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# Fractionation of iron isotopes between strongly peraluminous granites and their sedimentary sources: a case study of the Archean Ghost Lake batholith

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Strongly peraluminous granites representing partial melts of metasedimentary rocks (*i.e.*, "S-type" granites) have heavier Fe isotope compositions than their sources due to isotopic fractionations during partial melting [1]. A previous study on Proterozoic rocks from the Black Hills (South Dakota, USA) documented up to ~0.2‰ fractionation between granitic melt and source [2], a finding that was reproduced by subsequent isotopic fractionation modeling of biotite dehydration melting [3]. These findings demonstrate that S-type granites may broadly track their source region Fe isotopic composition with a predictable and quantifiable fractionation. As Archean sedimentary rocks display greater variability in $\delta^{56}$Fe [4], Archean S-type granites may display $\delta^{56}$Fe values that vary from the relatively limited range in values observed in Proterozoic and Phanerozoic S-type granites [1]. We have measured the Fe isotope composition of granites from the Archean Ghost Lake batholith and associated source metasedimentary rocks from the Sioux Lookout terrane (Superior Province, Canada). The $\delta^{56}$Fe values range from 0.111–0.316 for the granites (averaging 0.186 ±0.009‰; n=11), 0.003–0.191 for metapelites (averaging 0.138 ± 0.009‰; *n*=10), and –0.001 ± 0.044‰ (95% c.i.) for one restite. Granite $\delta^{56}$Fe measurements correlate positively with Rb, U, Pb, and negatively with K/Rb and $Na_2O/K_2O$, suggesting links between Fe isotopes and internal differentiation of the batholith. We combined thermodynamic phase equilibrium modeling and published mean iron force constants to model Fe-isotope fractionation between granites and their source during biotite dehydration melting. The observed isotopic fractionation between granites and metapelites can be achieved if partial melting occurs under reducing conditions (*i.e.*, low $Fe^{3+}/\sigma Fe$), expected for marine siliciclastic sediments deposited before the Great Oxidation Event (GOE). Forthcoming work on Archean and Proterozoic "S-type" granites will help to determine whether their Fe isotopic compositions capture changing redox conditions in marine sedimentary rocks across the GOE.

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