V52A-07: Controls on the organization of the plumbing system of subduction volcanoes : the roles of volatiles and edifice load

Friday, 15 December 2017
11:50 - 12:05
New Orleans Ernest N. Morial Convention Center - 208-209

Geochemical data indicate that subduction zone magmas are extracted from the mantle and rises through the crust, with a wide range of volatile contents. The main controls on magma ascent, storage and location of eruptive vents are not well understood. Flow through a volcanic system depends on magma density and viscosity, which depend in turn on chemical composition and volatile content. Thus, one expects that changes of eruption sites in space and time are related to geochemical variations. To test this hypothesis, we have focussed on Klyuchevskoy volcano, Kamchatka, a very active island arc volcano which erupts lavas with a wide range of volatile contents (e.g. 3-7 H_20 wt. %). The most primitive high-Mg magmas were able to erupt and build a sizable edifice in an initial phase of activity. As the edifice grew, eruption of these magmas was suppressed in the focal area and occurred in distal parts of the volcano whilst summit eruptions involved differentiated high alumina basalts.

Here we propose a new model for the development of the Klyuchevskoy plumbing system which combines edifice load, far field tectonic stress and the presence of volatiles. We calculate dyke trajectories and overpressures by taking into account the exsolution of volatiles in the magma. The most striking result is the progressive deflection of dykes towards the axial area as the edifice size increases. In this model, the critical parameters are the depth of volatile exsolution and the edifice size. Volatile-rich magmas degas at depth and experience a large increase in buoyancy which may overcome edifice-induced stresses at shallow levels. However, as the volcano grows, the stress barrier migrates downwards and may eventually act to stall dykes before gas exsolution takes place. Such conditions are likely to induce the formation of a shallow central reseroir, in which further magma focussing, mixing and contamination may take place. This model accounts for the co-evolution of magma composition and eruptive pattern that is observed at Klychevskoy volcano and should be useful to interpret data from other subduction volcanoes where hydrous magmas play a major role.

Plain Language Summary

Authors

Alberto M. Roman *
Institut de Physique du Globe de Paris

Olga Bergal-Kuvikas
Nanyang Technological University

Nikolai Shapiro
Institut de Physique du Globe de Paris

Benoit Taisne
Asian School of the Environment

Evgenii Gordeev
Institute of Volcanology and Seismology

Claude P Jaupart
Institut de Physique du Globe de Paris

Find Similar

View Related Events

Day: Friday, 15 December 2017