

Mathematical Modeling of Trace Element Fractionation During Incongruent Dynamic Melting

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A recent significant achievement in trace element modeling is the development of the congruent (eutectic) dynamic melting (CDM) model, during which only melt is generated. However, melting reactions in the mantle and crust often produce not only melt but also minerals. By introducing melting reactions into dynamic melting model, we present a series of equations for incongruent dynamic melting (IDM). We also compare incongruent dynamic melting with incongruent batch melting (IBM) and congruent dynamic melting (CDM). The difference in calculation results between IDM and IBM is significant, particularly for incompatible elements in the residual melt and the total residue. The difference between IDM and CDM is noticeable when the fraction of the product minerals is significant and when the distribution coefficient of the product mineral is sufficiently different from those of the reaction minerals. More real-

istic but more complex IDM models are also derived to further account for the progressive changes in partition coefficients, the variations in the net fractional contribution of a phase to the total melt, and the consumption of a solid phase. The IDM equations presented here are very useful in modeling partial melting of both mantle and crust. Applications of these equations to specific problems will be presented.

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