The Crucial Role of Tectono-sedimentary Records of China in Understanding Paleogeographic Evolution

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Citation: Chen et al., 2019. The Crucial Role of Tectono-sedimentary Records of China in Understanding Paleogeographic Evolution. *Acta Geologica Sinica* (English Edition), 93(supp. 1): 5-7

The Central-east Asian continent, in which China is presently located, is a composite terrane composed of many small or micro -scale blocks and orogenic belts (Ren et al., 1999). Compared with large-scale cratons such as North America and Siberia, the blocks that make up China are much smaller. For example, the North China and Siberian blocks, as well as some part of the ancient African continent, belonged to part of the Colombia supercontinent and connected with Baltica (Rogers and Santosh, 2002; Lu et al., 2002). After major rifting episodes at 1.8-1.6 Ga, the North China Block began to evolve independently. In contrast, the Tarim and Yangtze blocks were part of the Rodinia supercontinent that had formed during the Grenville orogeny (equivalent to the Sibao movement in South China); and then separated during the breakup of Rodinia (Li et al., 2008). When Pangaea formed, the Tarim, Yangtze and North China blocks were not incorporated in that supercontinent, but were isolated within the Prototethys Ocean. In our view, prior to the Triassic, the scattered small-scale plates of the North China, South China and Tarim blocks drifted within the Panthalassa Ocean, which gave them unique tectonic backgrounds. During the Mesozoic, when the pangaean supercontinent progressively disassembled due to the initiation of a number of rift basins around the world, China's major blocks were joining together into a new unified and stable composite continent of Asia, which has not since experienced strong extension. Therefore, the plate tectonic evolution of the China blocks can be divided roughly into two stages: a pre-Triassic drifting stage of scattered small-scale plates and a Mesozoic-Cenozoic intra-continental (united-terrane) tectonic development stage.

A very important debate in this context is the affinity of these small-scale blocks to other larger cratons. For example, there are several models for the tectonic position of the South China Block within Rodinia to Gondwana, including whether it was located adjacent or linked to the western margin of Australia continent, or adjacent to the northern margin of the Indian continent or drifted in isolation within the Proto-Tethys ocean, and whether any of its margins were influenced by plate subduction or mantle plumes (Li et al., 2008; Zhou et al., 2006; Wang et al., 2013; Cawood et al., 2013; Li et al., 2014; Yao et al., 2014; Xu et al., 2016; Wang et al., 2018; Zhao et al., 2018). Consequently, study of the affinity of China's small-scale blocks is crucial to unraveling tectono-sedimentary belts of the global plate framework, and is an important window for the reconstruction of global paleogeography. One tool is zircon U-Pb geochronology that constrains the provenance of clastics preserved on these blocks. For example, the detrital zircon age spectrum of Sinian-Cambrian sandstone in western Cathaysian revealed a common source-sink system across the South China Block, the Qiangtang micro-plate and the west-middle portion of the northern India Block, which suggests that these terranes had an affinity with each other (Fig. 1). After Cambrian, South China Block may have shifted to be adjacent to NW Australia responding East and West Gondwana assembled to be a supercontinent eventually, and then separated from Gondwana to become an isolated block.

In addition, the sedimentary basins on these small-scale blocks are likely to record events during the tectonic convergence and divergence process of supercontinent cycle. During intervals of active tectonic movement, basements are influenced by rifting which can result in craton destruction. However, it is difficult to recognize these buried rifts because of their immense burial depths, the later reactivation of the litho-sequences, the poor quality of the seismic data and the lack of deep-drilling boreholes. The obscured evolution of these major basins is one of the most difficult challenges in paleogeographic reconstructions. For example, an Early Cambrian Mianyang-Changning Taphogenic Trough in the upper Yangtze craton was discovered only recently when sufficient data was obtained during deep gas explorations within the Sichuan Basin (Hou et al., in press; Zou et al., 2014). The lower Cambrian Qiongsi black shale that formed during the rifting sequence is usually a deep-water organic-rich deposit with source rock that later entered the maturation kitchen. The upper Longwangmiao dolomite in the post-rifting sequence is shallow-marine sediment of an epeiric sea that was then sealed by evaporates or other tight rocks, therefore is very favorable for reservoir development. The giant Anyue gas field (proven reserves of 4400×10^8 m^3, Du et al., 2014) was a result of this same basin evolution, while another example is the Permian Puguang gas field in northeastern Sichuan Basin. Therefore, due to the sensitive tectonic-sedimentary response, the small-scale blocks recorded abundant documents on its geological affinity to big plate, paleoclimate, paleoenvironment etc., which is crucial to understanding global paleogeographic evolution and to revealing the complex process of its overlying basin and the potential hydrocarbon reservoir.

