Magma sources and petrogenesis of middle Paleozoic ultramafic-mafic rocks from the east part of the Qilian block, NW China: Implications for subduction and underplating

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Field relationships, mineralogy, petrology, geochemistry, geochronology, and Nd-Hf-O isotopes of the ultramafic-mafic rocks from the east part of the Qilian block are studied in the present work. The Aganzheng intrusive body only exposed in the Zhigoumen, Shiguanzi, Xianggoumen outcrops and includes olivine pyroxenite, clinopyroxenite, pyroxene hornblendite, hornblendite, dioritic norite. The gabbroic and dioritic 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 Aganzheng intrusive body and the country rock.
Major element contents of Aganzheng ultramafic-mafic rocks show subalkalic series and are characterized by low SiO_2 contents (38.09-54.96 %), low TiO_2 contents (0.09-0.72 %), low P_2O_5 contents (0.00-0.36 %) and alkali contents (Na_2O+K_2O 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 Aganzheng 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 ε_{Nd}(430 Ma) values are −6.9–+2.5 and T_{DM} values are 3.6–1.4 Ga. The SHRIMP ages are 433±2 Ma for the Zhigoumen pyroxenite (101-2101A), 434±3 Ma for Shiguanzi gabbro (101-2104A) and 412±3 Ma for the Xianggoumen serpentinite (101-2107A). In situ zircon O-Hf isotope, the $\delta^{18}O$ compositions of vary from +9.03 to+9.50 (except three points +11.33, +12.38, +12.44) and ε_{Hf}(t) value is +0.29 to +4.13 for the Zhigoumen pyroxenite (101-2101A), the $\delta^{18}O$ compositions of vary from +6.39 to +7.12 and ε_{Hf} (t) value is +7.76 to +13.26 for Shiguanzi gabbro (101-2104A). and the $\delta^{18}O$ compositions of vary from +4.68 to+5.31 and ε_{Hf}(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 Qaidam blocks, and to subsequent subduction or thermal underplating.

Keywords: Ultramafic-mafic rock, SHRIMP, Nd-Hf-O isotope, Qilian Block, Underplating