Geophysical Research Abstracts
Vol. 18, EGU2016-3884, 2016
EGU General Assembly 2016

Sandstone provenance and tectonic evolution of the Xiukang Mélange from Neotethyan subduction to India–Asia collision (Yarlung-Zangbo suture, south Tibet)

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The Xiukang Mélange of the Yarlung-Zangbo suture zone in south Tibet documents low efficiency of accretion along the southern active margin of Asia during Cretaceous Neotethyan subduction, followed by final development during the early Paleogene stages of the India–Asia collision. Here we investigate four transverses in the Xigaze area (Jiding, Cuola Pass, Riwuqi and Saga), inquiry the composition in each transverse, and present integrated petrologic, U–Pb detrital-zircon geochronology and Hf isotope data on sandstone blocks.

In fault contact with the Yarlung-Zangbo Ophiolite to the north and the Tethyan Himalaya to the south, the Xiukang mélange can be divided into three types: serpentinite-matrix mélange composed by broken Yarlung-Zangbo Ophiolite, thrust-sheets consisting mainly chert, quartzose or limestone sheets(>100m) with little intervening marix, and mudstone-matrix mélange displaying typical blocks-in-matrix texture. While serpentinite-matrix mélange is exposed adjacent to the ophiolite, distributions of thrust-sheets and blocks in mudstone-matrix mélange show along-strike diversities. For example, Jiding transverse is dominant by chert sheets and basalt blocks with scarcely sandstone blocks, while Cuola Pass and Saga transverses expose large amounts of limestone/quartzarenite sheets in the north and volcaniclastic blocks in the south. However, turbidite sheets and volcaniclastic blocks are outcropped in the north Riwuqi transverse with quartzarenite blocks preserved in the south.

Three groups of sandstone blocks/sheets with different provenance and depositional setting are distinguished by their petrographic, geochronological and isotopic fingerprints. Sheets of turbiditic quartzarenite originally sourced from the Indian continent were deposited in pre-Cretaceous time on the northernmost edge of the Indian passive margin and eventually involved into the mélange at the early stage of the India–Asia collision. Two distinct groups of volcaniclastic-sandstone blocks were derived from the central Lhasa block and Gangdese magmatic arc. One group was deposited in the trench and/or on the trench slope of the Asian margin during the early Late Cretaceous, and the other group in a syn-collisional basin just after the onset of the India–Asia collision in the Early Eocene. The largely erosional character of the Asian active margin in the Late Cretaceous is indicated by the scarcity of off-scraped trench-fill deposits and the relatively small subduction complex developed during limited episodes of accretion. The Xiukang Mélange was finally structured in the Late Paleocene/Eocene, when sandstone of both Indian and Asian origin were progressively incorporated tectonically in the suture zone of the nascent Himalayan Orogen.