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Phanerozoic tectonics of the South China Block: Key observations and controversies

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ABSTRACT

The Phanerozoic tectonic regimes of the South China Block (SCB) hold a key to understanding of its geodynamic evolution with respect to formation of numerous mineral resources. Despite long-time debates in the past three decades, there is still no consensus on the two key points whether the Phanerozoic tectonothermal events were due to subduction of the Pacific plate or intracontinental reworking and whether the three periods of tectonothermal events in the middle Paleozoic (Kwangsian), Triassic (Indosinian) and Jurassic–Cretaceous (Yanshanian) are mainly driven by tectonic transition in subduction of the oceanic crust from Paleotethyan in the west to Pacific in the east. This paper presents an overview of key geological observations in the SCB with respect to its Phanerozoic tectonics. Available data show that there are distinctive sedimentary, magmatic, structural and metamorphic records across the Xuefeng-Jiangnan Domain in the SCB. The geological signatures associated with the Kwangsian and Indosinian tectonothermal events are predominantly preserved in the eastern SCB, including the eastern Yangtze and Cathaysia Blocks to the east of the Xuefeng-Jiangnan Domain. They are characterized by strong thrusting/transpression, anatexic granitic magmatism, high-grade metamorphism and the poor involvement of the juvenile mantle-derived rocks. The two events were dated at ca. 400–460 Ma and ca. 200–250 Ma, respectively. The Yanshanian tectonothermal event is dominantly represented by the development of a wide magmatic belt of exceeding 1300 km (from the coastal province to the Xuefeng-Jiangnan Domain) and a broad deformational belt of more than 2000 km (from the coastal province to the Sichuan basin). The Yanshanian I-, S- and A-type granites, syenite and volcanic rocks display two arrays, which are oblique and parallel to the coastal provinces of the southeast China, respectively. They were mainly formed at the three age-spans of 152–180 Ma, 120–130 and 87–107 Ma with the peak of 158 Ma, 125 Ma and 93 Ma, respectively. The stillstand time of the Yanshanian magmatism was temporally overlapped by the deformation time of the top-to-the-NW progressive transpression or sinistral strike-slip at 132–142 Ma and 95–112 Ma, respectively. In conjunction with the observations and controversies, a geodynamic model is proposed for the Mesozoic tectonic evolution of the SCB.

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1. Introduction

The South China Block (SCB) is a major continental block with a complex tectonic history in East Asia. It occupies the bulk of southern China, and is traditionally considered to link with the Qinling-Dabie-Sulu orogen by the Xianghuai-Guangji Fault to the north, the Indochina Block through the Ailaoshan-Song Ma suture zone to the south, and the Songpan-Gantze Block by the Longmenshan Fault to the west, and is bounded by the Pacific plate to the east (Fig. 1). It is generally accepted that the SCB is formed by amalgamation of the Yangtze Block in the northwest with the Cathaysia Block in the southeast during the early Neoproterozoic time (e.g., Guo et al., 1989; Shu and Charvet, 1996; Charvet et al., 1996; Li, 1998; Li et al., 2002; Li et al., 2008, 2009b; Zhao and Cawood, 1999; Zhou et al., 2009; Wang et al., 2006b, 2007b). However, their Phanerozoic tectonic relationship is still unclear with respect to known observations between the two blocks. Some authors considered that the Yangtze and Cathaysia Blocks remained contiguous (e.g., Li et al., 2010e; Charvet et al., 1994, 1996; Chen et al., 2010b; Shu, 2006; Shu et al., 2008a, b, 2009a, b; Wang et al., 2004a, 2004b, 2005a, 2005b, 2005c, 2007a, 2007b, 2007c, 2010a, 2010b), whereas others hypothesized that they rifted apart to form the Paleozoic ocean (e.g., Hsü et al., 1990; Liu, 1991; Liu and Xu, 1994; Xu et al., 1996; Ma et al., 2004; Chen et al., 2006). Available structural, lithological and geochemical data suggest that the present tectonic patterns of the SCB bear the signature of the strong overprinting of middle Paleozoic, Triassic and Jurassic–Cretaceous tectonothermal events during the Phanerozoic period, which are called "Kwangsian", "Indosinian" and "Yanshanian" movements in the Chinese literatures, respectively (e.g. Ren, 1964,

