

Cause of across-arc geochemical and Sr-Nd-Hf isotopic variations: A case study from Early Paleozoic arc-type mafic intrusions in the southern Central Qilian block, China

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Cause of across-arc geochemical and Sr–Nd–Hf isotopic variations above subduction zone is debated. Petrogenesis of arc-type mafic rocks can provide insights into the cause of the variations. We carry out an integrated study of U–Pb zircon dating, geochemical and Sr–Nd–Hf isotopic compositions for the Keqianyakou, Jinyuan (rear-arc) and Liushendong, Yishenchun (volcanic front) mafic plutons in the southern Central Qilian belt. These plutons have magma crystallization ages of 454–465 Ma. During their magma evolution, cumulation and fractional crystallization were widespread, while crustal contamination was negligible. Isotopic and geochemical compositions favor involvement of oceanic sediment melt as transport agent for slab signature. Comparing with the rear-arc mafic rocks, the rocks from volcanic front have more evolved Sr–Nd–Hf isotopic ratios and higher strongly incompatible element contents. The Sr–Nd and Nd–Hf two-end-members mixing models and geochemical simulation show that decreasing proportion of oceanic sediment melt incorporated into the mantle wedge and decreasing partial melting extent of the metasomatic mantle wedge took place with depth. Such variations probably recorded the "drying out" of the slab as hydrous fluid during on-going oceanic slab subduction, which contributed to the fluid-fluxed melting of the oceanic sediment. In response to decreasing involvement of oceanic sediment melt with depth, the degree of partial melting of the metasomatic mantle also shows a decreasing tendency. Combining with the feature of modern arc magmatism, we suggest that the northward subduction of the South Qilian (North Qaidam) oceanic slab is responsible for the magmatism in the southern Central Qilian block.