

XIONG Fuhao, MA Changqian, JIANG Hong'an, LIU Bin and HUANG Jian, 2013. Multi-Style Modification of Subcontinental Lithospheric Mantle during a Tethys Orogeny: Evidence from Permo-Triassic Mafic Dike Swarms in Northern Tibet Plateau. *Acta Geologica Sinica* (English Edition), 87(supp.): 274-276.

Multi-Style Modification of Subcontinental Lithospheric Mantle during a Tethys Orogeny: Evidence from Permo-Triassic Mafic Dike Swarms in Northern Tibet Plateau

XIONG Fuhao^{1,*}, MA Changqian^{1,2}, JIANG Hong'an¹, LIU Bin¹ and HUANG Jian¹

¹ Faculty of Earth Sciences, China University of Geosciences, Wuhan 430074, PR China; E-mail: xiongfuhao@yeah.net

² State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, 430074 Wuhan, PR China

Orogenic basaltic magmas record critical information regarding the chemical composition of the sub-continental mantle and regional tectonic evolution. Several distinct mantle components can contribute to orogenic mafic rocks, such as subcontinental lithospheric mantle, plume-related OIB (oceanic island basalt)-type mantle sources, or depleted MORB (middle oceanic ridge basalt)-type

asthenosphere mantle. Besides, continental crust and subducted slab would also affect the mantle source either through contamination or through crust-mantle mixing. Therefore, detail studies on the geochemistry, Sr-Nd-Hf isotope and phenocryst minerals would be effective probes into magma generation processes, especially the modification of subcontinental lithospheric mantle.

