Variations in eruptive style of mexican basaltic maar volcanoes

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Maars are a special type of volcano that represent extreme conditions of explosivity due to the sudden conversion of thermal to mechanic energy during the interaction of ascending magma with water. Variations in the eruptive style can be attributed to several factors such as magma extrusion rate, explosion depth variation, water/magma ratio, increasing cratering, and viscosity, among others. In Central Mexico, monogenetic volcanism is extensive, and, although scoria cones are dominant, maars form small volcanic fields such as Valle de Santiago (Guanajuato) and Serdan-Oriental Basin (Puebla). In these volcanic fields, maars of basaltic composition are characterized by deep craters that reach the local water table, forming a crater lake; they are by far the most abundant, in comparison with volcanoes of rhyolitic composition, which instead form tephra rings. Based on the stratigraphic fluctuations on their eruptive style, basaltic maars in Central Mexico can be grouped into two main groups: a) Hoya Cintora-Joyuela type volcanoes are characterized by an entirely dry magmatic activity starting from hawaiian lava flows, followed by strombolian scoria and a transitional explosive phase that changes to wet phreatomagmatic maar-forming activity, which includes the periodic injection of juvenile material, particularly at the end of the eruptive phase. b) Atexcac type volcanoes characterized by an evolution from highly fragmented surge-dominated eruptions to coarse brecciated deposits followed by an alternation of wet and dry layers in the upper part of the sequence. This reveals a general drying trend, with the periodic injection of new magma as well as the abrupt fluctuations in water/magma ratios during the construction of the eruptive succession sequence. Perhaps initial magma extrusion rates played an important role in producing these different maar volcanoes, with higher rates for the first type that inhibited phreatomagmatic activity at the beginning. Also, the location of the explosions within the upper unconsolidated granular aquifer (brown tuff) or the deeper highly-fractured bedrock aquifer may control the efficiency of the explosions. Deepening and lateral migration of explosion loci are observed in both maar types, and the lateral migration is strongly controlled by the regional stress regime.