EVIDENCE FOR GRAVITY SCALING AND IMPLICATIONS FOR EXPLOSION CRATERS

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Dimensional and similarity analyses predict that crater dimensions scale as the cube-root or quarter-root of the explosion energy release depending on whether or not the gravity field is considered significant in the cratering process. Experiments with buried explosions reveal that crater dimensions scale with explosion energy to a power intermediate to 1/3 and 1/4. Surface burst crater data indicate that crater radius and depth are proportional to explosion energy to a power which is different for each crater dimension. These experimental observations are at variance with expectations of dimensional and similarity analyze . s and are attributed to our inability to achieve similitude in the experimental environment. Achievement of similitude in experiments is often impossible thereby making identification of proper scaling rules difficult. Crater data have been examined from recent hypervelocity impact experiments in which the conditions of similitude have been more nearly achieved than in explosion cratering experiments. Examination of the data from similar experiments indicates that fourth-root or gravity scaling is the rule which best relates crater dimensions to energy of the impacting projectile. Implications for chemical and nuclear explosions are that in experiments the specific energy and dimensions of the explosive must be scaled as the fourth power of explosion energy release in a gravitational field which is constant if model experiments are to be similar to the large scale prototype. Additionally, medium properties must be scaled in similar experiments. To avoid the difficult constraint of similitude on scaling medium properties, similar cratering experiments can be conducted in accelerating frames. Experiments in accelerating frames are suggested for both explosive sources and for hypervelocity impact projectiles which approach the conditions of similarity and which may fortifier elucidate the question of crater scaling.