Trace-element partitioning between plagioclase, alkali feldspar, Ti-magnetite, biotite, apatite, and evolved potassic liquids from Campi Flegrei (Southern Italy)

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ABSTRACT

Partition coefficients (Min/L) for a series of geochemically relevant elements have been calculated from combined EMP/LA-ICP-HRMS analyses of plagioclase, alkali feldspar, Ti-magnetite, biotite, apatite, and trachytic/trachyphonolitic melt pairs in selected Campi Flegrei rocks. Pl/L values are generally very low for most of the trace-elements but Sr, Ba, and Eu. Kfs/L values for the latter elements record a systematic increase as the melt composition changes from trachyte to trachyphonolite, likely due to increasing structural compliance of the sanidine in the trachyphonolites related to larger Na/K values. Conversely, Kfs/L values for transitional, highly charged incompatible elements (e.g., LREE) decrease from trachyte to trachyphonolite, possibly in response to the decrease of melt polymerization. Min/L values for titanomagnetite generally decrease with the increasing melt evolution, the highest values being those measured for Ti, V, and Sc. Ti, Ba, Sc, Rb, Nb, Ta, and V are compatible in biotite in equilibrium with trachytic melt, whereas Cs, Sr, and Pb are incompatible and REE are strongly incompatible, as supported by the extremely low Pl/L values (0.003–0.008). Partition coefficients for apatite and trachyphonolitic glass pairs are high for Sr, REE (particularly MREE), and Y, large for Th, U, and V, generally low for HFSE, and variable for other LILE. The comparison of measured Min/L values for Campi Flegrei trachytes/trachyphonolites with other sets of partition coefficients reported in literature for evolved systems suggests that a reliable data set for magma evolution modeling requires: (1) a thorough preliminary selection of natural samples; (2) the adoption of accurate microanalytical techniques; (3) the direct measurement of Min/L values for each specific melt composition.

Keywords: Campi Flegrei, partition coefficients, plagioclase, alkali feldspar, Ti-magnetite, biotite, apatite, LA-ICP-HRMS

INTRODUCTION

Although trace-element partition coefficients are a powerful and widely used tool in modeling the evolution of magmatic systems, reliable data sets that describe the trace-element partitioning behavior in highly differentiated potassic alkaline liquids are still scarce or lacking. In a companion paper, Fedele et al. (2009) reported the results of detailed EMP/LA-ICP-HRMS investigations aimed at obtaining an internally consistent set of trace-element partition coefficients for clinopyroxene/melt pairs from selected Campi Flegrei trachytic/trachyphonolitic samples. These samples resulted particularly suitable for partitioning studies in virtue of their glassy nature and their moderately porphyritic character. In addition, the employed microanalytical technique allowed the authors to reliably assess the attainment of mineral/glass chemical equilibrium and to consequently recognize suitable sites for the correct evaluation of the mineral/liquid partition coefficients. Major- and trace-element analyses of plagioclase, alkali feldspar, Ti-magnetite, biotite, and apatite from the same Campi Flegrei samples investigated by Fedele et al. (2009) are here presented to complete the study on the trace-element partitioning for the typical paragenesis of evolved potassic melts.

GEOLOGICAL BACKGROUND

The Campi Flegrei is an active volcanic field covering an area running from the city of Naples to its western suburbs, whose last eruption occurred in AD 1538 (D’Oriano et al. 2005 and references therein). Fumarolic and hydrothermal phenomena (plus sporadic bradiseismic crises) are the only evidence of ongoing a volcanic activity, which has been predominantly explosive, characterized by a great number of eruptions, building numerous (mainly monogenetic) volcanic edifices, and very rare effusive manifestations of limited areal extent (e.g., Morra et al. 2010; Mello et al. 2012 and references therein). The Campi Flegrei district is characterized