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Tectonostratigraphic history of the Ediacaran–Silurian Nanhua foreland basin in South China

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ABSTRACT

This paper presents the tectonostratigraphic evolution of the Ediacaran–Silurian Nanhua Basin in South China and explores the relationship between clastic sedimentation in the basin and evolution of the adjacent Wuyi–Yunkai orogen. Sedimentary facies in the basin comprises, in an ascending order, turbiditic marine, shallow marine, and fluvial-dominated deltaic facies, featuring a lateral migration from southeast to northwest. We interpret the Ediacaran–Silurian Nanhua Basin as a foreland basin with a three-stage evolution history. Stage 1: the Ediacaran–Cambrian stage, recording the start of tectonic subsidence with turbiditic marine siliciclastic deposition, fed by exotic orogens outboard South China; Stage 2: the Ordovician to earliest-Silurian stage, characterized by a migrating depocenter with dominant shallow marine and deltaic siliciclastic deposition, fed by the local and northwestward propagating Wuyi–Yunkai orogen; Stage 3: the Silurian stage, showing the arrival of depocenter in the Yangtze Block during the waning stage of the orogeny with deltaic deposition in the remanent foreland basin. The Wuyi–Yunkai orogen remained the dominant sedimentary source region during Stage 3. Stage 1 was likely related to the collision of the South China Block toward northern India during the assembly of Gondwana, whereas Stages 2 and 3 recorded sedimentation during the northwestward propagation and subsequent orogenic root delamination/collapse of the Wuyi–Yunkai orogen, respectively. The Wuyi–Yunkai orogeny in South China is interpreted to have resulted from the far-field stress of the collision between South China and Indian Gondwana.

1. Introduction

The South China Block (SCB), including the Yangtze Block in the northwest and the Cathaysia Block in the southeast (Fig. 1a inset), is one of the major continental blocks in East Asia and experienced major tectonic events that shaped the region. The early Paleozoic Wuyi–Yunkai orogeny was a regional-scale event responsible for deformation and metamorphism over much of the Cathaysia Block (e.g., Ren, 1964, 1991; Huang et al., 1980; Yang et al., 1986; Charvet et al., 1996, 2010; Wang et al., 2007; Faure et al., 2009; Li et al., 2010b), and the inversion of the Ediacaran–Silurian Nanhua Basin between the two blocks (Fig. 1a). However, the mechanism and timing of the amalgamation between the Cathaysia and Yangtze blocks remain a matter of debate. There are two main opposing opinions regarding the formation of the SCB. One considers that the amalgamation of the Cathaysia and Yangtze blocks occurred in the Phanerozoic (e.g., Hsu et al., 1988, 1990; Shui, 1988; Liu and Xu, 1994), and that a "Huanan Ocean" existed between the two blocks from the late Neoproterozoic to early Paleozoic (Shui, 1988; Liu and Xu, 1994) or even to the middle Mesozoic (Hsu et al., 1988, 1990). Shui (1988) suggested that the Yangtze and Cathaysia blocks first amalgamated at their eastern ends during the early- to mid-Neoproterozoic, with a remnant ocean to the west until the Cambrian. Further amalgamation eventually closed the ocean during the late-Ordovician to Silurian, resulting in the intense regional deformation and metamorphism, an event traditionally attributed to the "Caledonian orogeny" (e.g., Huang et al., 1980; Yang et al., 1986; Ren, 1991). The boundary between the Yangtze and Cathaysia blocks was therefore considered to be a lower Paleozoic suture (Liu and Xu, 1994; Chen et al., 2006), although there is little geological or geophysical evidence for such an ocean closure (e.g., Li, 1998; Yao et al., 2015a). The model of Hsu et al. (1988, 1990), Hsu (1994), on the other hand, requires the ocean to be closed by an Alpine-style collision during the Jurassic. Again, there is a lack of evidence for such a young suture, and the so-called "Mesozoic Banxi mélange" was later shown to consist of Neoproterozoic rocks with different tectonic affinities (e.g., Zhou, 1989; Li et al., 1994, 2003). The alternative opinion considers that the Yangtze–Cathaysia amalgamation occurred in the Precambrian, at either 1100–900 Ma (e.g., Li et al., 2002, 2008, 2009) or 820–750 Ma (e.g., Zhou et al., 2002a, 2002b; Wang et al., 2004). However, mid-Neoproterozoic intracontinental rifting in the SCB has long been recognized (e.g., Wang, 1985; Dong and Liu, 1991; Li, 1991a), and the mid-