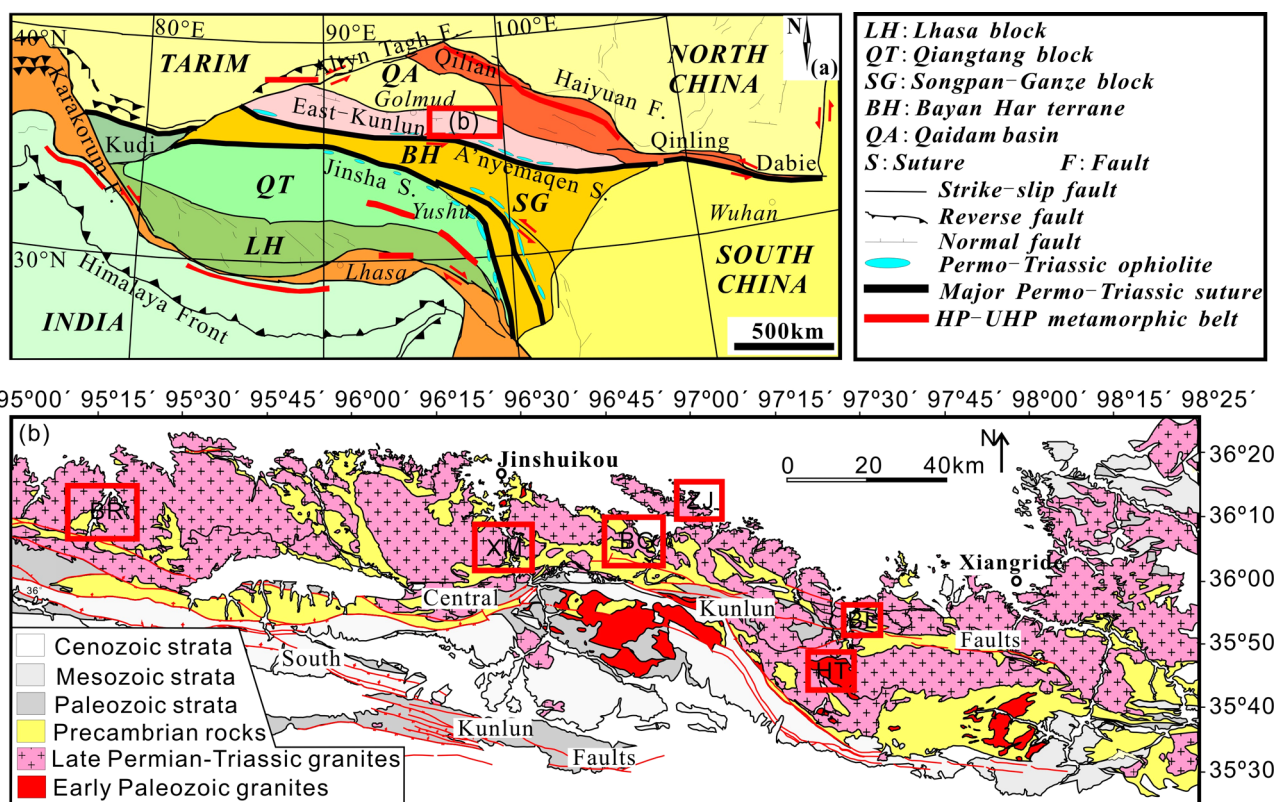


Fig.1 a) Tectonic outline of the Tibetan Plateau showing the studied area; b) Simplified geological maps of the East Kunlun showing the distribution of mafic dike swarms (Note: BR=Bariqili, XM=XiaoMiao, BG=BingGou, ZJ=ZongJia, HT=HaTu, BL=BaLong).

* Corresponding author. E-mail: xiongfuhao@yeah.net

As one important basaltic magma, mafic dike swarms, playing an important role in understanding many geological problems, are key elements to understanding geodynamic processes in mantle. In northern Tibet plateau, there are multi-stage mafic dike swarms distributed in the East Kunlun orogenic belt (EKOB). To contribute to a better understanding of the mantle characteristics and mantle evolution process, we study these mafic dike swarms and present the mineralogy, isotopic and geochemical data for these mafic dikes.

Whole-rock geochemistry indicate that most dikes are basalt to basaltic andesite, except the upper Triassic Zongjia dikes are basaltic trachyandesite. All the rocks are calc-alkaline series, with Mg# ranging from 30 to 61.

Amphibole Ar-Ar age dating indicates a 278 ± 3 Ma for Xiaomiao, and zircon LA-ICP-MS U-Pb age dating indicates 258 ± 2 Ma for the Hatu, 252 ± 3 Ma for the Balong, 251 ± 2 Ma for Bairiqili, 226 ± 2 Ma for Binggou, 218 ± 4 Ma for Zongjia. These dikes could be divided into four stages, i.e., lower Permian, upper Permian, lower Triassic and upper Triassic.

Previous studies have show that the EKOB is formed by the closure of Paleo-Tethys ocean during late Paleozoic-early Mesozoic (Konstantinovskaia et al., 2003; Yang et al., 1996). Yang et al. (2009) and Jiang et al. (1992) have distinguished Mid-Ocean Ridge Basalt (308 Ma) and island arc volcanic rocks (260 Ma), respectively, which may constrain the time of ocean opening and subduction.

