PHASE STABILITY IN ULTRABASIC ALKALINE MELTS: COMPARISON BETWEEN EXPERIMENTAL AND MODELING METHODS

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Resumo

Fractional crystallization is a much relevant mechanism during the evolution of primitive magmas, such as in ultrabasic alkaline systems. The investigation and accurate quantification of such differentiation process through trace element modeling require the appropriate knowledge of phase stability and crystal/melt partition coefficients, which depends on the intensive parameters during magma crystallization, as the fugacity of the volatile species. The fugacity of O_2 (f_{O2}) might change both the mineralogy and crystallization sequences, as for the Fe-Ti oxides, and might change partition coefficients for elements involved in heterovalent cationic substitutions to a significant extent, a topic still poorly constrained for those systems. In this study, we carried out crystallization experiments starting from two ultrabasic alkaline samples (basanite and tephrite) from the dike swarm of Northern Serra do Mar Alkaline Province at pressures between 0 to 2.0 GPa and a temperature range between 1150 and 1360 °C. Experiments under atmospheric pressure were performed with a high-temperature vertical furnace coupled to a gas mixing system, under three oxygen fugacities controlled by CO-CO_2 appropriate mixtures and corresponding, relative to quartz-fayalite-magnetite (QFM) buffer, to DQFM = -2, 0, and +2, respectively (± 0.1 log units). Low- to high-pressure runs were done with a Bristol-type end-load piston cylinder, using a ¾" or ½" crushable MgO, graphite, pyrex glass and NaCl assemblies, buffered at relatively reduced oxidation state, C-CO-CO2 (CCO), as controlled by a graphite capsule inside the conventional Pt sample capsule. The starting compositions were natural samples and natural samples doped with 30 trace elements at ppm level by the addition of standard elemental aqueous solutions. The experimental results were compared with those expected from geochemical modeling through the Rhyolite-MELTS v.1.2.x software, as it is an easy approach to understand this petrological case. The modeling was carried out with steps of 100 MPa, 5°C, and 2 log units for f_{O2}. Also, uncertainties in volatile composition (H_2O and CO_2) were considered using 3 different ratios, which is an inherent difficulty in the modeling procedure. Therefore, divergences between ideal behavior and natural systems are common. In this work, we evaluate the observed divergences in the studied cases and tested attainments of equilibrium of the experimental data on the basis of both textural and chemical criteria.

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Palavras-chaves: ALKALINE MELTS , EXPERIMENTAL GEOCHEMISTRY, GEOCHEMICAL MODELING