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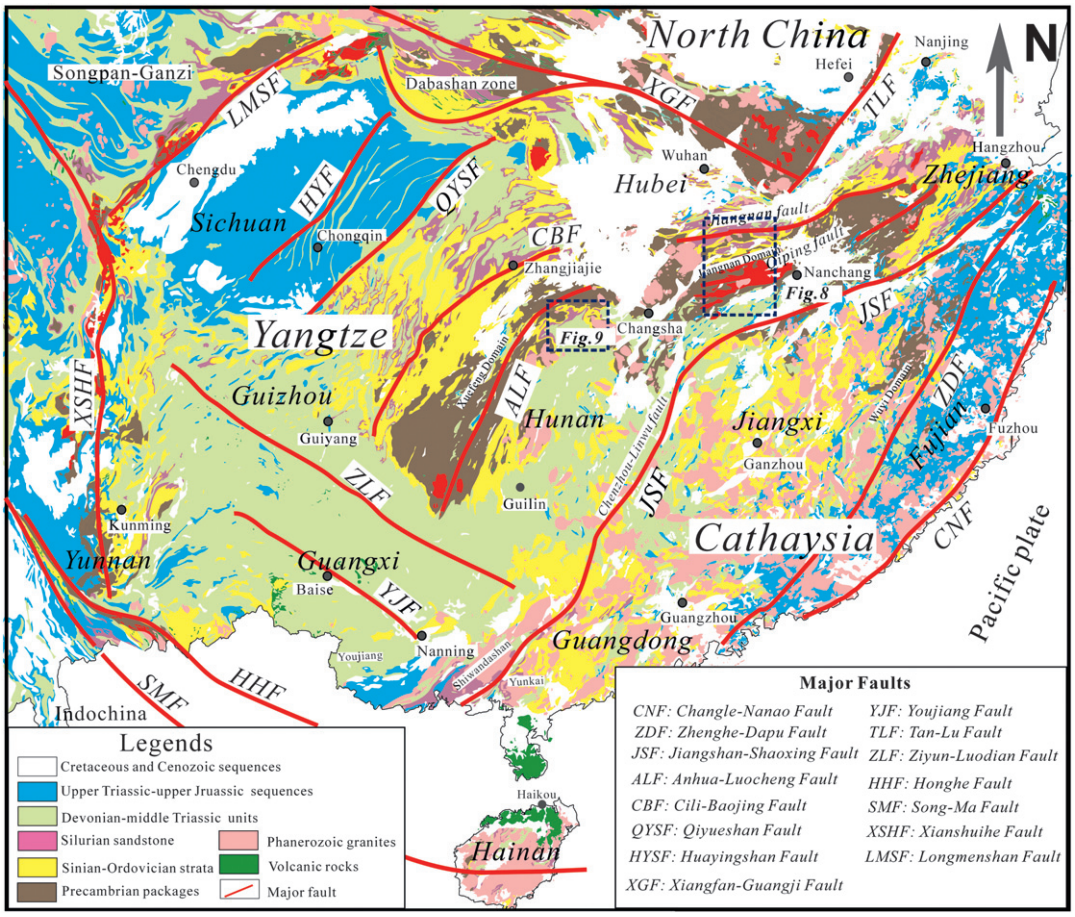

Fig. 1. Geological map of the South China Block showing the major NE- and EW-trending faults.

1991; Hunan BGMR, 1988; Wang et al., 2005b, 2007c, 2007d, 2007e, 2010a, 2010b; Li et al., 2010e).

The middle Paleozoic event was originally named as the Kwangsian movement by Ting (1929) based on the presence of the unconformity between middle Devonian and Silurian strata. It is also regarded as the Caledonian movement in the Chinese literature as a correlation with the Caledonian event in Europe (e.g., Huang, 1945; Ren, 1964, 1991; Huang, 1978; Huang et al., 1980, 1987). The tectonic belt associated with this event was also named as the Wuyi-Yunkai tectonic zone or the Wuyi-Yunkai orogen (Li et al., 2010e; Yang et al., 2010). Chen et al. (2010b) and Wang et al. (2010b, 2011b) recently suggested esteeming the original definition of Ting (1929) and referred this event in the SCB as the "Kwangsian orogeny" to distinguish it from the Caledonia in Europe. The Triassic tectonothermal event was initially defined as the Indosinian movement based on the observation of the angular unconformities in Triassic strata of the Indochina Block in Vietnam (e.g., Deprat, 1914; Fromagat, 1932), and then extensively used to name the Triassic orogeny in the SCB, which is marked by an unconformity overlying the upper Triassic strata. This event was also named as the Anyuan movement in Chinese literatures (e.g., Jiangxi BGMR, 1984; Hunan BGMR, 1988). The Jurassic–Cretaceous tectonothermal event in the SCB was extensively named as the Yanshanian movement in the Chinese literatures, which was originally used for the Yanshan mobile belt in the northern part of the North China Block (NCB) (e.g., Ren, 1964, 1991; Huang et al., 1980; Chen, 1992).

Extensive studies have been carried out on the three tectonic events over the past seventy years, leading to the publication of various observations and hypotheses (e.g., Hsu and Ting, 1942; Huang, 1945; Jahn et al., 1990; Charvet et al., 1994, 1996, 2010; Shu et al., 1994, 2006, 2008a, 2008b; Chen and Jahn, 1998; Zhou and Li, 2000; Wang et al., 2002, 2003b, 2005b, 2005c, 2007c, 2007d, 2007e, 2008, 2010b, 2011b; Li et al., 2006, 2007; Zhou et al., 2006a, 2006b, 2007, 2009; Li and Li, 2007). However, there is a lack of broad review and synthesis of these observations with arguments for or against the hypotheses. In addition, there are still controversies about whether these events were caused by subduction of Paleotethyan or Pacific oceanic crust with possible continental collision or just by intracontinental reworking with indirect link to plate subduction (e.g., Hsü et al., 1990; Hsü et al., 1990; Liu and Xu, 1994; Zhou and Li, 2000; Wang et al., 2003b, 2004b, 2005b, 2005c, 2007c, 2007d, 2007e, 2011b; Ma et al., 2004; Chen et al., 2006; Li et al., 2006; Shu et al., 2006, 2008a, b; Zhou et al., 2005, 2006a, 2006b, 2007; Li and Li, 2007; Li et al., 2010e). In order to advance our understanding of the Phanerozoic tectonic evolution in the SCB, this paper presents an overview of the existing observations and hypotheses. We mainly focus on (1) introduction to general geological observations, and (2) description and discussion of the existing hypotheses and controversies. Along with relevant arguments, a geodynamic model is proposed for the Mesozoic tectonic evolution of the SCB.

2. Main faults

In the SCB, there are abundant NE- and NW/WNW-trending faults (Fig. 2). This is based on our recompilation for the major faults in Hunan, Jiangxi, Jiangxi, southwest Zhejiang, Guangdong, Guangxi and Hainan Provinces of South China (e.g., Jiangxi BGMR, 1984; Fujian BGMR, 1985; Guangxi BGMR, 1985; Guangdong BGMR, 1988; Hunan BGMR, 1988; Zhejiang BGMR, 1989). These NW/WNW faults include

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