

Experimental investigation of trace element partitioning between amphibole and alkali basaltic melt: Toward a more general partitioning model with implications for amphibole fractionation at deep crustal levels

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ABSTRACT

Time-series experiments were carried out in a piston-cylinder apparatus at 0.8 GPa and 1030–1080 °C using a hydrous K-basalt melt as the starting material to determine the element partition coefficients between amphibole and silicate glass. Major, minor, and trace element compositions of amphibole and glass were determined with a combination of electron microprobe and laser ablation inductively coupled plasma mass spectrometry. Results show that the main mineral phase is calcic amphibole, and the coexisting glass compositions range from basaltic trachyandesite to andesite. We estimated the ideal radius, the maximum partition coefficient and the apparent Young's modulus of the A, M1-M2-M3, and M4-M4' sites of amphibole. The influence of melt and amphibole composition, temperature, and pressure on the partition coefficients between amphiboles and glasses has also been investigated by comparing our data with a literature data set spanning a wide range of pressures (0.6–2.5 GPa), temperatures (780–1100 °C), and compositions (from basanite to rhyolite). Finally, we modeled a deep fractional crystallization process using the amphibole-melt partition coefficients determined in this study, observing that significant amounts of amphibole crystallization (>30 wt%) well reproduce the composition of an andesitic melt similar to that of the calc-alkaline volcanic products found in Parete and Castelvolturbo boreholes (NW of Campi Flegrei, Italy).

Keywords: Amphibole, trace element partition coefficient, lattice strain model, Campi Flegrei