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Garnet's impact on the petrogenesis of Himalayan leucogranites

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Granite is a major component of Earth's continental crust, typically generated through crustal anatexis followed by complex magmatic differentiation. Mineral reactions during crustal anatexis have been extensively studied such as the influence of garnet during partial melting of biotite or amphibole. However, its role in muscovite-related melting process remains less constrained.

This study addresses this gap by examining the influence of garnet on the chemical and isotopic composition of Miocene Himalayan leucogranites, formed predominantly through muscovite melting. These leucogranites exhibit elevated Mg isotopic compositions (average $\delta^{26}Mg$ = 0.04 ‰, n = 31) compared to their source rocks, including metasediments and metaplutonic rocks (average $\delta^{26}Mg$ = −0.14 ‰, n = 23). By integrating Mg isotopes and rare-earth element data with phase equilibrium modeling, our results demonstrate the presence of garnet in the melting residue during muscovite dehydration melting, and highlight the previously underappreciated geochemical influence of garnet during muscovite-related anatexis.