Geochronology and geochemistry of the Paleoproterozoic mafic dike swarms from the Dunhuang Block

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Mafic dike swarms have been described as igneous record related to the breakup and dispersal of continental masses. Studying their origin and distribution are thus important for the understanding of the regional magmatic-tectonic evolution during the late Paleoproterozoic and possible relationship between the Dunhuang Block and the Columbia supercontinent. Here detail petrolography, zircon U-Pb age, and geochemistry are presented of the mafic dikes in the Dunhuang Block. The mafic dikes are tabular, E-W trending, mainly consist of the diabase and diabasic gabbro. Fine-grained gabbroic rocks are seen in the center of some of the thick dikes. These rocks are massive, showing ophitic texture with tholeiitic affinity and dominated by basaltic compositions. Zircon SHRIMP U-Pb dating of these dykes yields emplacement age of 1867 ± 8 Ma. According to their geochemical features, the mafic dikes are subdivided into three groups (G1, G2, and G3). G1 dikes have low SiO_2 (47.80–48.82%), high MgO (6.00–8.44%), Cr (92–170 ppm), and Ni (46–106 ppm), indicating that they were not significantly affected by fractional crystallization or crustal assimilations. This result is consistent with their insignificant Nb-Ta troughs on the incompatible elements spider diagrams. Compared to G1 dikes, G2 dikes show higher SiO_2 (49.18–49.76%), lower MgO (4.92–5.23%), Cr (35–44 ppm), and Ni (72-82 ppm). They show moderate Nb-Ta depletion on the primitive mantle normalized spider diagrams. Compared with G1 and G2 dikes, G3 dikes exhibit lowest SiO_2 (46.05–49.76%) and MgO (4.07–4.37%) and highest TiO_2 (3.38–3.50%), P_2O_5 (1.81–1.94%), and total alkalis (5.04–5.73%). In addition, G3 dikes have higher total REE abundances and extremely depleted in Nb-Ta with Nb/La ratios from 0.25 to 0.27. Although these mafic dikes show different REE and trace element patterns, the element signatures (Nb/La, Th/La, Ce/Nb, Th/Nb, and (Zr/Nb)N ratios) are similar to those of the intraplate basalts, while different from the volcanic arc basalts or mid-ocean ridge basalts. This may suggest that the primitive magmas of G1, G2, and G3 were derived from an OIB-like mantle source, which may be related to the plume magmatism or to an intracontinental extension setting, associated with the initial breakup of the Columbia suppercontinent.