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Zinc isotopic compositions of late Cenozoic basaltic rocks from Vietnam: constraints on recycled carbonates in the mantle source

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We determined the Zn isotopic compositions of late Cenozoic alkaline to sub-alkaline basaltic rocks from central and southern Vietnam. These rocks have $d^{66}Zn$ values of +0.29‰ to +0.51‰, which are much higher than those of normal mantle represented by non-metasomatized peridotites ($d^{66}Zn$ = +0.17‰ ± 0.08‰). Previously measured $d^{26}Mg$ values for the same samples range from −0.62‰ to −0.28‰, and $d^{26}Mg$ and $d^{66}Zn$ values show a negative correlation. The positive correlation between $\delta^{66}Zn$ and Zn content for the samples is incompatible with kinetic fractionation during chemical or thermal diffusion. The lack of a significant correlation between MgO and $\delta^{66}Zn$ precludes the occurrence of olivine fractionation. Furthermore, fractionation during partial melting is on the order of ~0.06‰, which does not explain the differences in $\delta^{66}Zn$ between the Vietnamese basalts and the mantle, which are up to ~0.34‰. This suggests the presence of recycled carbonates, such as dolomite and/or magnesite, in the mantle source. High Zn/Fe ($\times 10^4$) ratios of 11-17 and a positive correlation between the $Fe_2O_3^*/SiO_2$ and $\delta^{66}Zn$ support the presence of recycled carbonated oceanic crust in the mantle source. The alkaline basalts are characterized by much higher $d^{66}Zn$ and lower $d^{26}Mg$ values compared with the sub-alkaline basalts. A positive correlation between $\delta^{66}Zn$ and estimates of mantle potential temperature and pressure for primary melt compositions of the studied basalts from Vietnam suggests that carbonatitic melts derived by the partial melting of carbonated eclogite were near-solidus melts and that hotter mantle domains likely carried a higher proportion of dense C-bearing eclogite.