Use of newly measured zircon/melt partition coefficients to identify the source of Hadean zircons

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D(zircon/melt) trace element partition coefficients were measured for Mg, Al, P, Ca, Sc, Ti, V, Y, Nb, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Th, and U at 0.1 and 0.2 GPa, 800°C and 1.5 GPa, 900-1300°C. Onuma diagrams for +3 and +4 ions show systematic trends in D; the +3 curve peaks at the ionic radius of Lu, while the +4 curve peaks at Zr. Like [1], we used D values to calculate the REE content of the melt that crystallized the 4.4 Ga Jack Hills zircons. Unlike [1] who calculated $(La/Yb)_N$ >1 and inferred an evolved (crustal) melt, we calculated using our D values a melt with $(La/Yb)_N$ < 1 for all temperatures < 1200°C, more consistent with a mantle-derived melt. The discrepancy is due to the use of D datasets with different D(Lu)/D(La) values. Our measured values range from 27-2062; the value used by [1] was 56,687. Caution is needed when calculating melt compositions using mineral/melt D values; the inferred melt composition depends strongly on the set of D values used. Because calculated melt compositions range from LREE-enriched to LREE-depleted, REE concentrations in Hadean zircons do not place tight constraints on the nature or source of the magmas they crystallized from.

We also estimated the Lu/Hf of the magma that the Jack Hills zircons crystallized from. From our 7 experiments at 800°C the average D_{Hf} = 11.7 and D_{Lu} = 45.2. The average $^{176}Lu/^{177}Hf$ of Jack Hills zircons from [2] is 0.0006215. Using present-day natural abundances of ^{176}Lu and ^{177}Hf we obtain $(Lu/Hf)_{zircon}$ = 0.00447. Thus $(Lu/Hf)_{melt} = (Lu/Hf)_{zircon} * D_{Hf}/D_{Lu}$ = 0.0012, consistent with the estimate of [2] of < 0.01. This value is lower than chondrite and nearly all crustal and mantle rock types, and suggests that garnet may have been in the source of the magma that crystallized the zircons, or in the source of its precursor, which implies high-pressure melting.

[1] Peck *et al.* (2001) *Geochim. Cosmochim. Acta* **65**, 4215-4229. [2] Blichert-Toft & Albarede (2008) *Earth Planet. Sci. Lett.* **265**, 686-702.

Nd-Sr-Pb geochemistry and petrogenetic framework for metallogenesis, south-central Alaska

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South-central Alaska, located at a nexus of disparate terranes along the Pacific margin, includes Wrangellia composite terrane (WCT) (magmatic arc), and parallel, but more outboard Chugach-Prince William terrane (accretionary wedge). New geochemical and Nd-Sr-Pb isotope data were obtained on rocks from WCT (western Alaska Range) including ca. 55-65 Ma high-K calc-alkaline to alkali-calcic granitic rocks (titanite+magnetite-bearing quartz-monzo-diorite and -monzonite, granodiorite, granite). The rocks have a range of Rb/Sr ~0.1-19, and are associated with porphyry Cu-Mo and Cu-Au mineralization, and polymetallic veins (Mo, Cu, Pb, Zn, Ag, Au). WCT also contains ca. 65 Ma zoned ultramafic to granite plutons and subalkaline tholeiitic picrobasalt, basalt, basaltic andesite with Cr, Au, base- and PGE metals. Most granitic rocks are metaluminous to peraluminous (ASI=0.8-1.1), subalkaline (K_2O+Na_2O ~7.5% at SiO_2 = 65 wt.%; K_2O/Na_2O ~0.4-1.3), light REE-enriched ($[La/Yb]_N$ ~5.8-14.9, no negative Eu anomalies), and have Sr/Y ~11-53 (granodiorites) to Sr/Y<9 (granites). Granitic rocks have negative anomalies for Nb and Ti, and positive anomalies for Pb (primitive mantle-normalized). Mafic rocks also reveal some arc-related features (e.g., Ce/Pb = 2.2-10.0, and Nb/U = 3.5-17.3) and features consistent with continental or within-plate tholeiites. The mafic rocks are light-REE enriched ($[La/Yb]_N$ ~3.5-6.6, generally no Eu anomalies), Sr/Y~8-52, and have negative anomalies for Nb, P and Ti. Initial Pb (at ~55 Ma, $^{206}Pb/^{204}Pb$ ~18.57-18.79; $^{207}Pb/^{204}Pb$ ~15.48-15.52; $^{208}Pb/^{204}Pb$ ~37.98-38.25), Nd (granitic rocks εNd_{55Ma} ~ +5.7 to -4.0; mafic rocks εNd_{55Ma} ~ +6.3 to +1.6) and Sr isotopic compositions ($^{87}Sr/^{86}Sr_{55Ma}$ <0.7072 and $^{87}Sr/^{86}Sr_{55Ma}$ <0.7046, respectively) are consistent with both mantle and crustal contributions. Plate subduction preconditioned the subcontinental lithosphere and lower continental crust through fluid and melt transfer. Subsequent ridge subduction at a migrating triple junction and consequent opening of a slab window (ca. 56 Ma?) under the continental margin possibly produced contaminated mafic magmas (crustal assimilation of an enriched mantle source) and chemically relatively unevolved intermediate and granitic magmas (and highly evolved derivatives).