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Research paper

Geological characteristics and tectonic significance of unconformities in Mesoproterozoic successions in the northern margin of the North China Block

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ABSTRACT

Several stratigraphic breaks and unconformities exist in the Mesoproterozoic successions in the northern margin of the North China Block. Geologic characters and spatial distributions of five of these unconformities, which have resulted from different geological processes, have been studied. The unconformity beneath the Dahongyu Formation is interpreted as a breakup unconformity, representing the time of transition from continental rift to passive continental margin. The unconformities beneath the Gaoyuzhuang and the Yangzhuang formations are considered to be the consequence of regional eustatic fluctuations, leading to the exposure of highlands in passive margins during low sea-level stands and transgressive deposition on coastal regions during high sea-level stands. The unconformity atop the Tieling Formation might be caused by uplift due to contractional deformation in a back-arc setting, whereas the uplift after the deposition of the Xiamaling Formation might be attributed to a continental collision event. It is assumed that the occurrences of these unconformities in the Mesoproterozoic successions in the northern margin of the North China Block had a close bearing on the assemblage and breakup of the Columbia and Rodinia supercontinents.

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1. Introduction

The North China Block became a part of the Columbia Supercontinent (Rogers and Santosh, 2002, 2003; Zhao et al., 2003; Li et al., 2010, 2012; Santosh, 2011; Zhai and Santosh, 2011) after the Luliang orogeny. Since the late Paleoproterozoic, many rift basins have developed in both the southern and northern margins of the North China Block (Lu et al., 2002; Peng et al., 2008) in an extensional tectonic setting and it is in such a setting that the Mesoproterozoic Changcheng and Jixian systems developed in the northern margin of the North China Block (Chen, 1983; Wang and Qiao, 1987; He et al.,

1994; Wen, 1997). The Yanliao Rift Trough (Hong, 1997; Liu et al., 1997; Wen, 1997; Zhang and Zhu, 2000; Huang et al., 2001; Meng and Ge, 2002, 2004; Qiao, 2002; Qiao and Gao, 2007) developed in the Yanshan–Liaoxi areas. The Changcheng and Jixian systems are a set of thick clastic and carbonate rocks with a thickness up to 9000 m (Chen et al., 1980; He et al., 2000a, 2000b). Fig. 1 shows the distribution of the remnants of the Meso-Neoproterozoic strata in the northern margin of the North China Block. The remnants of Meso-Neoproterozoic strata of Jixian in the Hebei are very thick, but it thins and pinches at Huanghua, Qinhuangdao in the east, Datong, Yangquan in the west, and Shijiazhuang in the south. In addition, there are lots of remnants of Meso-Neoproterozoic strata in the Inner Mongolia (Fig. 1), which were thought to represent the deposition in another Mesoproterozoic rift, the Baiyunebo-Zhaertai Rift Belt (Hong, 1997; Meng and Ge, 2002, 2004).

The Changcheng System, a set of shallow marine clastic and carbonate assemblages, consists of the Changzhougou, the Chuanlinggou, the Tuanshanzi and the Dahongyu formations in ascending order (Fig. 2), and is widely distributed and is more than 2600 m thick (Chen et al., 1980). The Jixian System, with a thickness

