A numerical model for the calculation of mineral-melt equilibria in calc-alkaline magmas

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We present results of calibrations of a new phase equilibria model calculating melting-crystallization relationships in hydrous and anhydrous calc-alkaline systems, ranging from high-alumina basalts to dacites. This model is the further development of the COMAGMAT program which simulates magma fractionation in a wide range of pressures and oxygen fugacities.

For the purpose to modernize the basic model a set of empirical mineral-melt equations for Oliv, Plag, Aug, Opx and Pig have been calibrated. More than 25 experimental studies conducted at 1 atm to 15 kbar and dry to water saturated conditions were included in the processing. Comparison of the calculated crystallization temperatures and mineral compositions with those obtained in experiments indicate a good accuracy of ±10-15°C and 1-2 mol%. The calculated liquid lines of descent are also coincident with experimental data.

This new model was used to study the genesis of clearly defined calc-alkaline series of the Bezymianny volcano (Eastern Kamchatka). Using a typical HAB as a parental magma, a set of calculations simulating fractional crystallization at the range of pressures 2-5 kbar has been carried out. During simulations oxygen fugacity was varied from NNO to NNO +1, whereas initial water content was about 2-3 wt.%. Results of these calculations demonstrate that an early crystallization of Mt ± Hbl is necessary to generate petrochemical trends corresponding to those observed in the Bezymianny volcano lavas.