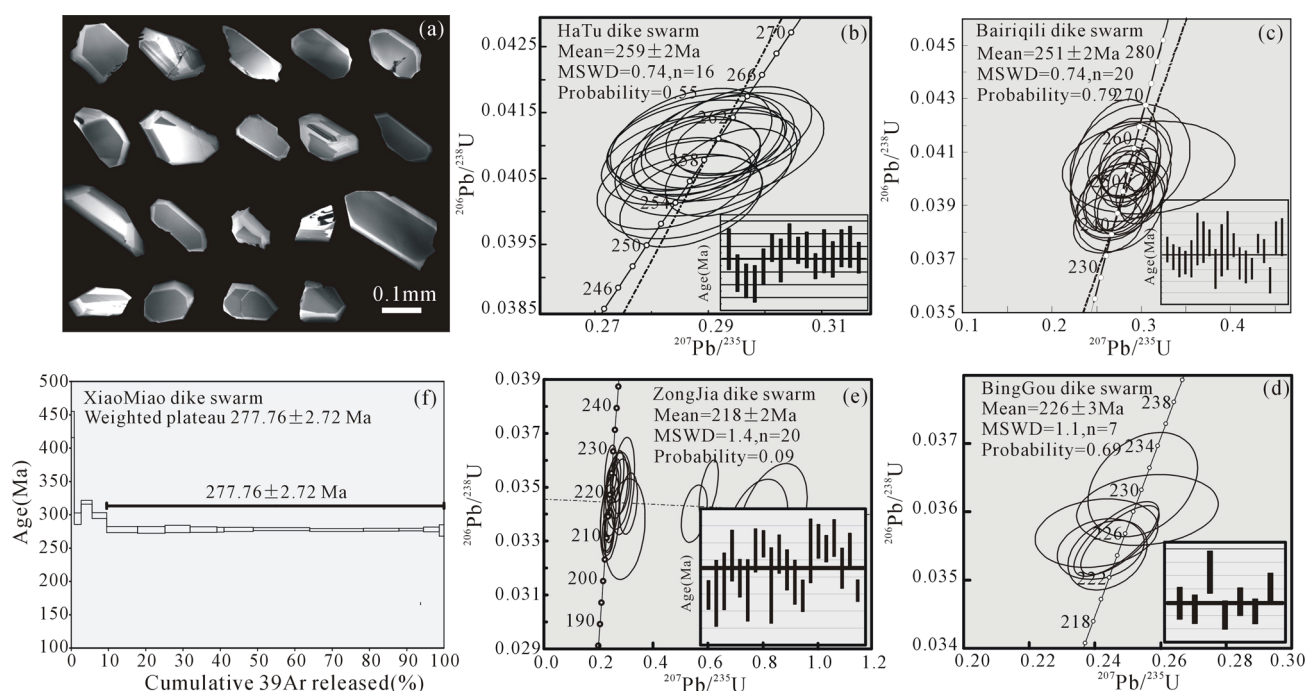


Fig.2 a) Representative CL images of zircons for mafic dike swarms showing magmatic origin; b, c, d and e) Zircon U-Pb concordia diagrams and inserted weighted average age diagrams for HT, BR, BG and ZJ, respectively; f) Hornblende Ar-Ar age diagram for XM.