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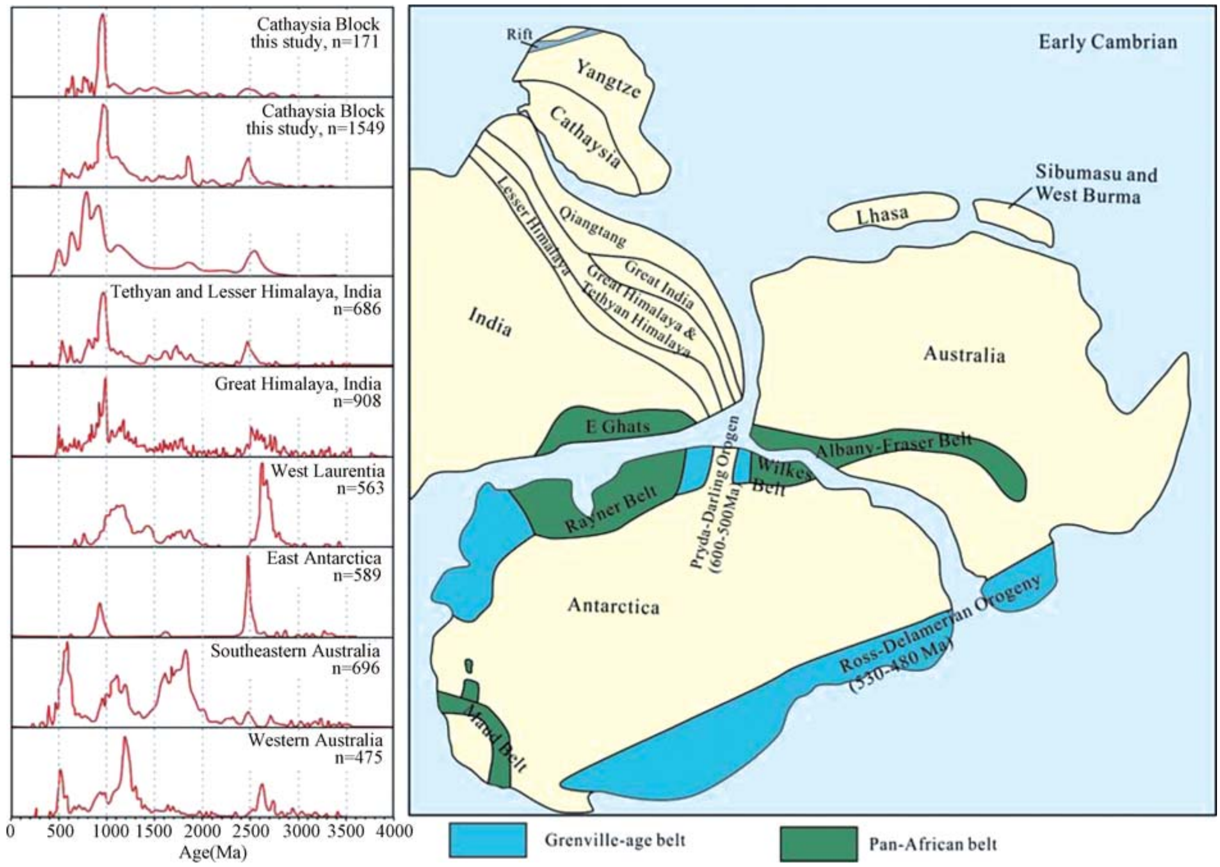

Fig. 1. Affinity between the South China block and Gondwana.

(a) The zircon U-Pb age spectrum correlated among the potential blocks related Gondwana (Xiong et al., in press); (b) South China plate located to the north margin of India plate.

Key words: paleogeography, sediment, Cambrian, Neoproterozoic, China

Acknowledgments: This work was sponsored by the National Natural Science Foundation of China (Grant No. 4187020378).

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