Geochronology and geochemistry of late Silurian-early Devonian mafic-ultramafic complexes in the eastern section of Qilian block, NW China: Implications for late early Paleozoic tectonic evolution of the Qilian orogeny belt

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Field relationships, mineralogy, petrology, geochemistry, geochronology, and Nd-Hf-O isotopes of the mafic-ultramafic rocks from the east part of the Qilian block are studied in the present work. The Aganzhen intrusive body only exposed in the Zhigoumen, Shiguanzi, Xianggoumen outcrops and includes Hornblende peridotite, wehrlite, olivine-bearing pyroxenite, hornblende-bearing pyroxenite, websterite, clinopyroxenite, hornblendite, olivine-bearing gabbro. The gabbroic rocks are also layered or massive cumulates with rock types varying continuously from noritic gabbro through hornblende gabbro to dioritic norite. Contact metamorphic zones are well developed between the Aganzhen intrusive body and the country rock. Major element contents of Aganzhen ultramafic-mafic rocks show subalkalic series and are characterized by low SiO₂ contents (38.09-54.96 %), low TiO₂ contents (0.09-0.72 %), low P₂O₅ contents (0.00-0.36 %) and alkali contents (Na₂O+K₂O 0.01-5.35 %), but high MgO contents (9.68-33.06 %), Ni contents (116-1505 ppm), Cr contents (713-2808 ppm). Similar LREE-rich pattern ((Ce/Yb)ₙ =0.95-3.80 except two Samples) and tiny Eu anomaly (Eu/Eu* =0.6-1.2) indicate the Aganzhen ultramafic-mafic rocks have the same magma source. Trace elements are enriched in LILE (Rb, Th, U, K), relatively depleted in HFSE (Nb and Ta), and the La/Yb, Ce/Yb, Th/Yb, Nb/La, La/Sm values suggest the limited crustal contamination during the rise of the magma. The εNd(430 Ma) values are −6.9 ⫱2.5 and TDM values are 3.6-1.4 Ga. The SHRIMP ages are 433±2 Ma for the Zhigoumen websterite(101-2101A), 434±3 Ma for Shiguanzi hornblendite(101-2104A) and 412±3 Ma for the Xianggoumen serpentinite(101-2107A). In situ zircon O-Hf isotope, the δ¹⁸O compositions of vary from +9.03 to +9.50 (except three points +11.33, +12.38, +12.44) and εHf(t) value is +0.29 to +4.13 for the Zhigoumen pyroxenite(101-2101A), the δ¹⁸O compositions of vary from +6.39 to +7.12 and εHf(t) value is +7.76 to +13.26 for Shiguanzi gabbro(101-2104A), and the δ¹⁸O compositions of vary from +4.68 to +5.31 and εHf(t) value of +0.28 to +2.79 for the Xianggoumen serpentinite(101-2107A). According to the above datum, we suggest that middle Paleozoic magmatisms last ~20 m.y. (434-412 Ma) on the northern margin of the Qilian Block was related to the Early Paleozoic continental collision between the Qilian and Alax blocks, and to subsequent subduction and
thermal underplating.