Pyroxene residence time of two contrasting Plinian eruptions at Popocatèpetl volcano (Mexico).

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Popocatèpetl volcano in Mexico is one of the most active volcanoes on Earth and it also ranks very high in term of threatened population, with more than 20 million people living within 70 km from the crater. The ~14.1 ka Pumice with Andesiste Plinian eruption (PwA) was the most powerful on record at Popocatèpetl reaching as far as Mexico City. The ~23.5 ka Tochimilco Plinian eruption marked the transition from the old Ventorillo volcanic edifice to the modern Popocatèpetl cone. Plinian events are punctuated by periods of quiescence and present-day like interplinian activity. In particular the Ventorillo and El Fraile effusive activities preceded the Tochimilco and the PwA Plinian events, respectively. Both pumices and lavas are andesite to dacites with a mineralogical assemblages of plagioclase > pyroxene (opx > cpx except for PwA) > Fe-Ti oxides ± amphibole. The pyroxene population is characterised by complex zoning and frequent disequilibrium textures testify magma mixing and hybridisation processes between a mafic end-member, dominated by olivine + Cr-spinel + pyroxene ± plagioclase, and an evolved end-member, characterised by plagioclase + pyroxene + Fe-Ti oxide + apatite. Fe-Mg elemental diffusion modelling on orthopyroxene indicates pre-eruptive crystal residence time ranging from a few days to hundreds years. However, the Tochimilco pumice is characterised by pre-eruptive mafic injections from a few days (< 7 days) to a maximum of 25 years with the majoritiy of timescales around 7-30 days and 1-5 years. On the contrary, pyroxens of PwA have longer residence times (10-500 years) with very few crystals recording shorter timescales (~ 6 months–5 years). Effusive events mirror the pattern shown by the corresponding explosive eruption. While mafic injections triggered the Tochimilco explosive eruption, the causal link between mafic injections and eruption is questioned by the longer timescales of the PwA, which point to different direct triggering causes (e.g.. volatiles), possibly associate with closure of the system and extensive crystal cargo remobilisation.