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Numerical and experimental studies of collapse calderas.

A comparison of results.

A. Geyer (1), **J. Martí** (1), A. Folch (1)

(1) Institute of Earth Sciences "Jaume Almera" IJA-CSIC, Barcelona, Spain.

Collapse calderas play an important role in volcanic environments. Field studies reveal the existence of different subsidence scenarios which explain the wide variety of morphological depressions observed in nature. Analogue experiments and numerical models contribute also significantly to understand the collapse mechanisms and the resulting structures. Experimental analogue models are adequate to study qualitatively the structural evolution of collapse calderas, including the nucleation and subsequent development of the fault system. Experiments suggest that the structure and geometry of the collapse is controlled by multiple factors such as the chamber geometry, the chamber depth to width ratio, the host rock material, and the pre-existing topography, geological structures and local stress field. Most experimental apparatus involve either a balloon filled with air or water or a silicone reservoir as an analogue for the magma chamber. Both groups of devices proportionate similar results but present some differences on the fault system and its temporal evolution. The most important handicaps of experiments are the properties of the host rock analogue materials and the difficulty to scale gravity (as in a real collapse caldera, experiments are carried out at the Earth's gravity field). In contrast, numerical studies are adequate to predict semi-quantitative general conditions for fault formation and propagation. However, in practice, they also oversimplify rheology and geometry. The predictions of numerical studies are strongly dependent on rheology and set of boundary and initial conditions imposed.

We perform a set of analogue experiments using two different experimental devices, one with a balloon as the magma chamber analogue and the other involving a silicone reservoir, in order to look into the differences on the results due to the experimental method. In addition, we repeat the experiments considering two different physical models solved numerically. The first one reproduces elastic behaviour and the second incorporates damage. The comparison between analogue experiments and numerical solutions indicates weather the results are controlled by the experimental apparatus or by the magma chamber and host rock features. In addition, we investigate the error on experimental models due to the effect of gravity not being correctly scaled.