

Olivine compositional changes in primitive skarn environments: A reassessment of divalent cation partitioning models to quantify the effect of carbonate assimilation

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The geochemical evolution of olivine from primitive skarn environments has been studied by atmospheric pressure experiments carried out at 1,250, 1,200, and 1,150 °C under QFM oxygen buffering conditions. The used starting materials were three synthetic basalts (i.e., ^{melt}Mg#₇₈, ^{melt}Mg#₇₅, and ^{melt}Mg#₇₂) doped with variable amounts of CaCO₃, in order to reproduce the natural concentration levels of CaO-rich magmas interacting with the skarn rock shells. Results from decarbonation experiments evidence that the crystallization of Fo-CaO-rich, NiO-poor olivines is more favored at high *T* when primitive basaltic magmas assimilate increasing amounts of carbonate materials. The number of large size Ca cations entering olivine crystal lattice is proportional to the amount of Ca-O-Si bonds available in the melt. Due to differences between Fe²⁺ and Mg cation radii, the Ca-Fe²⁺ substitutions into M2 crystallographic site are more facilitated than Ca-Mg ones, thus enhancing the Fo component in olivine. The partitioning behavior of Ni, Mg, Fe²⁺, Mn, and Ca between olivine and melt has been also investigated to better understand cation redistribution mechanisms at the magma-carbonate reaction zone. Under the effect of CaCO₃ assimilation, the partitioning of divalent cations can be parameterized as a function of *T*, bulk composition (i.e., CaO and MgO contents in both olivine and melt) and melt structure (i.e., NBO/*T*). In turn, cation exchange reactions are primarily controlled by the strong depolymerizing effect of CaCO₃ assimilation that increases the number of structural sites critically important to accommodating network-modifying cations in the melt phase.