EVIDENCE OF CONTINUOUS IMMISCIBILITY WITHIN MAGMATIC FLUIDS (79AD ERUPTION OF MT VESUVIUS)

FULIGNATI, P.[1], KAMENETSKY, V.S.[2], MARIANELLI, P.[1], SBRANA, A.[1]
[1] Dipartimento di Scienze della Terra, University of Pisa, via S. Maria, 53 56126 Pisa, Italy.
[2] School of Earth Sciences and CODES, University of Tasmania, Australia, Dima.
E-mail: fulignati@dst.unipi.it

The Vesuvius magmatic system is characterized by the presence of shallow reservoirs hosted within the carbonate Mesozoic basement (dolostone and limestone). The outer margin of the 79 AD magma chamber, consisting of crystallized magmas (clinopyroxenites to foid-bearing K-syenites), continuously grades into carbonate country rocks through a skarn shell and thermometamorphic marble. Studied samples are foid-bearing syenites and consist of a network of euhedral crystals of K-feldspar, other constituents are leucite, nepheline, K-pargasitic amphibole, garnet and biotite. The foamy appearance of foid-bearing syenites can be interpreted to result from the crystallization of K-feldspars in the presence of exsolved fluids accumulating under the roof of the magma chamber. The occurrence of multiphase fluid inclusions in these rocks testifies the exsolution of a non-silicate, volatile-rich phase from the phonolitic magma at the peripheral parts of the 79AD Vesuvius magma chamber.

The results of our work suggest that this immiscible phase could further experience another unmixing event that occurs in essentially "post-magmatic" environment.

Abundant cogenetic multiphase fluid inclusions are hosted within K-feldspars of foid-bearing syenites and consist of vapor bubble(s), interstitial liquid and clear daughter minerals of cubic shape (halite and sylvite) + two or more rounded and tabular daughter minerals (sometimes birefringent) + opaques.

Heating/cooling experiments were carried out on these multiphase inclusions. During heating, solid phases begin to dissolve at about 150°C and melt completely at 530°C (Fig. 1). These low temperatures of melting argue for a non-silicate composition of daughter minerals, and thus bulk inclusion content. The remaining vapour bubble dissolves at 880°C (Fig. 1). During subsequent cooling, vapour bubble nucleates at 785°C and increases in size (Fig. 2). Unmixing of at least two melt phases occurs instantaneously at 500°C in all studied inclusions (Fig. 2). Globules of one melt float freely in the matrix of another melt, change their shape and size, coalesce and split apart continuously down to 100-150°C. The movements of globules slow down with decreasing temperature until final solidification at 40-50°C.

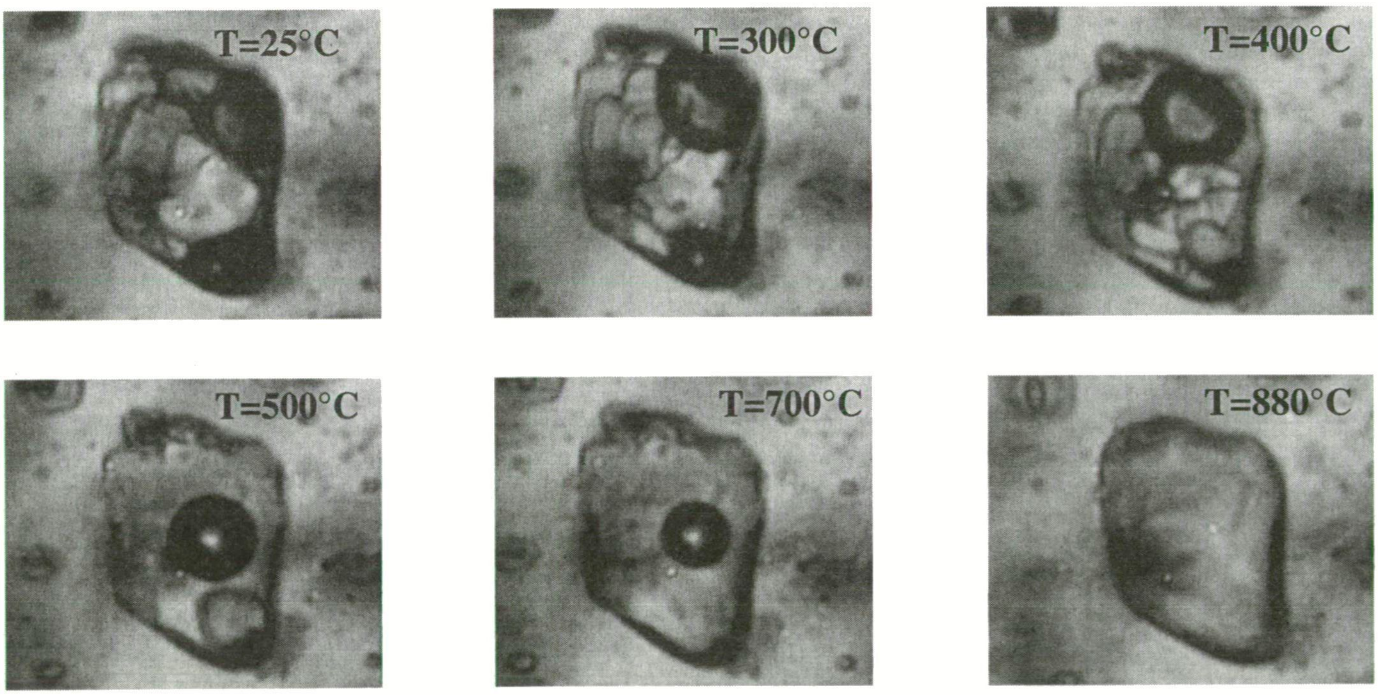

Fig. 1. Behaviour of multiphase fluid inclusions during heating experiments (inclusion length is about 40 microns).

