Acoustic fluidization during impact crater's formation

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Attempts to explain the apparent temporary decrease of the dry friction in fragmented rocks around forming impact crater resulted in the acoustic fluidization model (AF), now more than 20 years in use [1, 2]. The AF model has allowed us to reproduce the evolution trend of the crater morphology with the final crater diameter from simple bowl-shaped craters to complex craters with the central uplift (central mounds, concentric inner rings). At the same time the physical AF mechanism is still obscured [3]. The main technique to parametrized the AF model is the fitting modeled crater profiles to the observed natural crater shape (e.g. [4, 5]). This work presents a continuation of the internal AF model analysis with an attempt to compare fitted AF parameters (amplitudes and decay times of assumed internal oscillations), found in numerical experiments of a crater shape at planetary bodies with various gravity accelerations – from the Earth (g = 9.8 m s-1) to Vesta asteroid (g 0.22 m s-1). The preliminary summary of successful model runs show, that in the first approximation we observe the linear increase of internal oscillation's decay time, Tdec, with the final crater diameter, Drim . Numerical values of Tdec (measured in seconds) are approximately equal to the rim crater diameter Drim (measured in km). For the smallest modeled terrestrial crater Steinheim (Drim 3.8 km) the best fit for Tdec is about 6 s. In the largest modeled craters on asteroid Vesta (Drim 500 km) the best fit is for Tdec about 800 to 900 s. Meanwhile, the characteristic lithostatic pressure inside the crater-forming rock flow (estimated at a depth Drim/8) decreases factor of 40 from Earth to Vesta. For example, for Drim 100 km, the characteristic pressure decreases from 300 MPa to 7 MPa. Hence, the internal oscillation decay, assumed in the AF model, does not correlate with the absolute ambient pressure values, pointing to less wide range mechanisms, governing the temporary dynamic dry friction decrease in fragmented rocks near a forming impact crater.

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