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Fluid-Fluxed Melting and Mixed Magma Sources: The Origin of Post-collisional Porphyry Cu Deposits in Eastern Gangdese Belt, Southern Tibet

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The recent discovery of large porphyry Cu deposits (PCDs) associated with calc-alkaline Miocene magmas in the eastern section of the Paleocene-Eocene Gangdese magmatic arc in the Himalaya-Tibetan orogenic belt raises new questions about the origin of water-rich (>10 wt %) and oxidized (ΔFMQ 0.8–2.9) magmas in a continental collisional setting and about the recycling of metal deposits from older arcs in such a setting. Coeval with these PCD-bearing Miocene granitoids, there is a suite of barren "alkaline volcanic rocks" that crop out in the western part of the Gangdese arc. A systematic geochemical and Sr-Nd-Hf-O-Os isotope investigation, together with zircon chemistry of the three major magmatic suites in the Gangdese belt (Paleocene-Eocene arc suite, PCD-hosting Miocene high-K calc-alkaline suite, and Miocene alkaline volcanic suite), reveals the genesis and the relationships between these three suites. The Miocene PCD-bearing magmas were formed through partial melting of the lower crustal sections of the juvenile/subduction-modified Paleocene-Eocene arc root in the presence of aqueous fluids. Melting was triggered by the intrusion of alkaline melts derived from a metasomatized, old, lithospheric mantle. In the east this melt mixed with the newly formed melts from the arc roots, but in the west it crossed the crust to extrude as alkaline volcanic rocks along rift margins. Decompression of hydrous and oxidized alkaline melts from such mantle source in the east, as it rose to underplate the thickened juvenile lower crust, released oxidized fluids, which caused water-fluxed melting of the lower crust and formed hybrid melts. Such hydrous and oxidized melts are ideal for porphyry deposit formation and assimilated preconcentrated cumulate sulfides from the lower arc sections. The lack of significant lower crust melting in the west explains the uneven spatial distribution of Miocene porphyry deposits.