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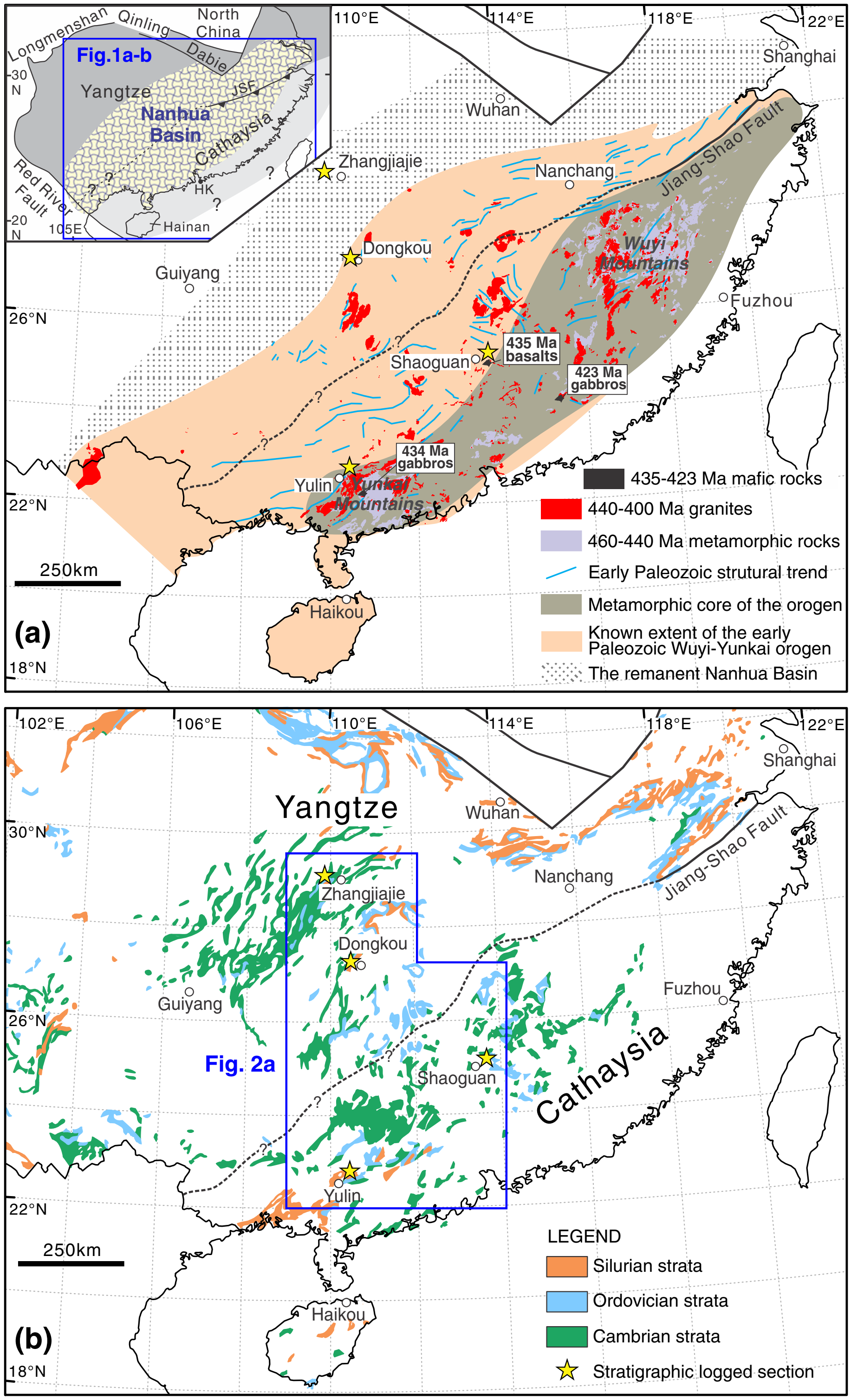

Fig. 1. (a) A simplified regional map of the South China Block (SCB), highlighting the regional extent of the Ordovician–Silurian Wuyi–Yunkai orogenic core, fold-and-thrust belt, and the remanent Nanhua Basin. Geological components such as distributions of lower Paleozoic metamorphic rocks, granites, mafic rocks, and early Paleozoic structural trends are also presented in the map (modified after Li et al., 2010b; Yao et al., 2012, 2015b). The 435 Ma basalts and the 423 Ma, 434 Ma gabbros are from Yao et al. (2012) and Wang et al. (2013), respectively. The inset shows the Cathaysia and Yangtze blocks as parts of the SCB, and the geographic location of the Nanhua Basin, which includes the Cryogenian Nanhua failed-rift basin and the Ediacaran–Silurian Nanhua foreland basin. (b) Distribution of Paleozoic sedimentary outcrops in the SCB, highlighting the Cambrian, Ordovician, and Silurian rocks. Localities of the four logged stratigraphic sections are marked with yellow stars.

Neoproterozoic Nanhua Basin was further shown to be a failed rift basin at ca. 850–700 Ma (Li, 1998; Wang and Li, 2003; Li et al., 2010a), thus arguing against a 820–750 Ma Yangtze–Cathaysia amalgamation.

The failed mid-Neoproterozoic Nanhua rift basin was succeeded by a lower Paleozoic basin of a similar age as the Wuyi–Yunkai orogeny (Ordovician–Silurian) (Li et al., 2010b), and further studies suggested that orogenesis-related clastic deposition in this lower Paleozoic basin could have started as early as in the Ediacaran (Yao et al., 2014). As no systematic basin analysis has been conducted on the Ediacaran–Silurian strata, the precise nature and evolution of this basin is still