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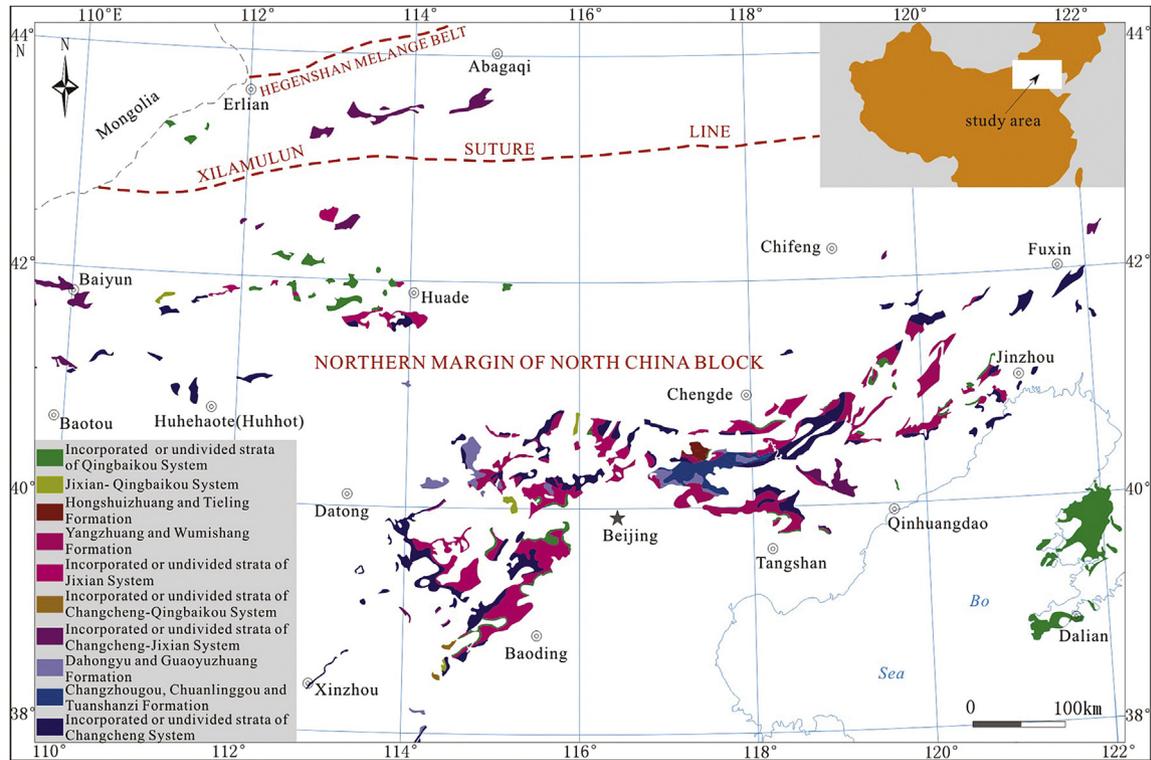


Figure 1. Distribution of remnants of Meso-Neoproterozoic strata in the northern North China Block.

of about 6000 m (Chen et al., 1980), consists of the Gaoyuzhuang, the Yangzhuang, the Wumishan, the Hongshuizhuang and the Tieling formations from bottom to top (Fig. 2), dominated by carbonates in the lower section and shale, argillaceous dolomite and sandstone assemblage in the upper. The Qingbaikou System

consists of the Longshan and the Jingeryu formations from bottom to top, mainly composed of sandstone, shale and minor carbonate, less than 400 m thick (Chen et al., 1980). It is noteworthy that the Xiamaling Formation belongs to the Mesoproterozoic according to the age of the interlayered volcanics. The SHRIMP U-Pb ages of

STRATA		ISOTOPIC AGE / Ma		CAUSES OF UNCONFORMITIES	TECTONIC SETTING		
Erathem/System	Formation						
NEO-PROTEROZOIC	QINGBAIKOU	Jingeryu	800	810–900 ^① 853 ^② 862 ^③	Breakup of Rodinia supercontinent	Continental extensional lift	
		Longshan		855 ^④ 873 ^⑤			
MESOPROTEROZOIC	JIXIAN	Xiamaling	1000	1370 ^⑥ 1380 ^⑦ >1320 ^⑧	Continental collision Compression and uplift	Continental collision	
		Tieling	1400	1440 ^⑨	Active continental margin Compression and uplift	Active continental margin	
		Hongshuizhuang			Eustatic fluctuations	Passive continental margin	
		Wumishan					
		Yangzhuang					
		Gaoyuzhuang	1600	1380 ^⑩ 1434 ^⑪ 1560 ^⑫			
		CHANGCHENG	Dahongyu		1625 ^⑬ 1626 ^⑭	Eustatic fluctuations	Luanxian Uplift
			Tuanshanzi		1683 ^⑮ 1823 ^⑯	Formation and expansion of oceanic crust	Qinglong Uplift
			Chuanlinggou				Xingcheng Uplift
		QIANXI GROUP OF ARCHEAN	Changzhougou	1800	1805 ^⑰	Breakup of Columbia supercontinent	Continental lift

Figure 2. Diagram showing Meso-Neoproterozoic sequences, positions of unconformities, and interpretations of tectonic settings in the northern margin of the North China Block. ^① Li et al., 1996; ^{②③④} Wang et al., 1980; ^⑤ Meng and Ge, 2004; ^⑥ Gao et al., 2007, 2008a, 2008b; ^⑦ Su et al., 2008; ^⑧ Li et al., 2009; ^⑨ Wang et al., 1995; ^⑩ Zhong, 1977; ^⑪ Li et al., 2010; ^⑫ Lu and Li, 1991; ^⑬ Gao et al., 2008a, 2008b; ^⑭ Li et al., 1995; ^⑮ Wan et al., 2003.

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