Influence of pre-eruptive volatile contents on eruptive style at scoria cones: the case of Pelagatos volcano, Sierra Chichinautzin, central Mexico

Julie Roberge[1], Marie-Noelle Guilbaud[2], Paola Reyes-Luna[3]

[1]IPN, ESIA-Ticoman, Mexico, [2]Instituto de Geofisica, UNAM, Mexico, [3]Facultad de Ingeniera, UNAM, Mexico

E-mail: robergejulie@gmail.com

Volatiles dissolved in magmas impact greatly on volcanoes eruptive style. Their concentration in the melt and mode of exsolution control the ascent velocity of the magma, and hence the eruption intensity. Complex feedbacks exist between the rate and extent of volatile exsolution at shallow levels and groundmass crystallization. This in turn affects the mixture rheology and extent of fragmentation producing important shifts in eruption style (explosive to effusive). Melt inclusions contained in crystals potentially record the volatile content and composition of melts at various stages of the evolution of the magma during its ascent providing important insights on the degassing-crystallization processes at shallow crustal levels. In this work, we present new melt-inclusion data from Pelagatos scoria cone, to characterize magma ascent and eruption processes at monogenetic volcanoes. Pelagatos is a small, young (less then 14 000 years B.P) monogenetic volcano which is part of the Sierra Chichinautzin volcanic field located in the central portion of the Trans Mexican Volcanic Belt (south-east of Mexico City). Petrological and textural data from previous work by Guilbaud et al. (2009) indicate that Pelagatos magma was initially hot (over 1200°C), gas-rich (up to 5 wt% H2O), crystal-poor (about 10 vol% Fo90 olivine phenocrysts) and thus poorly viscous (40-80 Pa s) producing rapid magma rise. This in turns delayed degassing and cooling-induced crystallization up to shallow levels, driving the violent Strombolian eruptive style that is indicated by the morphology and structure of the proximal pyroclastic deposits. However, the water-content estimate of Guilbaud et al. (2009) was indirect and based on models calibrated by experimental work, and melt-inclusion analyses of similar magmas elsewhere. To better constrain eruptive processes during the Pelagatos eruption, we constrained the pre-eruptive volatile content of the magma by analyzing major element composition and volatile content (H2O, CO2, Cl, S) in olivine-hosted melt inclusions from 4 different tephra layers within the scoria cone stratigraphy. Olivine hosts for the melt inclusions are Fo83-90. The melt inclusions are basaltic andesite to andesite in composition, with 1.84 - 6.02 wt% MgO, 51.95 - 59.21 wt% SiO2 and 0.64 - 1.55 wt% K2O. The H2O vary from 0.5 to 4.3 wt% whereas CO2 vary from below detection limit up to 976 ppm. Sulfur content varies from 35 to 1451 ppm, showing a decrease with increasing MgO content as expected from crystallization induced degassing. Furthermore, Cl content, which varies from 900 to 1267 ppm, shows no correlation with MgO or K2O. The new data combined with existing whole-rock and matrix glass data indicate that the melt inclusions represent melt quenched after various degrees of differentiation in the conduit. Hence, olivine growth and melt-inclusion entrapment were shallow and syn-eruptive, pointing to a very dynamic conduit system.