Melt-rock interactions on the genesis of potassic basalts from Northeast China

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Melt-rock interaction is a common mantle process occuring in the mantle during the ascending of melts. Here, we present a case study of Quaternary Nuominhe basalts from the Greater Khingan Range to investigate the effect of melt-rock ineraction on the formation of potassic basalts.The Nuominhe basalts are predominantly basanites with high MgO and alkalinities (MgO = 9.0–16.8 wt.%, K_2O+Na_2O = 6.0–8.2 wt.%). They are characterized by positively Ba, K and Sr, and negative Th-U, Zr-Hf, and Ti anomalies, similar to EM 1-type OIBs and average lower continental crust (LCC). Additional, they have EM1-type isotope compositions ($^{87}Sr/^{86}Sr$ = 0.70467–0.70483, ε_{Nd} = -4.1–-1.5, ε_{Hf} = -0.3–2.3, $^{206}Pb/^{204}Pb$ = 17.03–17.36). These compositional feathers suggest a LCC recycling-associated enriched source (EM1-type) for them. On the other hand, the Nuominhe basalts contained zoned olivine xenocrysts whose cores have high Fo_{89-92} and low CaO (< 0.1 wt.%), consistent with those from the nearby mantle peridotitic xenoliths. In contrast, their rims have low Fo_{75-86} and high CaO (> 0.1 wt.%), which are similar to those olivine phenocrysts crystallized from the host basalts. These textural feathers demonstrate that melt-rock interaction played an important role in the formation of Nuominhe potassic basalts.

In Northeast China, besides of Nuominhe basalts, lavas with EM1-type geochemistry are distributed mainly along the northern margin of Songliao basin, including Wudalianchi, Erkeshan, and Keluo. These rocks show good correlations between $^{87}Sr/^{86}Sr$ and K_2O/Na_2O and Rb/Nb. Notably, these ratios decrease with increasing lithospheric thickness, which may reflect melt-perdotite interaction. Phlogopite precipitated when potassic melts passed through the lithospheric mantle, and K and Rb contents of the residual melts decreased over time. Therefore, the compositions of potassic basalts were controlled by both their enriched sources and reactions with lithospheric mantle.

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