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Recycling of metal-fertilized lower continental crust: Origin of non-arc Au-rich porphyry deposits at cratonic edges

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Recent studies argue that subduction-modified, Cu-fertilized lithosphere controls the formation of porphyry Cu deposits in orogenic belts. However, it is unclear if and how this fertilization process operates at cratonic edges, where numerous large non-arc Au-rich deposits form. Here we report data on the lower-crustal amphibolite and garnet-amphibolite xenoliths, hosted by Cenozoic stocks that are genetically related to the Beiya Au-rich porphyry deposit along the western margin of the Yangtze Craton, China. These xenoliths are thought to represent cumulates or residuals of Neo-proterozoic arc magmas ponding at the base of arc at the edge of the craton and subsequently underwent high-pressure metamorphism at ca. 738 Ma. The amphibolite xenoliths are enriched in Cu (383–445 ppm) and Au (7–12 ppb), and a few garnet-amphibolite xenoliths contain higher Au (6–16 ppb) with higher Au/Cu ratios (2×10^4–8×10^4) than normal continental crust. These data suggest that metal fertilization of the base of an old arc at the edge of the craton occurred in the Neo-proterozoic via subduction-modification, and has since been preserved. The bulk-rock geochemical and zircon Hf isotopic data indicate that melting of the Neo-proterozoic Cu (Au)-fertilized low-crustal cumulates at 40–30 Ma provided the metal endowment for the Au-rich porphyry system at the cratonic edge. We, therefore, suggest that the reactivated cratonic edges, triggered by upwelling of asthenosphere, have the potential to host significant Au ore-forming systems, especially non-arc Au-rich porphyry deposits.