Acta Geologica Sinica (English Edition), 2019, 93(supp.2): 49–50

Magma Sources and Petrogenesis of Middle Paleozoic Mafic-ultramafic Rocks from the East Part of the Qilian Block, NW China: Implications for Subduction and Underplating

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Citation: Tung et al., 2019. Magma Sources and Petrogenesis of Middle Paleozoic Mafic-ultramafic Rocks from the East Part of the Qilian Block, NW China: Implications for Subduction and Underplating. *Acta Geologica Sinica* (English Edition), 93(supp.2): 49–50.

Abstract: 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, olivinebearing 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 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 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 $\delta^{18}O$ 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

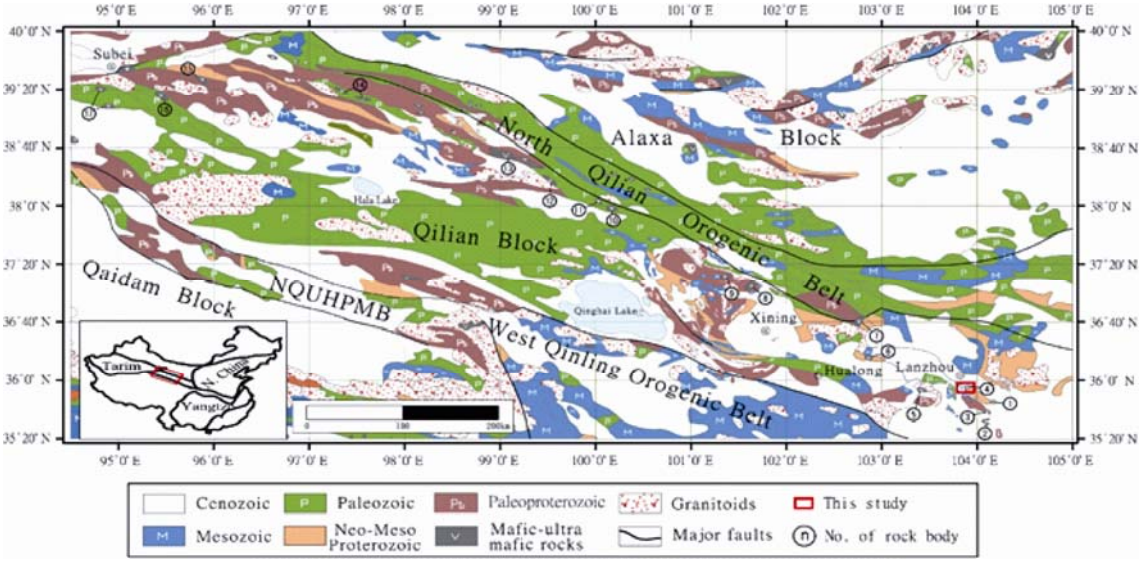

Fig. 1. Simplified geotectonic map of the Qilian orogenic belt and the adjacent area (modified after Tseng et al. 2007).
1-17 are the mafic–ultramafic intrusive bodies into the Precambrian metamorphic complexes (BGMRGP 1989; BGMRQP 1991).4 is the Aganzhen mafic–ultramafic intrusive body under the present study and is enlarged in Figure 2.

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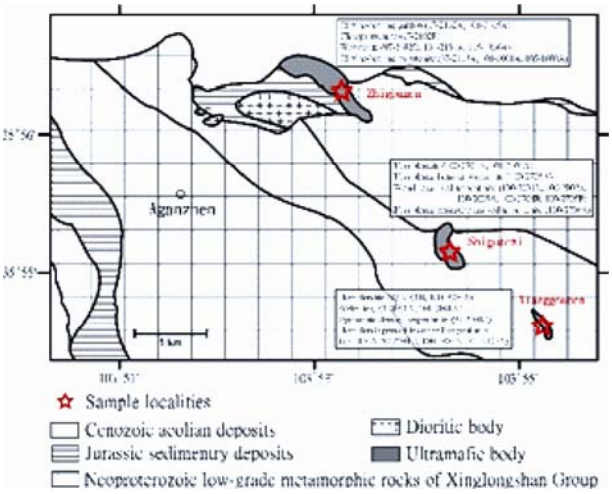

Fig. 2. Geological map of the Aganzhen mafic–ultramafic intrusive body and sampling localities.

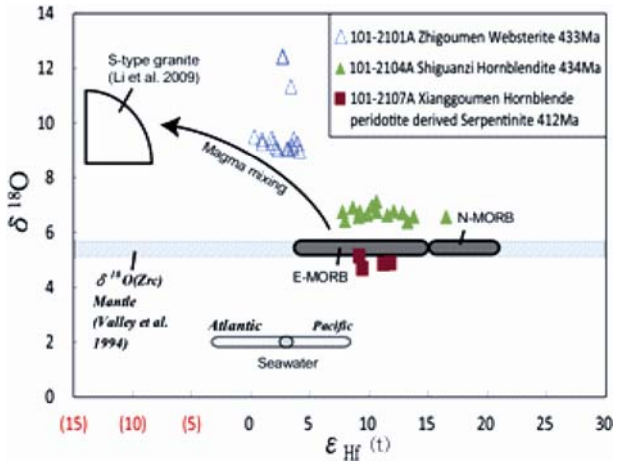

Fig. 3. A Hf-O isotope diagram comparing the compositions of the Aganzhen zircons analyzed here with compositions of typical mid-ocean ridge basalts(N-MORB and E-MORB from Geldmacher et al., 2011), and the compositions of seawater-from Zimmermann et al. (2009) and Rickli et al. (2009). Isotopic compositions of zircons from S-type granites are from Li et al. (2009).

$\delta^{18}O$ 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 $\delta^{18}O$ compositions of vary from +4.68 to+5.31 and εHf(t) value of +0.28 to +2.79 for the Xianggoumen hornblende peridotite derived 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.

Key words: Qilian block, mafic-ultramafic rocks, Nd-Hf-O isotopes, SHRIMP, subduction, underplating

About the first author

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