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Evolution of the Lower Cretaceous Coqen basin in northern Lhasa, central Tibet Plateau: stratigraphy, sedimentology, and detrital zircon geochronology

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Early Cretaceous is a critical time for understanding the evolution of the Lhasa block, the main part of the Tibet Plateau, as the Lhasa terrane collided with the Qiangtang terrane in its north, while the Neo-tethyan oceanic lithosphere started a new subduction in its south forming a new arc-trench-basin. The Coqen basin is the ideal place to document the Early Cretaceous evolution of the Lhasa terrane. This study present stratigraphy, sedimentology, and detrital zircon geochronology in the Coqen basin with the objective to analyze the tectonic evolution in space and time for the Tibetan Plateau prior to the India-Asia collision.

The Lower Cretaceous in the Coqen basin include Zelong Group, Duoni Formation and Langshan Formation. The Zelong Group consists of intermediate to felsic lavas with minor mafic and volcaniclastic rocks erupted during 143-102 Ma. The Duoni Formation compries conglomerate, sandstone, siltstone and mudstone in the south, deposited in fluvial-deltal environments, whereas the quartzose and lithic sandstone, siltstone and mudstone in the north, deposited in a coastal environment. The interbeded volcanic rocks from the lower part of the Duoni Formation yield zircon U-Pb ages at ∼122.5 Ma. The overlying Langshan Formation is characterized by abundant foraminiferal Orbitolinas and rudist-bearing wackestones and packstones, deposited in a low-energy carbonate lagoon environment. The Langshan Formation deposited between ∼119-115 Ma and ∼98 Ma according to the study on Orbitolinas, which is consistant with the volcanic rocks found in the middle part of the Langshan Formation with the ages of 112.5 and 110.3 Ma, respectively.

Sandstone detrital modal compositions of the Duoni Formation plotted into the fields of “magmatic arc” and “recycled orogen”. The detrital zircons yield the age populations between 110 and 150 Ma, with the peak at ∼130 Ma. Additional ages range in 500–600 Ma, 900–1000 Ma, 1050–1250, 1700–2000 Ma and ∼2500 Ma. Compared to the potential sources, the Zelong volcanic rocks and the pre-Carboniferous strata within the northern part of the Lhasa terrane are the most possible sources for the Duoni Formation.

The evolution of the Early Cretaceous Coqen basin can be indivied into two stags. During Aptian time (∼123-115 Ma), the Duoni Formation received materials southward from the Zelong volcanic rocks and the sedimentary basement rocks in the central Lhasa terrane. The basin developed in a retro-arc setting related to the northward subduction of Neo-tethyan oceanic lithosphere, resulting in the occurrence of the Zelong volcanics arc meanwhile. Our data are inconsistent with the foreland basin related to the Lhasa-Qiangtang collision in the north as previous interpreted. During latest Aptian-earliest Cenomanian (∼115-98 Ma), the Coqen basin was prevailed by the shallow marine Langshan limestone, developed in a sag basin that developed in the retro side of the Neo-tethyan oceanic lithosphere subduction. The mechinism of this sag basin was the dynamic subsidence resulted from the low-angle or flatted subduction of the Neo-tethyan oceanic lithosphere during this time interval.