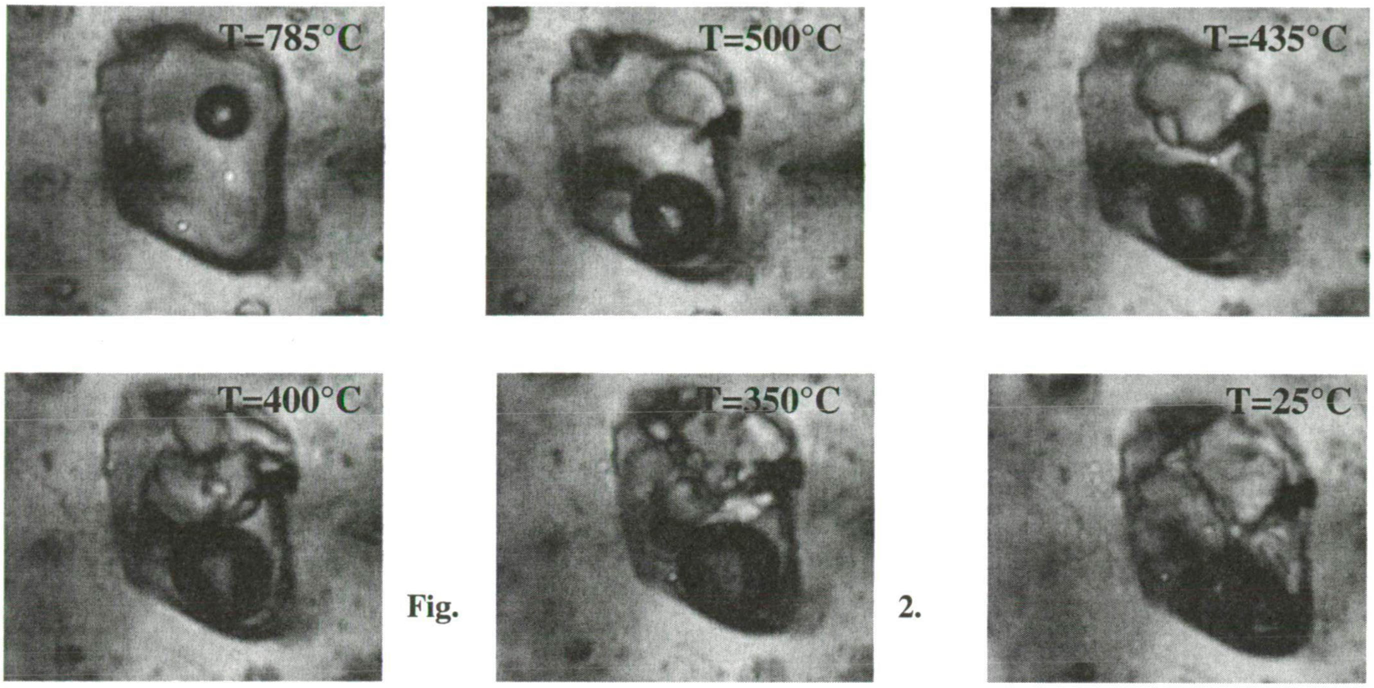

Fig. 2. Behaviour of multiphase fluid inclusions during cooling after the total homogenization.

The similarity of observed phase transformations inside inclusions suggests their homogeneous trapping at magmatic temperatures. However, it is worth noting that this unmixing process occur under 1atm and rapid cooling experimental condition and an extrapolation to natural systems should be taken with caution.

By analogy with results of the study of xenoliths from the Vesuvius 472AD eruption (Fulignati et al., 2001) we interpret unmixed phases as globules of the Na-K chloride melt set in the matrix of Ca-carbonate melt. Raman spectroscopy investigation on daughter minerals is in progress and will help a better characterization of the composition of these inclusions.

We want to remark that the observed unmixing process could be just one event in a series of similar events. Processes of melt immiscibility occurring during late magmatic differentiation play important role in the generation of many magmatic-hydrothermal ore deposits. We infer that immiscibility between low viscosity, highly fugitive non-silicate melts may significantly influence partitioning of metals, scavenged from a silicate magma and complexed by different ligands during the early stages of development of magmatic-hydrothermal systems.

References

FULIGNATI, P., KAMENETSKY, V. S., MARIANELLI, P., SBRANA, A., AND MERNAGH, T. P. (2001): Melt inclusion record of immiscibility between silicate, hydrosaline and carbonate melts: Applications to skarn genesis at Mount Vesuvius. Geology, **29**, 1043-1046.