COLLAPSE OF A TRANSIENT CRATER CAVITY: FIRST RESULTS FROM ANALOGUE EXPERIMENTS.

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Introduction: Except for very small impact craters, the shape of almost all craters is modified by gravity driven mass movements. In simple craters the shape of the transient cavity that forms at the end of the excavation stage [1] is moderately modified, in complex craters the mass movements are substantial. To understand the kinematics of crater wall collapse in simple and complex craters we conducted analogue experiments with a variety of materials (sand, sand+flour mixtures, glass beads) and recorded the particle displacements by means of Particle Image Strainometry (PIS) [2].

Experiments: The experimental setup consisted of a 50 cm box filled with the analogue material. A paraboloidal cavity mimicking a transient crater was created either with a replica that was removed after filling of analogue material was completed or by a partly buried balloon. The gravitational instability of the cavity was induced by a piston installed beneath the cavity moving downward at constant velocity [2]. In case of the balloon experiments, the cavity walls instantaneously collapsed when the balloon was punctured. Two cameras, installed at high angles to the target surface, recorded the collapse of the cavity. Pulsed LED flashes illuminated the setup. We used the Strain Master 3D software package by La Vision to record changes in the position of material points. PIS provides an accurate measure of the instantaneous displacement field of laboratory flow and is adapted for strain monitoring in analogue sandbox experiments [3]. Scaling of material cohesion and density between experiment and nature resulted in a scaling factor of ~ 10^4, thus the 10 cm cavities formed in the experiments roughly correspond to 1 km cavities in nature.

Results: In the first set of experiments (using the replica), numerous slumps developed at the cavity rim and reached the cavity center. A slump often triggered the onset of subsequent adjacent flows. Slumps created lobate headscarps and superimposed onto each other at the bottom of the cavity, thereby filling the cavity. Additionally a system of circumferential tensile fractures formed outside the cavity. These concentric fissures allowed for slow creeping of the entire mass inside the concentric fissures into the cavity. Their occurrence resembles the concentric fissures around the 108 m Snowball crater [4].

The second set of experiments (exploding balloon, sand+flour) led to the simultaneous initiation of cohesive slumps along the steep rim. While moving inward these slumps subsequently disintegrated into granular flows due to oblique and frontal collision with other flows. The central portion of the crater floor is characterized by a rather turbulent and chaotic flow that resulted in a flattish morphology.

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