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A Sheeted Dike Complex in the Protrozoic Miaowan Ophiolite Complex on the Northern Yangtze Craton: Recording Seafloor Spreading

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The Proterozoic Miaowan Ophiolite Complex is a highly dismembered ophiolitic complex cropping out near the northern margin of the Yangtze Craton (Peng et al., 2012). The rocks of this complex consist of, from bottom to top, ductily deformed serpentinized harzburgite, sepentinized dunite, layered and isotropic gabbro, a sheeted dike complex (SDC), meta-pillow lavas, and layered metasedimentary rocks (Deng et al., 2012; Jiang et al., 2012; Peng et al., 2012; Wang et al., 2012). The SDC is a very important and significant part of the Miaowan ophiolitic sequence, and grades downward into gabbro and ultramafic rocks, and upward into meta-pillow lavas. Some dikes preserve one-way chilled margin, typical of extensional ophiolitic settings, whereas most preserve double-way chilled margin, in cases where chilling direction can be determined. The SDC is mainly composed of meta-diabase (dolerite), meta-plagiogranite, and small amounts of meta-gabbro and ultramafic rocks. LA-ICPMS zircon dating yields an upper intercept age of 1026±79 Ma from one meta-plagiogranite and 1043±23 Ma from another one in the SDC, and 1096±32 Ma from one meta-gabbro at the bottom of SDC, suggesting the SDC formed at circa 1026-1096 Ma, consistent with the formation age of the Miaowan ophiolite. Geochemical studies of the meta-diabase show that their magma is sub-alkaline type (low potassium tholeiite). Based on the different geochemical discrimination diagrams, the samples plot in the mid-ocean ridge basalt field. The chondrite-normalized rare earth (REE) element patterns of the meta-diabase from the SDC show flat patterns to a slight depletion in LREE with no obvious Eu anomalies, (La/Yb) N = 0.56-0.94, all of which are similar to N-MORB patterns. Average Ce/Zr, Zr/Nb, Th/Yb, Zr/Y and Ti/Y are respectively 0.11, 46.09, 0.11, 2.69 and 361. These features show that the diabases are N-MORB type tholeiites, typical of ridge spreading settings (Deng et al., 2012). The meta-plagiogranites from the SDC show LREE enriched and slightly HREE depleted chondrite-normalized REE distribution patterns, with obvious significant negative Eu anomalies (δEu=0.68). On the MORB-normalized trace element diagram, they are slightly enriched in LILE and depleted in HFSE. Their negative anomalies for Ta, Nb, Sr, P and Ti, are interpreted to be derived from fractionation of minerals of Ti-bearing phases, apatite and plagioclase (Deng et al., 2012). We suggest that the plagiogranites in SDC may be derived from strong fractional crystallization of a mafic-magma chamber. Based on the geochemical data of meta-diabase from the sheeted dikes, together with regional relationships and geochemical characteristics of other units in the Miaowan ophiolite, we propose that the Miaowan ophiolite may has initially formed in a ridge spreading system.

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