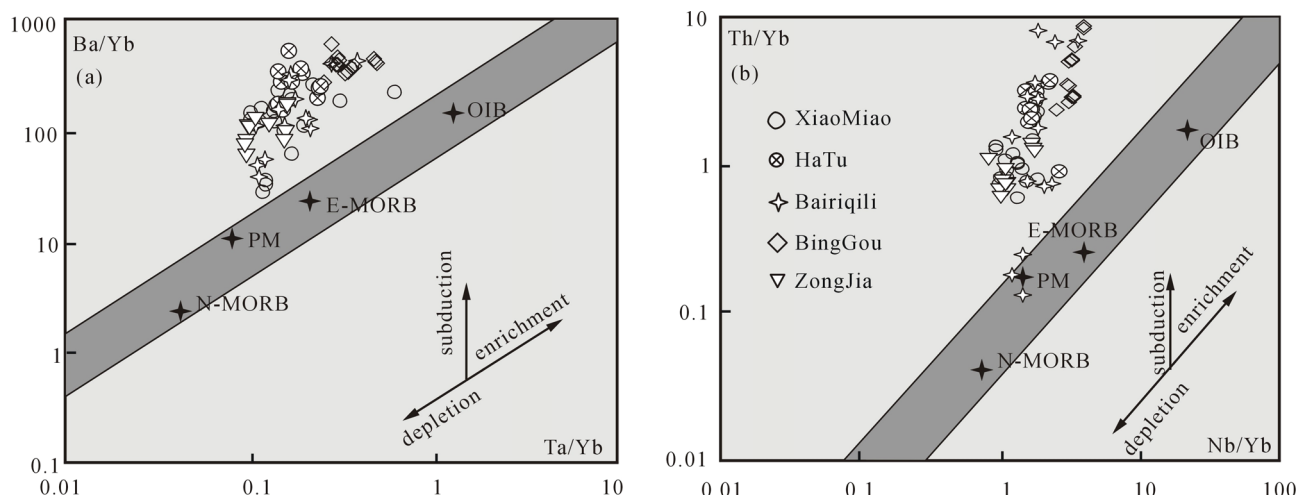


Fig.3 Ba/Yb vs. Ta/Yb and Th/Yb vs. Nb/Yb discriminative diagrams

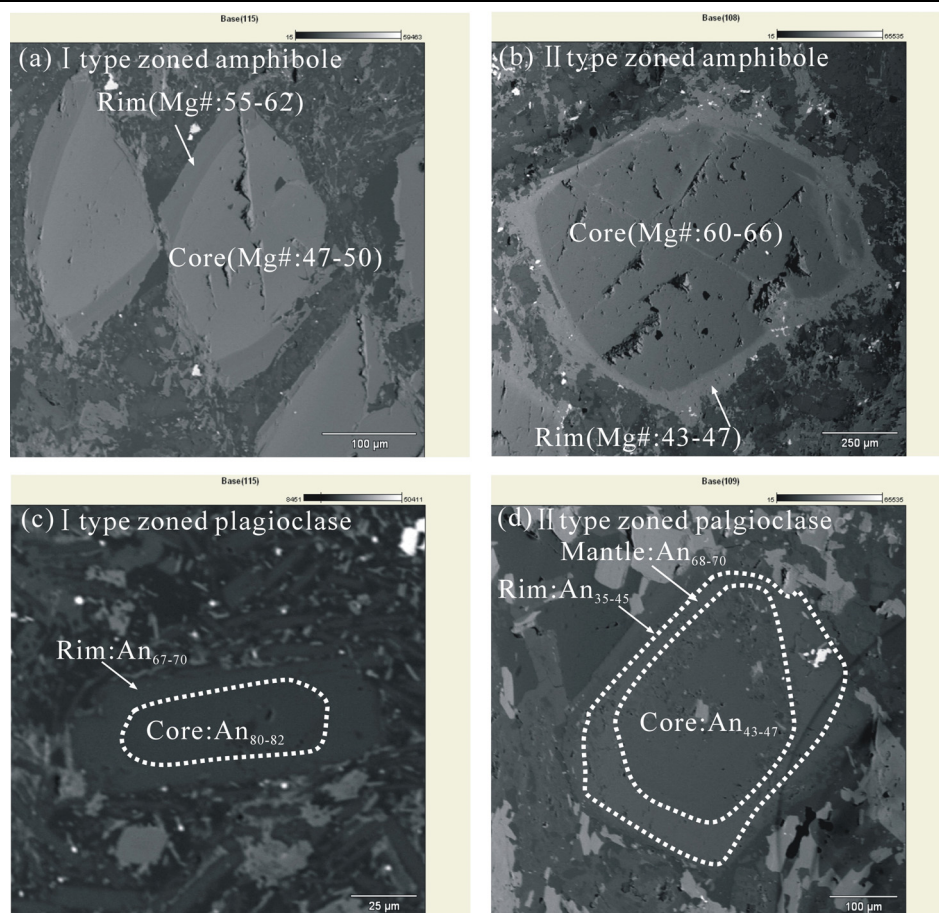


Fig.4 Mutl-style mineral zoning in mafic dyke swarms, a and b are zoned amphiboles, c and d are zoned plagioclases.

Recently, Xiong et al. (2013) have identified the syn-collisional granite (240-231 Ma) and post-collisional granite (226-208 Ma) in EKOB, which could constrain the time of continents collision and accompanied extension in the deep lithosphere. Therefore, combined with the geochronology of this study, we could conclude that these mafic dikes formed throughout from subduction to post-collisional settings.

The studied mafic dikes exhibit LREE enrichment ((La/Yb)_n=3.4-11.4) with weakly negative Eu anomalies (Eu/Eu*=0.7-1.2). Their primitive mantle-normalized trace element patterns are characterized by enrichment of large-ion lithophile elements (Rb, Ba, Th and U), depletion of high-field-strength elements (Nb, Ta, Zr and Hf) and positive Pb and negative Ti anomalies. They have relatively high initial ⁸⁷Sr/⁸⁶Sr ratios ranging from 0.7071 to 0.7120 and variably εNd(t) values from 2.9 to -7.4. The rocks have similar zircon εHf values (0.91 to -2.79), which are distinguished from the crust-derived granitoids (Xiong et al., 2012). These features are indicative of an EM2 source region, suggesting a lithospheric mantle source modified by subducted components.

Plagioclase and amphibole crystals are characterized by

reverse zoning, with compositional changing from core to rim. The rim of Plagioclase with An₆₇₋₇₀ suggest there would be two different mantle magma interaction besides crust-mantle mixing. Besides, the chemical composition of some plagioclase and amphibole crystals also show “Normal” zoning, which imply the presence of crust-mantle mixing. Mineralogy, petrology and isotope geochemical studies show that mantle metasomatism and crust-mantle mixing were the essential keys to the genesis of dikes.

All the data suggest that the lithospheric mantle are being metasomatic at different depths in different stages, with variable amounts and compositions of slab input. These lower Permian to lower Triassic mafic dike swarms could be explained by the slab fluids metasomatism, while the occurrence of the post-collisional mafic dike swarms could be explained by the slab melts metasomatism. Furthermore, the infiltration of enriched asthenosphere into the lithospheric mantle would be another key to the mantle metasomatism.

Key words: mafic dike swarms, mantle metasomatism, tectonic evolution, orogenic belt, Tibet plateau