reached, the rising or sinking of the lithosphere will continue. When surface settings are being unloaded (i.e., melting of ice, sediment erosion), the new stress would be given continuously at existing fractures, inducing extension of the length of the microfracture. Also, it would trigger an earthquake arisen from stress releases which can induce rock failures suppressed by loads. A lot of numerical analysis method is being used to modeling this problem. Finite element method which considers the model a continuum-based has been widely used to analyze various phenomena of the earth’ s tectonic systems. However, since the finite element method considers the model a continuum-based, when it comes to observing surface extensional fractures on rifting regions along the basins being expanded, it is not suitable enough to study the rock failure mechanism. In this study, we simulated a time-dependent isostatic rebound with brittle failure of surface bedrock due to the removal of loads using DEM (discrete element method). The discrete element method is introduced by Cundall and Strack (1979), which can deal with the complex behavior of the material as a result of interactions between discrete particles. We used the open-source discrete element analysis software package YADE which holds good maintainability and expandability due to command scripting system using python.

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