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2D and 3D Numerical Modelling of Caldera Development

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The manner in which calderas develop is a key question in volcanology and has important implications for associated volcanogenic risk and geothermal and ore exploitation. To
better understand the structural evolution of calderas, I use a 2D and 3D discrete element model of a frictional cover undergoing piston-like subsidence at its base, simulating magma chamber deflation and cover collapse. These novel simulations capture not only the 2D and 3D initiation of calderas but also much of the complexity of faulting during their later development. In all models,
both normal and reverse faults accommodate deeper subsidence at higher structural levels.
Curved, outward-dipping reverse faults are consistently the fi rst structures to develop; subsequent caldera growth is mainly the result of movement on vertical or steeply inward-dipping
normal faults. This may be followed by a later phase of lateral collapse on shallower normal
faults. The roof aspect ratio (R = cover thickness/piston width) is seen to be an important factor: calderas with low aspect ratios ($R \leq 1$) exhibit a coherent central subsiding block, while
those with higher aspect ratios have a complexly faulted internal structure.