

Trace element mass balance in hydrous adiabatic mantle melting: The HAMMS1 model

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A numerical mass balance calculation model for the adiabatic melting of a hydrous metasomatized peridotite source was programmed in order to simulate trace element compositions of mid ocean ridge basalt, back arc basin basalt, ocean island basalt, and large igneous province basalt. The Excel spreadsheet-based calculator, Hydrous Adiabatic Mantle Melting Simulator ver.1 (HAMMS1) uses: (1) a thermodynamic adiabatic melting model of mantle peridotite; with (2) experimentally parameterized melting relationships in terms of pressure, temperature, water content, and degree of partial melting. The trace element composition of the model basalt is calculated from the accumulated incremental melts within adiabatic melting, with consideration of source mantle depletion. The mineralogic mode in the mantle in adiabat is calculated using experimental parameterization, and is incorporated into the program. Partition coefficients of the residual mantle minerals are from lattice strain model based parameterization tested by the latest compilations of experimental results. The parameters that control the trace element composition in the model are: (1) mantle potential temperature, (2) water content in the source mantle, (3) depth of termination of adiabatic melting, and (4) source mantle depletion. It is possible to obtain the above controlling parameters by using Monte Carlo fitting calculations and comparing the calculated basalt compositions with primary basalt compositions. Additionally, HAMMS1 compares those melting parameters with its major element model. HAMMS1 provides a unique estimate of the source conditions of basalt genesis using an incompatible trace element mass balance.

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