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Impact Cratering Physics al Large Planetary Scales[1]

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Present understanding of the physics controlling formation of $\sim 10^3$ km diameter, multi-ringed impact structures on planets were derived from the ideas of Scripps oceanographer, W. Van Dorn, University of London's, W, Murray, and, Caltech's, D. O'Keefe who modeled the vertical oscillations (gravity and elasticity restoring forces) of shock-induced melt and damaged rock within the transient crater immediately after the downward propagating hemispheric shock has processed rock (both lining, and substantially below, the transient cavity crater). The resulting very large surface wave displacements produce the characteristic concentric, multi-ringed basins, as stored energy is radiated away and also dissipated upon inducing further cracking. Initial calculational description, of the above oscillation scenario, has focused upon on properly predicting the resulting density of cracks, and, their orientations. A new numerical version of the Ashby–Sammis crack damage model is coupled to an existing shock hydrodynamics code to predict impact induced damage distributions in a series of 15–70 cm rock targets from high speed impact experiments for a range of impactor type and velocity. These are compared to results of crack damage distributions induced in crustal rocks with small arms impactors and mapped ultrasonically in recent Caltech experiments (Ai and Ahrens, 2006).

[1]In collaboration with Charles G. Sammis, Department of Earth Sciences, University of Southern California, and Mona Delitsky, Seismological Laboratory MS 252-21, California Institute of Technology.