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Tracing the origin of melt-enhancing fluids in TTGs via *in-situ* oxygen isotopes

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Newly-formed continental crust generated through partial melting of hydrated mafic rocks has compositionally changed from dominantly tonalite-trondhjemite-granodiorite (TTG) in the Archaean to calc-alkaline granite in the Phanerozoic. Fluid-fluxed melting has been recently invoked as an important trigger for continental crust formation[1]. However, the source of these fluids has remained difficult to ascertain[2]. TTGs and their ~9 kbar amphibolitic source (i.e., 1650 m.y. basaltic protolith) are well-exposed in the Proterozoic Georgetown Inlier, NE Australia[3]. Fluid-fluxed melting of these amphibolites was invoked for high-Sr, low-HREE 1560 Ma TTG magma formation. *In-situ* oxygen isotope and geochronology analysis of zircon and garnet from garnet amphibolites, tonalites (veins), and associated metasomatic rocks are combined to investigate the origin of the melt-enhancing fluids. The 1555 Ma amphibolites yielded $\delta^{18}O$ values of 1.0–3.0 ‰, whereas cogenetic tonalite and c. 1543 Ma metasomatic rocks yielded values of 5–6 ‰, marking a distinct difference between the mafic source and their felsic product. Low-$\delta^{18}O$ in amphibolites indicates interaction of the 1650 Ma basaltic protolith with high-temperature fluids on the sea floor upon eruption. In contrast, the uniformly high $\delta^{18}O$ values for the tonalite and metasomatic rocks indicate melt-enhancing fluids derived from a mantle-like source rather than from a sedimentary or hydrothermal source. Mantle-derived fluids circulating through the Georgetown Inlier lower crust between c. 1560–1540 Ma might have been released during the progressive opening of a mantle wedge above a retreating slab following the well-documented 1600 Ma collision of Laurentia and NE Australia[3]. The similarly mantle-like $\delta^{18}O$ signature of Archean TTGs thus could reflect the composition of melt-enhancing fluids generated within subduction-zone environments.

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