The multistage Cenozoic adakitic granitoids from the southeastern Gangdese belt, south Tibet, and their tectonic significance

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The Gangdese magmatic arc on the southern Tibetan plateau, records the Mesozoic Andean-type orogeny derived from the Neo-Tethyan subduction and the Cenozoic Himalayan orogeny resulted from the Indian-Eurasia collision. We here report the Cenozoic four-stage adackitic granitoids occurred in the southeastern Gangdese arc, they are formed at the Early Paleocene (62 Ma), Early Eocene (54 Ma), Late Eocene (38 Ma) and Oligocene (29 Ma), respectively. They have typical geochemical features of adakite, with high SiO_2 (63.28 %-72.64 %), $Mg^{\#}$ (39-54), Sr content (383-1214 ppm), Sr/Y (52.3-163) and $(La/Yb)_N$ (18.4-136), and low Cr (6.29-29.9 ppm), Ni (3.1-19.6ppm), Yb (0.3-1.17 ppm) and Y (3.73-14.4 ppm). The zircon Hf isotopic compositions indicate that the most granites are derived from the melting of juvenile crust, except for the the Early Eocene granite sourced from the old basement materials.

Most Mesozoic-Cenozoic Gangdese magmatic rocks show the geochemical features of calc-alkaline arc magmatism and while adakitic rocks were mainly formed at ca. 140 Ma, 100-80 Ma and 25-10 Ma. However, the studied granites from 62 to 29 Ma also display geochemical affinity to adakites. The Early and Late Cretaceous adakitic rocks are likely derived from partial melting of the subducting Neo-Tethyan slab. The certain geochemical features of this reported adakitic granitoids, such as relatively silica-rich, low Ni and Cr contents and the discernable concave-upward Dy-Ho-Er-Tm-depleted patterns, indicate that they result from partial melting of the thickened lower crust. Therefore, we suggest that the oberseved continous adakitic magmatism indicates that the southeastern Gangdese arc experienced a long-lasting crustal thickening process during the Cenozoic. This work also demonstrates that the adakite can be formed at various stages during the Andean-type and Himalayan-type orogenesis.