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Petrogenesis and tectonic implications of Paleoproterozoic metapelitic rocks in the Archean Kongling Complex from the northern Yangtze Craton, South China

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ABSTRACT

The Archean Kongling Complex in the northern Yangtze Craton is an ideal target to investigate the Precambrian accretion and evolution of continental crust in South China. This study aims to unravel the crustal evolution and tectonic setting of the Yangtze Craton during the Paleoproterozoic time, using integrated studies of petrography, zircon U–Pb and Hf isotopes and whole-rock geochemistry of Paleoproterozoic metapelitic rocks in the Kongling Complex. Four representative metapelitic rocks contain garnet, and three of them include high-temperature metamorphic minerals as sillimanite or staurolite. Zircons from the metapelitic rocks show nebulous-sector zoning and rim-core microstructures, suggesting a metamorphic origin or a detrital origin with metamorphic overprints. The metamorphic zircon grains and metamorphic overgrowths have concordant $^{207}Pb/^{206}Pb$ ages at ~2.0 Ga, while detrital grains yield three distinct age populations of >2.5 Ga, 2.4–2.2 Ga and 2.2–2.1 Ga. The age patterns indicate that the depositional age of the metasedimentary rocks was 2.1–2.0 Ga. