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Geochemistry and Geochronology of the High-Mg Gabbro Dykes from Quanji Massif: Implications for the Amalgamation of Tarim Block in NW China and Assembly of the Rodinia Supercontinent

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The Tarim Craton is one of the major continental blocks in China. Mafic dykes, ultra-mafic –mafic –carbonatite complex and ultra-mafic –mafic pluton of 0.82–0.75 Ga widely occur in Kuluktage, Aksu and Tieklik area along northern and southwestern margins of this craton, respectively. Researchers considered that the Tarim Craton was closely connected with, and possibly as an important part of the Rodinia supercontinent. However, controversies remain whether the ~0.82 Ga mafic dykes were the products of the breakup or assembly of the Rodinia supercontinent (Guo et al., 2005; Xu et al., 2005; Zhang et al., 2007, 2009, 2011, 2012a,b; Zhu et al., 2011; Xu et al., 2013). The Quanji Massif on the southeastern margin of the Tarim Block has a similar geological history with the Tarim Craton since the Neoproterozoic (Lu et al., 2008), and is interpreted as a fragment of the Tarim Craton. Here we report a suite of high-Mg gabbro dykes from the Yingfeng area in the northwestern Quanji Massif.

These dykes are exposed in the Yingfeng area in the westernmost of the Quanji Massif. They intruded both the ~1.80 Ga Yingfeng rapakivi granite and Mesoproterozoic Wangdonggou Group, and extend NE-SW with 3–8 meters variable length, the longest dyke being up to 500 meters. Euhedral prismatic magmatic zircons from the weakly deformed interior of an 8 m-wide dyke yield a weighted 206Pb/238U average age of 822.2 ± 5.3 Ma (MSWD = 1.0) , indicating the timing of emplacement age of the precursor magma. The rocks are made up of primary minerals of augite (~55%) and plagioclase (40–45%), with coarse grained gabbroic texture in the center part and fine-grained texture in the margin. They show small variations in major oxides of SiO2 (49.8–50.5 wt%), FeOt (8.50–9.67 wt%) and TiO2 (0.67–0.93 wt%), have low P2O5 (0.04 – 0.07 wt%), but possess high CaO (8.32 –13.4 wt%) and significantly high MgO (9.91–13.1 wt%) contents and Mg# numbers (66.4–72.6), high Cr (346–675 ppm), but relatively low Ni (139–213 ppm), consistent with formation from a primitive magma with low degree of olivine fractionation. The rocks display nearly flat chondrite-normalized REE patterns, with weak fractionation of the LREE relative to HREE. Their primitive mantle normalized incompatible elemental patterns show positive Rb, Ba and U but negative Th, Nb, Ti and Zr anomalies, comparable with those of arc-related basalts. The magmatic zircons show εHf(t) value from +4.6 to +13.5 and TDM of 0.85–1.23 Ga, , with oldest age nearly approaching the value for the coeval depleted mantle. The strongly depleted basaltic magma was probably sourced from a highly depleted Neoproterozoic subcontinental lithosphere mantle with mixture of some Mesoproterozoic materials in an arc-related setting.

Therefore, our data suggest a subduction-related tectonic regime prevailing at ~0.8 Ga along the southeastern margin of the Tarim Block. We propose an opposite verging double -sided subduction model for coeval subduction of the oceanic crust beneath both the southern and northern margins of the Tarim Block during early Neoproterozoic.

Keywords: High-Mg gabbro dykes; Geochemistry and geochronology; Double-sided subduction; Northwest China; Supercontinent Rodinia

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