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Bubble Number Density analysis of juvenile pyroclasts from the Pleistocene Lake Purrumbete Maar, Newer Volcanics Province, southern Australia

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The record of the 50-60 ka Lake Purrumbete maar deposits shows several changes in the eruption style. The facies range from thin dry magmatic scoria layers, to scoriaceous lapilli layers to dry phreatomagmatic lapilli ash and wet phreatomagmatic ash layers. This study aims to understand the role of volatiles and melt vesicularity in changing the eruption style from magmatic, to dry and wet phreatomagmatic by investigating the vesicularity, Bubble Number densities (BND) and shape parameter for the different facies.
Due to the great grain sizes variations of the different facies, three different size classes, 2 mm, 0.5 mm and fine ash (<65 μm) were used for the analysis. For each sample and size class juvenile clasts in BSE images of polished thin sections were analysed in terms of vesicularity and bubble structures. BND values, vesicularity and shape parameters were calculated using the program ImageJ 1.43. To be certain that the bubbles formed prior to fragmentation, only clasts with a cuspate outline and an even bubble distribution from the core to the rim were used. The preliminary results show, that the clast vesicularity of the phreatomagmatic samples vary in a wide range from 4 to 60% in the same sample, whereas the vesicularity of the scoriaceous clasts is in a more narrow range of 30 to 60%. The clasts show both stretched and round vesicles, often both in different parts of the same clast, indicating that these bubbles were entrapped in the rising magma and were sheared immediately prior to fragmentation. However clasts of both dry phreatomagmatic and scoriaceous lapilli facies show more often features of coalescence including lobate shapes and connected vesicles, than clasts of the fine ash facies. Furthermore each facies type has a distinct bubble size distribution. The calculated BND values show a dependency on the clast size. While for 2 mm sized clasts the BND values are in the range of 3-5x1013 m-3 the BND values for the smaller clasts (1 mm and fine ash) are 2 orders of magnitude higher (4-7x1015 m-3). Therefore coarser facies types such as the magmatic scoria layers have lower BND values than the fine phreatomagmatic facies types.
We suggest that the grain size is influenced by the vesicularity of the melt. Due to a decrease in thickness and stability of the bubble walls with increasing vesicularity, the melt becomes more fragile and easier to fragment. Lithic fragments from the underlying stratigraphy show that the fragmentation level for the phreatomagmatic units was shallow with less then 50m below surface. The lithic clast distribution gives no evidence for a deepening of the fragmentation level during the eruption. Therefore we conclude that the differences in bubble coalescence and BND values are due to conduit processes. Theses changes seem to have influenced the mixing process of magma and water and hence the efficiency of the fragmentation.