



Halogen behaviours during andesitic magma degassing: from magma chamber to volcanic plume

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Halogen (F, Cl, Br and I) behaviours during degassing of H₂O-rich silicic magmas are investigated using volatile content analysis in glass (matrix glass and melt inclusions) of volcanic clasts (pumice and lava-dome fragments) in a series of plinian, vulcanian and lava dome-forming eruptions. Examples are taken from andesitic systems in subduction zones: Montagne Pelée and Soufrière Hills of Montserrat (Lesser Antilles) and Santa María-Santiaguito (Guatemala). Halogens behaviour during shallow degassing primarily depends on their incompatible character in melts and on H₂O solubility. But variations in pre-eruptive conditions, degassing kinetics and syn-eruptive melt crystallisation, induce large variations in halogen extraction efficiency during H₂O degassing, up to prevent halogen loss.

In all studied systems, Cl, Br and I are not fractionated neither by differentiation nor by degassing processes: thus Cl/Br/I ratios remain well preserved in melts from reservoirs to eruption. These ratios measured in erupted clasts are characteristic of pre-eruptive magma compositions and may be used to trace deep magmatic processes. Moreover, during plinian eruptions, Cl, Br and I are extracted by H₂O degassing but less efficiently than predicted by available experimental fluid-melt partition coefficients, by a factor as high as 5. F behaves as an incompatible element and, contrary to other halogens, is never significantly extracted by degassing. Degassing during lava dome-forming eruptions of andesitic magmas occurs mainly at equilibrium and is more efficient at extracting halogens and H₂O than explosive degassing. The mobility of H₂O and halogens depends on their speciation in both silicate melts and exsolved fluids which strongly varies with pressure. We suggest that the rapid pressure decrease during highly explosive eruptions prevents complete volatile speciation at equilibrium and consequently strongly limits halogen degassing.