

Material conservation law in an open magma system: behavior of major exchange components in the upper mantle

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A mass balance equation in an open magma system formulated to extract information on magmatic processes from chemical compositions of natural rocks is applied to the major components. Their behavior during open-system reactions in the upper mantle is examined. Reactions are described by a set of reaction stoichiometry of net-transfer reactions and reaction constants for exchange reactions. Any melt fraction can reproduce the observed positive correlation between Fo-Cr# of spinel and Fo-NiO in olivine (mantle arrays) in the critical melting model that is open only to melt separation. When the reaction system is also open to influx of an evolved melt, the melting trend deviate from the mantle arrays only if the rate of melt influx is greater than the melting rate by several factors.