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Volcanic processes recorded by inclusions in sanidine megacrystals ejected from Quaternary Rockeskyll volcano, Eifel, Germany

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Sanidine megacrystals were ejected by a late stage explosive eruption at the Quaternary Rockeskyll volcanic complex, Eifel volcanic field, Germany. The homogeneous distribution of barium (about 1 % wt BaO equivalent to about 2 mole % celsian component) indicates that the nearly perfect single crystals must have crystallized in the Ostwald-Miers range from a huge reservoir, probably in the roof of a magma chamber. Irregularities during crystal growth caused trapping of hydrous melt inclusions, which are the objective of the present study.
The inclusions show a characteristic concentric microstructure, in the following described from the sanidine host towards the inclusion center: (1) Ba is enriched by a factor of 2 to 3 in a ca. 0.01 mm wide rim, compared to the otherwise homogeneous sanidine host; (2) inwards, the continuous rim is overgrown by a thin crust of Ba enriched sanidine with irregular surface; (3) a layer of glass with a composition similar to sanidine; (4) a second, thinner layer of glass slightly reduced in Na2O and K2O, separated from the first glass layer by a sharp interface with approximately spherical shape; (5) a bubble containing a fluid phase, composed of H_2O and minor CO_2.
This record is interpreted as follows: After crystallization of the sanidine megacrystals, a rise in temperature within the magmatic system caused some re-melting of the Ba-rich sanidine around the inclusions. Partitioning of Ba between the small included melt reservoir and the host caused formation of the Ba-rich rim (layer 1) by diffusive exchange. The onset of cooling lead to crystallization of the thin sanidine crust (layer 2). Finally, very rapid decompression and cooling during the subsequent explosive eruption caused sequential phase separation (two stages) in the remaining melt, the denser melt phase (layers 3 and 4) quenched to glass, the complementary low-density volatile-rich phase forming the central bubble. In summary, the microstructure and phase composition of the inclusions in the sanidine megacrystals recorded information on the history of the volcanic system prior to and during explosive eruption.