Low $\delta^{44/42}$Ca widely observed in continental basalts from eastern China: signal of recycled carbonate versus isotope fractionation created by magmatic processes

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In order to investigate the potential of Ca isotopes as a tool to trace crustal material recycling and magma processes, here we report high precision Ca isotopic data of 31 Mesozoic to Cenozoic basalts and andesites from eastern China, which are known for derivation from various mantle sources hybridized by agents from hydrous fluids to recycled silicate and carbonate materials. Compared to representative mafic igenous rocks previously reported (0.38±0.04, 2SD, N = 30), Mesozoic and Cenozoic basalts from eastern China have variably lower $\delta^{44/42}$Ca from 0.24 to 0.41, with an average of 0.32±0.09 (2SD, N = 31). No correlation of $\delta^{44/42}$Ca with loss of ignition, MgO and CaO indicates insignificant role of weathering and magma differentiation on Ca isotopic system of these samples. $\delta^{44/42}$Ca of Mesozoic and Cenzoic basalts varies considerably irrespective of indices for degree of partial melting (e.g., Nb and TiO_2), residual garnet proportion (e.g., $(Dy/Yb)_N$), source contamination (e.g., Ba/Th, δ^{26}Mg, δ^{66}Zn), and contribution of pyroxenite melting (e.g. Fe/Mn). The variable $\delta^{44/42}$Ca observed here thus cannot be related to source contamination or isotope fractionation created by magmatic processes in any simple way. Modeling based on available fractionation factors suggests both silicate and carbonatite melts of (recycled) mafic lithologies in the deep mantle shall have low $\delta^{44/42}$Ca due to the presence of isotopically heavy, residual garnet and Na-rich clinopyroxene. Further isotope fractionation may occur during interaction between these low $\delta^{44/42}$Ca agents and the upper mantle as well as partial melting of the hybridized sources, where garnet and / or orthopyroxene are dominant carrier of Ca in the solid phases. This study thus illustrates any Ca isotopic constraint on crustal material recycling cannot be made without filtering from isotope fractionation created by magmatic processes.

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