

## **The build up to a large explosive eruption 14,000 years ago at Popocatépetl volcano (Mexico)**

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Popocatépetl volcano (Mexico) is one of the world's most hazardous volcanoes: located next to the Mexico City metropolitan area (population >20 million), it has had at least five major Plinian eruptions in the last 23,000 years. These highly explosive events punctuate periods of quiescence, effusive and Vulcanian activity – a pattern shown by many arc volcanoes. Despite its significance to eruption forecasting and hazard mitigation, our understanding of the factors driving these transitions is still very limited. Magma mixing and mingling, which has been shown to be a common process for Popocatépetl magmas, is believed to exert major influence on timescales and types of eruptions.

While the present day interplinian activity is closely monitored and characterised, interplinian lavas in the stratigraphic record are poorly studied. This study presents the first detailed mineral and whole rock chemistry study of the El Fraile lavas erupted between 23 and 14 kyr BP, prior to the Pumice with Andesite Plinian eruption. The El Fraile lavas are andesites to dacites consisting of two mingled lavas with contrasting mineral assemblages and processing histories yet indistinguishable major element compositions. Black olivine-bearing lavas record mafic inputs and evolution through crystal fractionation of orthopyroxene, plagioclase and Fe-Ti oxides. In contrast, red amphibole-bearing lavas lack evidence of mafic input and crystal fractionation, indicating storage separate from the olivine-bearing magma.

Mingling of black and red melts occurred during eruption. Black lavas erupted at the end of the El Fraile sequence may record the beginning of stagnation and pooling of a mafic influx that triggered the Pumice with Andesite Plinian eruption. The El Fraile lavas show mineralogical and textural similarities to present-day eruptive products with significant implications for geochemical monitoring of present-day eruptive activity.