



Coupled degassing and crystallization in the open-system magma chamber from Villarrica volcano, Chile

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The question of degassing processes during magma ascent and its residence times in magma chambers are fundamental to understand magma evolution and the behaviour of volcanoes. There are some experimental works about recycling and remobilisation of magma from storage place up into the conduit and back to the storage place again. E.g. Kazahaya et al. (1994) and Stevenson & Blake (1998) postulated that convective overturn of dense degassed and less dense gas-rich magmas occurs easily in a vertical conduit linking surface volcanic activity and volatile degassing to a deeper magma chamber. Their model involves convection of magma in a conduit connecting a deep chamber to the near surface. The bulk density of the magma in the shallow degassing zone is greater than that of volatile-rich deeper magma as a result of having lost gas bubbles and dissolved volatiles; thus the degassed magma will sink. Hence, degassing provides a driving force for convection. This convection is, however, complicated because the loss of gas also induces large changes of viscosity and density due to crystallization. Further, degassed dense magma is expected to crystallize as it sinks due to pressure increase. However, this process might have significant implications for the differentiation in magma chambers as well as for surface volcanic phenomena. Large volumes of degassed magma might potentially be convectively stirred into the deep chamber and could provide a major driving force for fractional crystallisation. Conventionally, magma chambers are envisaged as evolving due to heat loss, but degassing and associated convective exchanges may be also significant. Analyses of melt inclusions trapped in phenocrysts were used to investigate systematically the degassing process by incorporating crystallization and associated changes in magma composition. A general model of degassing shall be developed at the pertinent active volcano

Villarrica in Chile whilst using the Electron Microprobe to analyse rock samples from the lava flows 1971 and 1984 as well as freshly sampled scoria collected from the top of the lava lake (November 2004). Villarrica was chosen because it has well-monitored eruptions with precisely dated lava and ejecta and also because andesitic steady-state volcanism is a rare phenomenon. The volcano provides an excellent framework for studying andesite petrogenesis. It has been also monitored for SO₂ degassing during the years 2000 and 2001 with COSPEC done by Witter et al. (2004). Rock samples from Villarrica volcano have been analysed for volcanic volatiles such as H₂O, S, Cl and F to establish the extent of disequilibria and models will be compared with estimates of gas and magma fluxes. While the importance of volatiles (primary H₂O) in magma generation at active continental margins is widely acknowledged, the actual amount and composition of these volatiles is less firmly established, particularly in andesitic magmas. Using the assumption that melt inclusions are indicative of magma's major element and volatile composition at the time of mineral formation, the composition of primary inclusions add to our understanding of the physical and chemical processes and conditions involved during volcanism at Villarrica volcano.

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