

Formation of a Polymagmatic phreatomagmatic complex in Michoacán-Guanajuato Volcanic field, México

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Phreatomagmatic complex of Irapuato is located at the NE extreme of 40,000 km² vast, Plio-Quaternary monogenetic field of Michoacan and Guanajuato situated in the central part Mexico, within the Trans Mexican Volcanic Belt. It consists of three tuff rings and one small scoria vents. The northern vent of San Joaquin is quasi-circular (crater diameter of 2079m) followed by nested crater of La Sanabria (crater diameter of 1860 m) and San Roque (crater diameter of 1844m) in the order of formation event, that shows horse-shoe shaped vents with extreme erosion towards west. The complex also contains a small scoria cone towards south (Figure 1). Based on their morphology, the complex should be 40 to 70 kyrs in age.

Major element concentrations show that the magma involved in the formation of the tuff ring complex is calc-alkaline basalt to trachybasalts (SiO₂= 51.1 to 52.5 wt.%, Na₂O+K₂O=5.60-5.62 wt.%), whereas the one involved with the scoria cone is alkaline basaltic trachy-andesite (SiO₂=50.57 wt.%, Na₂O+K₂O=5.60 wt.%) similar to alkaline trend T1 – OIB type magma identified in the region by the earlier workers. The OIB-like trend of juvenile fragments from the scoria cone in the multi-elemental plot of samples normalized by primitive mantle confirms the involvement of magma from a ruptured slab with possible mixing with mantle wedge fluids. Moreover, ternary diagram of tectonic discrimination of Ta-Th-Hf/3, shows presence of three types of magma: Arc type, E-MORB and OIB (rift) type (Figure 2).

Based on juvenile fragment population and the vesicularity percentage, we estimate the total volume of magma expelled during this eruption to be 7.23 x10⁸ m³, which with an eruption rate of ~6m³/s must have driven the formation event of ~55-245 days in total.

The phreatomagmatic complex therefore, can be identified as polymagmatic, which is the first of its kind to be identified in this region.

