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Controls on the formation of Cu-rich magmas: Insights from the Late Triassic post-collisional Saishitang Complex in the eastern Kunlun Orogen, western China

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Petrogenesis of high Sr/Y andesitic to dacitic Cu-rich magmas remains highly controversial and has been attributed to either specific sources or differentiation processes/conditions. The collected a comprehensive petrological and geochemical dataset, including information on Cu, Au, and Pt systematics, for the Saishitang complex in the eastern Kunlun Orogen to investigate the influence of the magmatic source and differentiation processes on Cu enrichment in a post-collisional, slab-derived magmatic system. The Saishitang complex contains a ~ 233 Ma plutonic main body and tens of porphyritic dikes intruded at ~ 218 Ma. It also hosts copper skarn mineralization formed at 224–218 Ma. The main intrusion consists of quartz diorite, granodiorite, and minor monzogranite, whereas the porphyritic dikes vary from diorite to quartz diorite, granodiorite, and granite. The porphyritic diorites, with high MgO, Ni, and Cr contents and moderately high Sr/Y and La/Yb ratios, were likely derived from partial melting of the subducted slab and overlying sediments and then interacted with mantle peridotite. Mineral compositions and geochemical data, as well as mass-balance, Rayleigh fractionation and isotopic mixing modeling show that the parent magmas subsequently experienced simultaneous assimilation and fractional crystallization (AFC) at both the lower and the mid-to-upper crustal levels, and were finally emplaced at different upper crustal levels. Systematic Cu and Au variations during the Saishitang magmatic evolution suggest that the lower crustal AFC processincreased the Cu budget by approximately one order of magnitude and therefore was the most critical factor in controlling the formation of Cu-rich magmas, although other processes such as slab melting and sulfide saturation were also important.