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Structural evolution of matured collapse caldera

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Collapse calderas develop increasing their depth / diameter ratio (S/D). To properly characterize caldera evolution, a topographic S/D (ratio between topographic depth and topographic diameter; S/Dt) and a structural S/D (ratio between structural subsidence and ring fault diameter; S/Ds) are considered. The structure of a collapse caldera sifts from a fault-controlled structure with two-concentric ring faults at earlier collapsing stages, to erosion of its wall, accumulating debris on the floor, at later collapsing stages. While S/Dt and S/Ds show a similar increase at initial stages, when S/Ds˜0.33 the S/Ds becomes significantly different from S/Dt: while continuous caldera subsidence increases S/Ds, the erosion of the wall and the filling of the floor decrease S/Dt. These natural and modeling results show that the control on the shape of mature calderas (S/Ds>0.07) and approaching S/Ds = 0.3-0.4 passes from a mainly structural to a mainly erosional control. Both S/Dt and S/Ds are needed to describe the evolution of a collapse and the processes accompanying it. Evaluating S/Dt and S/Ds allows proper description of the precise evolutionary stage of a caldera and of the relative importance of the structural and erosional processes and allows making semi-quantitative comparisons between evolutionary stages.

Keywords: caldera, collapse, structure, volcano, eruption