Targeting monogenetic volcanoes from different angles to enhance our understanding of the complex eruption dynamics: case study Mt. Gambier, S.E. Australia (VEI 4)

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Monogenetic volcanoes can be very complex requiring a multidisciplinary approach to fully understand their dynamics. Here we present the improved understanding of the eruption dynamics of monogenetic volcanoes based on such an approach, with the 5 ka Mt Gambier Volcanic Complex in the Newer Volcanics Province of south-eastern Australia being the case study. This maar-cone complex is marked by the alternating magmatic and phreatomagmatic deposits reflecting multiple changes in eruption styles.

Detailed mapping was integrated with borehole data into a 3D model, so that the volumes of the different pyroclastic deposits and lava flows related to different eruption styles could be determined. In total a minimum volume of 3.25 x 10^8 m^3 of material was erupted with a minimum dense-rock equivalent volume of 1.97 x 10^8 m^3 of magma involved. These volumes are not only indicative for the VEI of this prehistoric eruption, which was 4, but also correspond to the amount of energy for this eruption stored as heat, and using these an estimate can be made of the minimum volume of groundwater necessary in order to produce the phreatomagmatic explosions and deposits.

Based on groundwater models and parameters from the local aquifers these volumes can be tested from a hydrodynamic point of view. This shows that with the aquifer conductivities or flow rates, *K*, ranging from 1.7 - 3.3 x 10^{-4} m s^{-1}, the available groundwater could not continuously recharge the root zones and diatremes of the maar-diatreme structures of Mt. Gambier, causing the strong alternations in magmatic and phreatomagmatic deposits observed at this volcanic centre. The control of the aquifer dynamics on the eruption dynamics is confirmed by the fact that the magmatic properties (i.e. viscosity, temperature, crystallinity, vesicularity and apparent ascent rate) are not different for the distinct magmatic and phreatomagmatic deposits.