

Comparison of the volcanic geology of the Tacambaro-Puruaran (arc front) and the Zacapu (arc inland) areas in the Michoacan Guanajuato volcanic field, Mexico

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The highest concentration of monogenetic volcanoes in the subduction related Mexican Volcanic Belt (MVB) occurs in its western-central part, where the arc reaches a maximum width of 150 km. This 40,000 km² area, the Michoacan-Guanajuato Volcanic Field (MGVF), hosts more than 1000 monogenetic volcanoes and vents, and the only two of the MVB born in historical times: Jorullo and Paricutin. The 690 km² Tacambaro-Puruaran area (TAC) is located at the volcanic front while the 2310 km² Zacapu area (ZAC) lies more inland, 60 km to the N, in a direction parallel to the subduction vector. The systematic comparison of the two areas allows for inferences regarding to the subduction process and associated magma genesis, and might help explain the unusual number of vents that comprise the MGVF.

Based on detailed mapping, volumes of erupted products were estimated with the aid of a Digital Elevation Model. Compositional and new ⁴⁰Ar-³⁹Ar and ¹⁴C data allowed us to estimate magma eruption rates and to determine variations in the relative proportion of different magma types erupted during the course of time. Our results indicate that MVB volcanism has been present in both areas since 5 Ma, but eruptions have become more frequent at the arc front. In the Holocene, at least 13 eruptions occurred in the TAC (average recurrence interval of 800 years, one of the highest monogenetic eruption frequencies detected within such a small area in a subduction-setting) while only 10 eruptions occurred in the much larger ZAC. Thus, volcanism has not migrated southward in this region, as often postulated, but rather has become more intense at the arc front. Compositions of erupted products are distinctly more diverse and less evolved at the arc front (high proportion of basaltic andesites and occurrence of exotic alkaline compositions in the TAC) than at greater distances from the trench (mostly andesites, but also dacites and rhyolites in the ZAC). Volcanic centers are preferentially aligned along SW-NE directions in the TAC compared to WSW-ESE in the ZAC, consistent with local fault strikes. A higher rate of lithospheric extension in the south during the Quaternary seems to have allowed a larger number of small, poorly evolved, and compositionally diverse dikes to reach the surface during this period.