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Petrology, zircon U–Pb ages, geochemistry and Sr-Nd-Hf isotopes of the Late Paleozoic gold-bearing magmatic rocks (porphyry intrusions) in Jiamante area, Northwest Tianshan: Implications for petrogenesis and mineralization

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A series of Cu-Au-Mo deposits distributed from east to west in the Northwestern Tianshan Orogenic Belt (NTOB), which is located in the northwestern China. The tectonic settings and associated geodynamic processes of these deposits have been disputed. This paper presents whole-rock geochemical data, in-situ U-Th-Pb ages and Sr-Nd-Hf isotopic composition for granite porphyry and quartz porphyry in the Jiamante gold deposit from the Yelimodun Basin, in the NTOB. These two type representative high potassium granitic intrusions have the LA-ICP-MS zircon U-Pb ages of 350.8±4 Ma, 351.7±3 Ma and 350.4±5 Ma, 353.9±2.5 Ma, interpreted as the crystallization ages. High contents of SiO_2 (71.1-75.2wt.%), K2O (4.96-6.33 wt.%), $Al2O_3$ (12.45-14.35 wt.%) and low contents of $Fe2O_3$T (1.47-3.25 wt.%), MgO (0.3-0.5 wt.%), and CaO (0.49-1.29wt.%), High ASI (Alumina Saturation Index, $Al2O_3$/(CaO+Na2O+K2O)=1.37–1.80 molecular ratios) can be found in these rocks. These porphyries are enriched in both large ion lithophile and light rare earth elements, but deplet in high field strength elements and are characterized by moderately negative Eu anomalies (Eu/Eu*=0.27–0.66) and strong depletion in Ba, Nb,Ti and Sr elements. These two porphyries have negative and positive zircon εHf(t) (-11.6 to +6.7) values, low Mg# ratios (21.85-35.51wt%), and low Cr (3.24ppm -11.35ppm) and Ni (1.88ppm-13.41ppm) contents. The regional geological and geochemical characteristics of the Early Carboniferous rocks in the Northwestern Tianshan show that peraluminous granitoids, with hybrid Sr-Nd-Hf isotopic signatures, suggesting that their parental magmas could be derived from the subduction of Paleo-Junggar Ocean beneath the Yili Block and the sediments from the Yili Block. In combination with the compositions of the volcanic rocks and basic lavas in the region in the Early Carboniferous, we suggest that the Jiamante peraluminous granitic porphyries and quartz porphyries were generated by the interaction between Wenquan group greywacke and southward subducted Junggar oceanic sediment-derived melts with minor basaltic oceanic crust derived melts, and that the magmas then retreated to the back and transformed into a extensional setting. Within an extensional setting, hydrothermal upwelling formed the Jiamante gold mine. The close association of the Early Carboniferous magmatic rocks and Au mineralization in the Jiamante area suggests that the arc magmatic rocks in the Yelimodun basin may have a high potential for Au mineralization.