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Permian subduction-accretion of the Zharma-Saur oceanic arc

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Migration of arc magmatism is of significant importance for accretionary orogens, but few examples have been documented in ancient orogens. In this paper we report Carboniferous-early Permian, intra-oceanic migrating arc magmatism of the Zharma-Saur arc in the Tarbagatay Mountains, West Junggar, NW China, in order to address the general role of a growing arc in accretionary orogenesis, and the controversial formation and timing of the Kazakhstan orocline in the Central Asian Orogenic Belt (CAOB). Our detailed field work suggests that plutons and dikes intruded and lavas erupted in the Zharma-Saur arc and in associated accretionary complexes that were dominated by ocean plate stratigraphy (OPS). Mafic to intermediate magmas have arc-type geochemical signatures such as depleted HFSEs and enriched LILEs and LREEs, and high εNd(t) (+5.72 to +6.78) to low 87Sr/86Sr values (+0.7035 to +0.7037). The Tarbagatay accreted rocks contain early Paleozoic pillow lavas, which have depleted LILEs, high εNd(t) (+7.41 to +8.17) and high 87Sr/86Sr values (+0.7041 to +0.7063). These data suggest that the Zharma-Saur arc was an intra-oceanic island arc that developed on accreted OPS material. U-Pb zircon isotopic data demonstrate that the Zharma-Saur arc magmas were late Paleozoic in age (the ZWTB I diorite pluton, 322 $\pm$ 3 Ma; the JLDK diorite pluton, 318 $\pm$ 4Ma; andesitic lavas, 312 $\pm$ 2 Ma, 310 $\pm$ 4 Ma, 301 $\pm$ 3 Ma). Integration with published geochronological data on the Zharma-Saur arc leads to a complex model of arc growth with a general southward younging of the arc rocks from 383 Ma to 262 Ma. These relations imply a southward growth and migration of the magmatic axis of the Zharma-Saur arc that was associated with a short period of ridge subduction. The magmatic activity of the Zharma-Saur arc that probably continued until the early Permian resulted from migrations towards the forearc and backarc, as well as oblique or parallel motion to the trench. These new results not only provide robust evidence for resolving controversies about the Phanerozoic accretionary and continental growth of the CAOB, but they also shed light on the types of migration of magmatism in accretionary orogens.