Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28922

Dilution drives deep degassing of sulfur in hydrous magmas

ERY C HUGHES[1] AND EDWARD STOLPER[2]

[1]Te Pū Ao GNS Science
[2]Caltech

Sulfur is thought to degas deep from hydrous magmas (e.g., arc basalts), in contrast to water-poor magmas (e.g., Kīlauea, MORBs) where S degasses at shallow levels in the magmatic system. This occurs for hydrous magmas whether they are relatively reduced (e.g., S is present predominantly as H_2S in the vapor and sulfide in the melt) or oxidised (e.g., SO_2 in the vapor and sulfate in the melt). Even deeper degassing of S occurs from melts containing both sulfide and sulfate due to the "sulfur solubility minimum" that occurs between 0 to +2 relative to the FMQ buffer for most basalts. Based on our thermodynamic modelling using the Python package VolFe, deep degassing from hydrous magmas also occurs for a fictive, inert, and ideal gas species (i.e., one that behaves like a noble gas but has a solubility similar to that of S). We show that dilution of S-bearing species in the vapor phase by degassing of dominantly H_2O, but also to some extent driven by degassing of CO_2, is the main driver of deep degassing of S. A similar effect drives deep degassing of H_2O in CO_2-rich systems. This mechanism does not require a direct effect of H_2O or CO_2 on the solubility of S; although H_2O does decrease the solubility of S under reducing conditions, thereby contributing as a secondary factor in the phenomenon of the deep degassing of S. The dilution effect impacts all volatile species, and its magnitude depends on the relative solubilities and concentrations of the different volatiles present. Noble gases will also degas deeper from hydrous magmas, perhaps contributing to the depletion of noble gases in E-MORBs relative to N-MORBs.