Modeling the crystallization and emplacement conditions of a basaltic trachyandesitic sill at Mt. Etna volcano

MANUELA NAZZARI[1,2], FLAVIO DI STEFANO[1], SILVIO MOLLO[1,2], PIERGIORGIO SCARLATO[2], VANNI TECCHIATO[1], BEN ELLIS[3], OLIVIER BACHMANN[3], CARMELO FERLITO[4]

[1]Dipartimento di Scienze della Terra, Sapienza-Università di Roma, Rome, Italy
[2]Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
[3]Department of Earth Sciences, Institute of Geochemistry and Petrology, ETH, Zurich, Switzerland
[4]Department of Biological, Geological and Environmental Sciences, University of Catania, Catania, Italy

This study documents the compositional variations of phenocrysts from a basaltic trachyandesitic sill emplaced in the Valle del Bove at Mt. Etna volcano (Sicily, Italy). The physicochemical conditions driving the crystallization of minerals have been reconstructed by modeling major and trace element analyses of clinopyroxene, feldspar (plagioclase and K-feldspar), and titanomagnetite. Clinopyroxene is the liquidus phase, recording decompression and cooling paths variable from 200 to 0.1 MPa and from 1050 to 940 °C, respectively. On the other hand, plagioclase and K-feldspar cosaturate the melt in a temperature interval of 1000-870 °C. Cation substitutions in clinopyroxene (Mg-Fe) and feldspar (Ca-Na) indicate that the ascent of magma is accompanied by H_2O exsolution up to 2 wt.%. This translates to a degassing-induced undercooling of 80 °C from the deeper parts of the plumbing system to the surface. The titanomagnetite compositional changes reflect oxygen buffering conditions variable from NNO-0.5 to NNO+0.8, possibly due to significant H_2O liberation and degassing at the time of emplacement. A fractional crystallization model for REE and HFSE has been adopted to quantitatively assess the role played by clinopyroxene and feldspar fractionation on the trace element pattern of the basaltic trachyandesitic sill. Assuming a primitive Etnean basalt as parental magma, REE and HFSE concentrations in the sill bulk rock are succesfully reproduced by prevalent clinopyroxene fractionation (55%) at depth, followed by minor fedspar segregation (14%) at shallow crustal levels.