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Origin and Significance of Oblique-slip Faulting during Caldera Collapse

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Although conventionally described as dip-slip, some faults at collapse calderas also display evidence for a strong strike-slip component. To investigate the origin and significance of this oblique-slip faulting, we firstly analysed Boundary Element Method (BEM) models of caldera collapse caused by subsidence of a magma reservoir roof. This constrained the initial elastic 3D stress field, from which the location, orientation and nature of faulting were predicted by assuming a simple Mohr-Coulomb failure envelope. We then compared the numerical model results to analogue models of caldera subsidence that we analysed by means of Particle Imaging Velocimetry (PIV) and by cross-sectioning. This constrained the geometry and kinematics of faulting as deformation progressed beyond the initial elastic phase. The results of both modelling approaches show that oblique-slip faults should occur during caldera subsidence and can account for their orientation, mode and location. The joint analysis of the models also identifies two main processes for producing oblique-slip faulting during caldera collapse: (1) pre-failure horizontal inward motion and (2) post-failure off-centred subsidence. This work hence indicates that the often presumed dip-slip nature of caldera-related faults may be less common in nature than previously recognised.