

# **Mafic recharge and diffusive re-equilibration of mafic elements in the lead-up to the world's youngest basaltic Plinian eruption: the 2019 eruptive sequence at Ulawun volcano, Papua New Guinea**

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The 2019 eruptive sequence at Ulawun volcano (5.05°S, 151.33°E, 2334m), which consisted of a Plinian eruption on June 26<sup>th</sup> and August 3<sup>rd</sup> (both VEI 4) and a Strombolian flank eruption on October 1<sup>st</sup>, includes the world's youngest Plinian eruptions of basaltic composition and represents the strongest and most mafic eruptions ever witnessed at Ulawun volcano since the start of monitoring. All three eruptions are characterized by only small seismic precursors and very quick eruptive onsets and cessations (<24h). Textural and crystal-melt equilibria analyses of samples from all three eruptions reveal eruption triggering by abrupt magma decompression leading to fast magma ascent and a large viscosity increase by disequilibrium crystallization of microlites (plagioclase >> olivine > clinopyroxene). Compositional zoning of plagioclase antecrysts further indicates a very mafic (An>90) and volatile rich (>4 wt.% H<sub>2</sub>O) initial magmatic intrusion with a rim-ward negative correlation between decreasing An-content and increasing mafic element concentrations (Mg, Fe, Ti) that perfectly mirror each other. The anorthite curve is interpreted as growth curve showing initial slow ascent and dehydration of the new magma while magnesium curves indicate diffusional re-equilibration of these mafic elements after disruption by mafic recharge. Increased magma decompression is assumed to have been triggered by volatile exsolution after this mafic recharge leading to a rapid, buoyant ascent of the magma and large undercooling of the magma causing disequilibrium microlite crystallisation. With plume heights of >19 km during peak Plinian activities it is further presumed that the erupted volatiles have reached Stratospheric altitudes. Despite their surprising rarity in the global geologic record, results from the 2019 Ulawun eruptive sequence confirm that basaltic Plinian eruptions have catastrophic hazard potential similar to their silicic equivalents, reinforcing initial ideas on their formation mechanism.