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Ocean Basalt Simulator version 1 : Trace element mass balance in adiabatic melting of a pyroxenite-bearing peridotite

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We present a new numerical trace element mass balance model for adiabatic melting of a pyroxenite-bearing peridotite for estimating mantle potential temperature, depth of melting column, and pyroxenite fraction in the source mantle for a primary ocean basalt/picrite. The Ocean Basalt Simulator version 1 (OBS1) uses a thermodynamic model of adiabatic melting of a pyroxenite-bearing peridotite with experimentally/thermodynamically parameterized liquidus?solidus intervals and source mineralogy. OBS1 can be used to calculate a sequence of adiabatic melting with two melting models, including (1) melting of peridotite and pyroxenite sources with simple mixing of their fractional melts (melt-melt mixing model), and (2) pyroxenite melting, melt metasomatism in the host peridotite, and melting of the metasomatized peridotite (source-metasomatism model). OBS1 can be used to explore (1) the fractions of peridotite and pyroxenite, (2) mantle potential temperature, (3) pressure of termination of melting, (4) degree of melting, and (5) residual mode of the sources. In order to constrain these parameters, the model calculates a mass balance for 26 incompatible trace elements in the sources and in the generated basalt/picrite. OBS1 is coded in an Excel spreadsheet and runs with VBA macros. Using OBS1, we examine the source compositions and conditions of the mid-oceanic ridge basalts, Loihi?Koolau basalts in the Hawaiian hotspot, and Jurassic Shatsky Rise and Mikabu oceanic plateau basalts and picrites. The OBS1 model shows the physical conditions, chemical mass balance, and amount of pyroxenite in the source peridotite, which are keys to global mantle recycling.

Keywords: Peridotite, Pyroxenite, Adiabatic melting, Trace element, Mass balance