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Secular shifts in oxygen isotopes of peraluminous granites

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Quantifying the amount of crustal versus mantle contribution to magmas is of paramount importance to understanding the evolution and growth of the continental crust. The oxygen isotope composition of igneous rocks –expressed as $\delta^{18}O$– are commonly used to address this problem. While the $\delta^{18}O$ of the unenriched mantle is generally presumed to have remained relatively constant through time, that of weathered crustal material is less well-defined. Shales have been used as a crustal endmember by past studies, although it is not clear whether this record is representative of what is assimilated by magmas**.** Here, we present a direct approach to constrain the crustal endmember by examining oxygen isotopes in peraluminous granites that are the products of melting of sedimentary rocks.

First, we present a new compilation of oxygen isotope data (bulk-rock, zircon, garnet, and quartz) from globally distributed peraluminous granites and high silica volcanic rocks with crystallization ages from ~3.2 Ga to ~5 Ma. Second, we couple thermodynamic modeling of partial melting of siliciclastic sedimentary rocks with modeling of oxygen isotopic fractionation to predict $\delta^{18}O$ differences between peraluminous melts and their source. Relying primarily on the zircon oxygen isotope record, we find two increases in the oxygen isotope composition of peraluminous granites through time. The first in the Paleoproterozoic showing an increase in average zircon $\delta^{18}O$ of 2-3‰, which has also been documented in previous studies[1].The second from the Neoproterozoic into the Paleozoic, showing a further increase in average zircon $\delta^{18}O$ by ~1‰. Our modeling results suggest source rocks for the granitic melts increased from ~7.5-9‰ to ~10-12‰ in the Paleoproterozoic, and to ~11-13‰ from the Neoproterozoic to Paleozoic. These values overlap with lower bounds of the shale $\delta^{18}O$ record[2,3], challenging its adequacy for constraining crustal recycling into magmas. The observed increases in $\delta^{18}O$ of peraluminous granites align with global changes in weathering, indicating shifts in Earth's surface conditions fundamentally influenced the igneous rock record.

1. Liebmann J. *et al.* (2021) *Geochim. et Cosmochim. Acta* **307**:242–257.
2. Bindeman IN *et al.* (2016) *Earth Plan. Sci. Lett.* **437**:101–113.
3. Bindeman IN *et al*. (2018) *Nature* **557**:545-548.