The distribution of REE between diopside and basaltic melt along a mantle adiabat: A coupled major and trace element study

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The distribution of REE between diopside and basaltic melt is important in deciphering the processes of mantle melting. A key parameter in understanding the fractionation of REE during mantle melting is the diopside-melt partition coefficient ($D_{REE}^{cpx-melt}$). In general $D_{REE}^{cpx-melt}$ from a given diopside-melt partitioning experiment can be quantitatively described by the lattice strain model [1]. Although attempts have been made in parameterizing $D_{REE}^{cpx-melt}$ as a function of temperature, pressure, diopside and melt compositions [1], a general formulation that can be used to calculate $D_{REE}^{cpx-melt}$ along a mantle adiabat is still not available for modeling mantle melting. As a first attempt, we analyzed published REE partitioning data for diopside and nominally anhydrous basaltic melts at pressure below 1.7 GPa and parameterized key partioning parameters in the lattice strain model (D_o, r_o and E) as functions of temperature and major element compositions of diopside. We found that D_o strongly correlates with Al^{IV}, Mg^{M2} and temperature, r_o is a linear function of Al^{VI} and Mg^{M2}, and E can be described by a linear combination of Al^{IV}, Al^{VI} and Mg^{M2}. Given the diopside composition along a mantle adiabat, it is possible to determine $D_{REE}^{cpx-melt}$ using the new parameterization. As an example, we consider melting of DMM along a mantle adiabat (1300°C potential temperature). The major element compositions of diopside were calculated using pMELTS [2]. The Al_2O_3 and MgO abundances in the residual diopside vary from 6.8% to 3.3% and 20.1% to 21.1% respectively. Quite suprisingly, variations in the calculated $D_{REE}^{cpx-melt}$ are very small (e.g. 0.056-0.058 for La, 0.293-0.338 for Sm, and 0.491-0.573 for Yb) in this particular example. Nonetheless, these pMELTS-derived $D_{REE}^{cpx-melt}$ at 1300°C potential temperature are slightly greater than those at 1400°C potential temperature, which results in upper to 2% difference in the predicted degree of melting. This suggests that a set of constant $D_{REE}^{cpx-melt}$ may be used to model adiabatic mantle melting, if the calculated major element compositions of the residual diopside using pMELTS can be taken as exact.

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The LA-ICP-MS zircon dating geochemical characteristics and its geological implication of the Yumuquan granite, Altyn Tagh

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The Yumuquan granitoid complex, located in the south margin of Altyn Tagh, northwestern China, contain many of melanocratic magmatic enclaves (MME) indicating the mixing between granitic magma and more mafic magma. The geochemical characteristics of the granitoid show high Al_2O_3 (14.44%~18.36%, avg. 15.88%), Sr (185~680 ppm, avg. 446 ppm), weak Eu negative anomaly (δEu_N=0.49~0.95), high $(La/Yb)_N$ ratios (15.6~37.4)and Sr/Y ratios (11~104, avg. 40), very lower Y (6.6~23.4 ppm, avg. 14.0 ppm) and Yb (0.8~2.8 ppm, avg. 1.5 ppm), similar to that of adakite but high K_2O/Na_2O ratios (avg. 1.26), suggest that it should derive from thickened lower crust. The LA-ICP-MS zircon U-Pb isotopic dating show that the age of Yumuquan granite is 496.9±1.9Ma (MSWD=0.68), corresponding with the ages of ultrahigh-pressure metamorphic rocks (509~487 Ma) exposed at south Altyn Tagh [1-4]. We propose that, accompanying with the continental deep-subduction and crustal thickening at Upper Cambrain (~500Ma) in the area of south Altyn Tagh, the lithospheric delamination and asthenopheric upwelling occurred, which heated the thickened lower crust to partially melt and generate the Yumuquan granites.

This study was supported by China Geological Survey projects (No. 1212010786006) and National scientific and technological support project (No. 2006BAB07B03-02)

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