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Circum-Tarim craton (NW China) mantle archives accumulative effects from plume and convergent events: peridotite xenolith evidence

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Circum-cratonic lithospheric mantle domains are normally vulnerable to impacts from tectonic thermal events prevailing beneath or surrounding the craton. Here we integrated Petrography and geochemistry for Piqiang peridotite xenoliths from the northwestern (NW) Tarim Craton. The peridotites have transitional compositions. The Group A1 lherzolites contain clinopyroxenes depleted in incompatible elements and are interpreted as melting residua with negligible metasomatism. The Group A2 lherzolites exhibit depletion of Nb and Ta with high Ti/Eu but low $(La/Yb)_N$ ratios in clinopyroxene, demonstrating a recent fluid metasomatism. The Group A3 lherzolites are likely overprinted by carbonatitic melts from the mixed source occurred long before the host magma eruption because the clinopyroxenes in these samples with equilibrium texture are enriched in incompatible elements and have highly variable $^{87}Sr/^{86}Sr$ ratios with low Ti/Eu and high $(La/Yb)_N$ ratios. Group B wehrlite with reaction texture is enriched basaltic components, show light rare earth element patterns and $^{87}Sr/^{86}Sr$ ratios similar to those of the host basalt and they may represent the products of melt–rock reaction.

Overall, Group A lherzolites display high whole-rock $^{187}Os/^{188}Os$ ratios, giving T_{RD} age from Neoproterozoic to Paleozoic. The correlations between $^{187}Os/^{188}Os$ ratios and 1/Os, whole-rock Al_2O_3 of peridotite xenoliths exhibit a tendency of melt mixing first and then melt depletion. This result suggests that the initial partial melting of Group A could be dated back to ~624 Ma at least. It provides evidence for mantle accretion to match Neoproterozoic oceanic subduction in the NW Tarim Craton. The youngest T_{RD} in Group A (19pq-2: ~298 Ma) is consistent with the T_{RD} model age peak of the adjacent Xikeer peridotites, and hence indicates the timing of mantle rejuvenation. This time point allows us to establish a link between mantle modification and Tarim mantle plume. We suspect that the plume drives the injection of convecting mantle with “juvenile” Os and then melt re-extraction in lithospheric mantle.

Collectively, our data reveal the mechanism of mantle evolution driven by Tarim plume and peripheral subduction/collision events beneath the Tarim circum-craton domains. Circum-cratonic lithospheric mantle domains are the ideal and irreplaceable region to understand the mantle formation and evolution.