

Experimentally determined mineral/melt partition coefficients for a Tasmanian nepheline basanite

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Mineral/melt partition coefficients for 48 major, minor and trace elements in amphiboles, micas, garnets, clinopyroxenes, orthopyroxenes, olivines and coexisting basanitic melts were determined by a combination of electron microprobe and LAM ICP-MS. The mineral and melt (glass) phases were produced in experiments that were primarily intended to replicate conditions of garnet lherzolite saturation on the liquidus of a primitive nepheline basanite (UT-70489) from Tasmania, Australia (1200 °C and 2.6 GPa) (Adam, 1990); but they were also used to investigate a broader range of conditions from 1025 °C and 1.0 GPa to 1190 °C and 3.5 GPa. With few exceptions, the measured partition coefficients can be parameterized as functions of cation radius, cation valence, the radius and elastic properties of the host cation site, and the electrostatic properties of the host cation site. The latter properties are themselves functions of crystal structure and composition; they can be systematically related to pressure, temperature and H₂O concentration in the melt phase.

Our findings are consistent with previous studies of the effects of lattice-strain and electrostatic potentials on partition coefficients (Blundy and Wood, 1994; Wood and Blundy, 2001; Blundy and Wood, 2003). However, the size and scope of our data set has enabled us to more closely interrelate the effects of physical conditions and mineral composition on the properties of individual crystallographic sites, and thus also on partition coefficients. We are also able to provide and evaluate partition coefficients that are specifically relevant to the origins of the Bow Hill nepheline basanite magma. This enables unusually close constraints to be placed on the source characteristics and melting processes responsible for the production of a basanite magma.

References

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