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Hydrocode Simulations of OMEONGA crater formation

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Abstract

Impact craters are the dominant surface features of the solid bodies of the Solar System, specially if no other geological processes are acting. An impact crater formation is a fundamental and tangled process that is far to be still understood in its whole. The understanding of impacts has been recently advanced thanks to numerical model. We have used iSALE hydrocode to model a terrestrial impact crater.

1. Introduction

The study of Earth impact craters may be difficult because of later modifications caused by the cumulative effects of erosion, transport, deposition and weathering.

2. Description of the crater

Omeonga (Wembo-Nyama) is located in Central Africa, and more precisely, in the Eastern Kasai province (R.D. Congo), centered at 3°37'50"S, 24°31'00" (Fig. 1). It is recognizable from satellite images for the perfect roundness of the ring underlined by the Unia River, a tributary river of the Lomani River. This structure was interpreted as an impact structure from geological observations [1].

Figure 1: GoogleEarth image of the Ring of Omeonga (Wembo-Nyama).

3. iSALE Simulations

We are using the iSALE hydrocode to model the formation of Omeonga crater to integrate the geological observations in favor of an impact origin [4, 5].

We hypothesize a rock projectile, about 2 km in diameter, that strikes the target with the typical velocity on Earth's orbit (25 km/s for asteroids) and perpendicular with respect to the surface. Since almost every impact occurs obliquely, with 45° as the most probable impact angle [6], we take into account a lower impact velocity to simulate a more reliable initial condition. However, impact angle and direction may have a minor effect on crater morphology, while they are important for crater size and ejecta curtain.

The target is made up by a 800 m sandstone layer that overlies about 30 km granite upper crust. The thermodynamic behavior of both the projectile and the target materials is calculated by the Tillotson equation of state (EOS).

At this initial stage, we set a different degree of porosity on both projectile and target materials, using as reference the ε-alpha model [7]. Finally, to reproduce all the features that characterize a complex crater, such as, terraced walls, flat floors and central peaks, we take into account the process of *acoustic fluidization* [8, 9, 10]. A series of simulations are carried out in order to find the correct set of fluidization parameters that allows simulating the buried Omeonga morphology.

4. Results

In Figure 2, we reported an example of one among our numerical simulations.

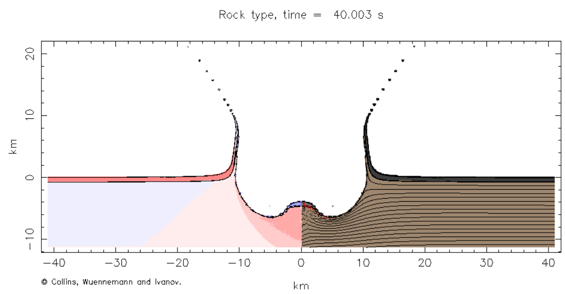

Figure 2: Plot-example of one iSALE simulation after 40 s after impact.

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