# Investigating the state of the reservoir below the Rabaul caldera (Papua New Guinea)

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The area of Rabaul (Papua New Guinea) consists of at least seven - possibly nine - nested-calderas that have formed over the past 200 ky. The last caldera-forming eruption occurred 1400 y BP, and produced about 10 km3 of crystal-poor, two-pyroxene dacite. The most recent major explosive activity in the area was preceded by decade-long unrest (starting in 1971) until the simultaneous eruption of Vulcan and Tavurvur, two vents on opposite sides of the caldera (September 19th, 1994). Ten years prior to the eruption, a peak of seismic activity and deformation occurred, which promoted part of the local population to evacuate spontaneously. The recent history at Rabaul is therefore a perfect example of the complexity and problems associated with volcanic unrest and activity in a caldera setting. In addition, it is possible to study the deposits of the eruptions that ensued from the prolonged period of seismic and deformational activity, and therefore gain insights into the processes responsible for the unrest. The 1994-to-present deposits show clear signs of mixing/mingling between basaltic and dacitic magmas, in the form of banded pumices, quenched mafic enclaves, and hybrid bulk rock compositions. We estimate that at least 20-35 wt% basalt has mixed with the resident silicic magma. The time scales of mixing indicated by kinetic modeling of plagioclase zoning suggest that replenishment events coincide with the main period of unrest (1971 to 1985). We use a petrological, geochemical, and numerical modeling approach to investigate the current state of the main reservoir and its evolution since the last caldera-forming eruption. Our working model is that basaltic melts ascend to shallow crustal levels before intruding a main silicic reservoir beneath the Rabaul caldera. Storage depths and temperatures estimated from mineral-melt equilibria and rock densities suggest that basalts ascend from ca. 20 km (600 MPa) to ca.7 km (200 MPa) and cool from ca. 1150-1100 C before intruding a dacitic magma reservoir at ca.950 C. Depending on the state of the reservoir and the volumes of basalt injected, the replenishing magma may either trigger an eruption or cool and crystallize. Preliminary geochemical modeling suggests that the caldera-forming dacitic magma could be generated by fractional crystallization of the basaltic magma at shallow depths (ca.7 km, 200 MPa) and under relatively dry conditions (less than 3 wt% $H_2O$). We use evidence from major and trace element geochemistry, volatile contents, and the comparison of successive eruptions since 1400 y BP to address the question of whether another potentially caldera-forming magma is presently brewing beneath Rabaul.