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# Pure sediment-derived A-type and S-type granites archive rapid sediment recycling in the central Asia accretionary

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There is a considerable controversy regarding the origin of S- and A-type granites with depleted radiogenic isotopic characteristics in the accretionary orogeny. However, conventional geochemical and isotopic data provide averaged information and therefore it is difficult to distinguish contributions from individual sources and understand their role in the crustal evolution. In this study, we present new zircon U-Pb-Hf-O isotopic, and whole-rock major and trace element data for ~300 Ma granitic intrusions in the Alatau Mountains, northwest China. The two-mica granites contain muscovite and high A/CNK values (1.10–1.18), compatible with typical S-type granites. Whereas, the biotite granites show metaluminous to weakly peraluminous compositions (A/CNK =0.97-1.07), and have high total alkalies ($K_2O + Na_2O$), high Zr, Nb, Ta content, and Ga/Al ratio with prominent negative Ba, Sr, P, Eu, and Ti anomalies, demonstrating their close affinity with A-type granites. All the granitoid samples have high $SiO_2$ (72.5–76.7 wt.%) but low MgO (0.10–0.60 wt.%) contents with high zircon $\delta^{18}O$ values (weighted mean values of 12.1‰-12.6‰) and the absence of mafic enclaves, indicating a pure sedimentary source. Their εNd(t) and εHf(t) values are slightly lower than those of the depleted mantle and associated Carboniferous volcanic rocks in the study area, but significantly higher than those of the Precambrian and Silurian-Devonian sedimentary materials. The Carboniferous inherited zircons show variable $\delta^{18}O_{zrn}$ (5.36 ‰ to 7.4 ‰) and positive εHf(t) values of +8.34 to +11.6, suggesting a juvenile arc source. Thermodynamic modeling results show that A-type and S-type granites were derived from the partial melting of Carboniferous greywacke with high geothermal gradient (~1367°C/GPa) at depths of ~20 km and the partial melting of Carboniferous pelites with a relatively normal geothermal gradient (~718°C/GPa) at depths of ~30-35 km, respectively. These features suggest that crustal reworking rather than crustal growth played a major role in the Late Paleozoic crustal evolution of the Alatau, NW Tianshan. Our results show that rapid crustal recycling via sedimentary–melting is critical for crustal reworking in accretionary orogens