Formation Age and Tectonic Setting of the Muli Arc-Ophiolite Complex in the South Qilian Belt, NW China

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Abstract: The Qilian orogenic belt is the northernmost orogen of the Tethyan domain and connects the Altaiids to the north. It contains an assembly of Precambrian micro-continental fragments, early Paleozoic island arcs, accretionary complexes, ophiolites, forearc and backarc basins, and high-pressure (HP) metamorphic rocks, indicating a long history of accretionary processes. Spatially, this orogen is adjacent to the Tarim, Qaidam, and North China blocks, which also extends into accretionary orogenic belts to the east and SW such as the Qinling and Kunlun belts. Abundant ophiolites in this orogen record the closure of an early Tethyan Ocean and amalgamations between micro-continents of North China, Qaidam, and Tarim. Thus, the ages and tectonic settings of these ophiolites within this belt provide important information regarding evolution of the Proto-Tethyan Ocean and assembly of micro-continental blocks, which aids understanding of the spatial and temporal relationship of this orogen within the Tethyan realm.

Dismembered ophiolites sporadically crop out along the northern margin of the South Qilian belt, and, from east to west, are locally referred to as the Lajishan, Gangcha, Muli, and Dadaoerji ophiolites. Much attention had been paid to these ophiolites, and several models for the tectonic evolution of this belt have been suggested. Considerable disagreement remains in respect of the temporal and spatial framework of the Qilian Orogen and details such as timing of subduction (s) and associated polarities, early collision events, and final closure of oceanic basins. In particular, the formation age and tectonic setting of Muli arc-ophiolite complex remains unknown, which limits understanding of the tectonics of the South Qilian belt and the history of the Proto-Tethys Ocean.

The Muli arc-ophiolite complex is distributed over 20 km² west of the township of Muli in the western segment of the South Qilian Belt and consists of serpentinite, dunite, cumulate gabbro, basalt, plagiogranite, and chert. Field mapping results demonstrate that these units have been largely destroyed by faulting and generally occur as blocks/slices. They are tectonically interlayered with Upper Ordovician – Lower Silurian siliciclastic turbidite. Arc-ophiolite rocks are intruded by 470–450 Ma subduction-related granitoid plutons and are unconformably overlain by shallow marine to non-marine sediments of Permian-Jurassic age. Basalts show typical subduction-related calc-alkaline geochemical affinity, representing portions of an island arc. Geochemical results for plagiogranites and spinels from serpentinite demonstrate that the Muli arc-ophiolite complex represents a super-subduction zone (SSZ)-type ophiolite.

U-Pb zircon data indicate formation associated with southward subduction of the Proto-Tethyan Ocean during a short interval between 539–522 Ma. Voluminous Late Ordovician - Early Silurian deep-water marine siliciclastic and volcaniclastic turbidites and volcanic arc rocks are exposed to the south of the Muli arc-ophiolite complex, whereas fluvial coarse-grained sandstones and conglomerates unconformably overlie the Cambrian-Middle Ordovician ophiolite-arc systems in the eastern South Qilian Belt. These indicate that closure of the Proto-Tethyan Ocean was diachronous during the early Paleozoic.

Key words: Muli arc-ophiolite complex, SSZ-type ophiolite, Proto-Tethys Ocean, Qilian Orogen

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