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Petrogenesis and geodynamic significance of silicic volcanism in the western Trans-Mexican Volcanic Belt

C. M. Petrone (1), L. Ferrari (2), M.A. Orozco (3), and M. Lopez Martinez (4)

(1) The Natural History Museum, Department of Mineralogy, London, Cromwell Road, SW7 5BD London, United Kingdom (C.Petrone@nhm.ac.uk), (2) Instituto de Geología, Universidad Nacional Autonoma de Mexico, Mexico City, 04510, Mexico, (3) Centro de Geociencias, Universidad Nacional Autonoma de Mexico, Campus Juriquilla, Queretaro, 76230, Mexico, (4) Centro de Investigaciones Cientificas y Educacion Superior de Ensenada, Ensenada, Baja California Norte, Mexico

Silicic volcanism in the western Trans-Mexican Volcanic Belt (WTMVB) was defined a Pliocene ignimbrite flare-up associated with the rifting of the Jalisco block from mainland Mexico (Frey et al., 2007; GSAB). With the integration of new and published geochronologic, geochemical, and isotope data we revise this interpretation and propose a new petrogenetic model. The oldest silicic volcanism consists of large silicic domes and minor pyroclastic flows (∼370 km3) emplaced to the north of Guadalajara above a thick succession of ∼11 to 8.7 Ma basaltic lavas, which yielded Ar-Ar and obsidian FT ages of ∼7.5 to 5 Ma. Shortly after (4.9 to 2.9 Ma) large amount of rhyolitic lavas and ash flow tuffs (∼500 km3) were emplaced in a WNW-ESE trending belt from Guadalajara to Compostela. Rhyolitic domes and flows (∼430 km3) were emplaced also in the Pleistocene mostly between Tequila and Guadalajara with the late Pleistocene La Primavera caldera (∼35 km3) as the sole explosive volcanic episodes. As a whole, silicic volcanism occurred from Late Miocene to the Pleistocene, and was dominated by dome and lava flows.

Most rhyolites have high LILE/HFSE values and negative spikes at Nb, P and Ti. They also show the same Ba/Nb and K/Rb values and slightly higher Rb/Sr ratios as the 11-8 Ma basalts. Rhyolite Sr isotope data (87Sr/86Sr init = 0.70371 – 070598) are only slightly more radiogenic than the 11-8 basalts (87Sr/86Sr init = 0.70349-0.70410), whereas Nd isotope ratios are indistinguishable from them. Sr and Nd isotope ratios of the rhyolites are also similar to the crust nearby, indicating that they can be compatible either with fractional crystallization (FC) of basalts or with crust assimilation/melting. However REE contents are too low to be the result of basalt FC. Isotope and REE data can be successfully modelled with an initial crustal melt which subsequently undergone fractional crystallization of feldspar and quartz. Late Miocene slab detachment and subsequent slab rollback produced pulses of mafic magma that were partly trapped in the crust yielding crustal melting. Extensional faulting since the Pliocene favours the eruption of silicic magma as effusive dome and lava flows. Rifting at the boundaries of the Jalisco block is seen as a rollback induced reactivation of crustal structures but is unlike to evolve into a Jalisco microplate.