ZENG Lingsen, WANG Yuhua, GAO Li'E, WANG Yaying, 2016. Elusive Cenozoic Metamorphism in Mafic Dike Swarms within the Tethyan Himalaya, Southern Tibet. *Acta Geologica Sinica* (English Edition), 90(supp. 1): 86-87.

Elusive Cenozoic Metamorphism in Mafic Dike Swarms within the Tethyan Himalaya, Southern Tibet

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Mafic dike swarms are well-developed within the Tethyan Himalaya, southern Tibet, in response to the breakup of Gondwana supercontinent, seafloor spreading of the Tethyan Ocean, and forearc hyperextension during the northward subduction of the Neo-Tethyan oceanic lithosphere (Zhu et al., 2008 & 2009; Zeng et al., 2012; Liu et al., 2015; Ji et al., 2016). These mafic rocks range in age from ~270 Ma down to ~45 Ma and emplaced in various structural levels. Country rocks, especially those at lower structural levels, had experienced greenschist to granulite facies metamorphism during the Himalayan orogeny. Conceivably, mafic dike or pluton within such country rocks should develope mineral assemblages consistent with the tectonic history of the Himalayan orogen. Documenting the nature of metamorphism in these mafic rocks would provide new physical as well as chemical constraints on how the continental materials at different structural levels respond to the continental collision processes.

Several relatively large diabase dikes (T0841 and T0840 series) occur to the west of Lhagoi Kangri Gneiss Dome. They overall occur as large lentoids within the phyllite at the upper structural level of the Himalayan slab. Within the diabases as well as in the low-grade metamorphic wall-rocks, there are abundant veins of carbonate composition that are either along or gently cross-cut the foliation. Within the phyllite, along the sheared plane, large and euhedral pyrite with beautiful strain shadow developed possibly during the shear deformation. Samples from these series show metamorphism features including (1) greenschist facies assemblage of chlorite + sericite + plagioclase; (2) reaction of ilmenite with fluids rich in CaO and CO_2 components to form titanite; and (3) formation of euhedral pyrite grains along the micro-carbonate veinlets. Zircon U/Pb analyses show that the diabase formed at 97.8±1.1 Ma (MSWD=1.4), whereas greenschist facies metamorphism and infiltration of carbonate fluids occurred at 49.3±0.9 Ma and 29.1±0.8 Ma, respectively, similar to many high-grade rocks along the Himalayan orogenic belt.

The exhumed granitic and garnet-bearing sedimentary gneisses within the Kangma Gneiss Dome represent the rock package from lower structural levels of the Himalayan slab. Within these relatively high grade gneisses, a number of discontinuous lentoid-shaped mafic rocks occur subparallel to the major foliations of the country rocks, indicating that these mafic dikes of diabase compositions had experienced intensive shearing. Interestingly, these dikes consist of two types of metamorphic assemblages, the matrix dominated by hornblende + plagioclase with isolated subordinated patches of garnet + epidote + plagioclase, which suggests that these mafic dikes experienced a prograded amphibolite to garnet amphibolite facies metamorphism. SHRIMP zircon U-Pb analyses yield that the mafic dikes formed at 176.4±3.6 Ma (N=7, MSWD=1.4) and garnet amphibolite facies metamorphism at 47.2±1.8 Ma (N=6, MSWD=1.8) with interventing ages of metamorphism from ~75 to 50 Ma.

Tethyan Himalaya experienced a major episode of mafic magmatism as well as meting of the lower crustal rocks during Mid-Eocene, possibly due to slab-breakoff of the subducted frontal dense oceanic lithophere during the incipient stage of the Indian-Eurasian collision (Zeng et al., 2011; Hou et al., 2012; Liu et al., 2014; Ji et al., 2016). Date presented above indicate that mafic rocks within the Tethyan Himalaya, regardless their emplacement levels, also experienced a major episode of metamorphism at ~48 Ma, possibly due to crustal thickening and heating during the early stage of the Indian-Eurasian collision. Therefore, mafic dikes within the Tethyan Himalaya in particular, and those in the other orogenic belts in general could provide valuable records to unravel the important processes associated with the tectonic evolution of orogenic belts.

Acknowledgement

This study was supported by National Science Foundation of China (Grant No. 41425010, 41503023 &

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41273034) and China Geological Survey (Grant No. 12120114022701 & 12120115027101).

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