



Large carbon dioxide abundance in magma from Kilauea volcano, Hawaii

M. Barsanti (1,2), D. Barbato (2), P. Papale (2), A. Longo (2), R. Moretti (3)

(1) Dip.to Matematica Applicata - Univ. Pisa, (2) INGV Pisa, (3) INGV-OV Napoli

Due to its low solubility in silicate melts, carbon dioxide concentrations in melt inclusions within magmatic crystals are commonly of the order of a few to a few thousands ppm, from one to several orders of magnitude less than typical concentrations of highly soluble water. CO₂ in magmas, at relatively low crystallizing pressures of tens to a few hundred MPa, is in fact mostly confined in the gas phase, out of direct petrologic observation. Integration of melt inclusion data with data from summit degassing at Kilauea crater revealed that CO₂ abundance in magma is at least 0.7 wt%, one order of magnitude larger than that in melt inclusions (Gerlach et al., 2006, doi:10.1029/2001JB000407). We develop here a method based on a statistical treatment of melt inclusion data, which allows the determination of the total H₂O and CO₂ concentration in the multiphase magma and the abundance of the gas phase at time of melt inclusion entrapment. The method is based on the use of a multicomponent non-ideal saturation model (Papale et al., 2006, doi: 10.1016/j.chemgeo.2006.01.013) and on the minimization of a χ^2 -like quantity by varying all the possible total H₂O–CO₂ pairs. For each total H₂O–CO₂ pair, a Monte Carlo simulation is performed to determine the probability of exceeding the experimental χ^2 . This gives both the confidence on the minimum number of H₂O–CO₂ pairs required by the data, and the confidence ellipses on the total H₂O and CO₂ contents. The new method is applied to a set of 29 high resolution SIMS melt inclusion data from a single specimen from the 1842-44 eruption of Kilauea (Hauri et al., 2002, doi: S0009-2541(01)00374-6), showing the existence of several magma batches with different total volatile contents. Total CO₂ abundance of 3-6 wt% within a degree of confidence of 90% is found to characterize the CO₂-richest magma batch. This total amount is two orders of magnitude larger than the dissolved ones, one order of magnitude larger than the previous estimate, and 30-60 times more abundant than the corresponding total H₂O content.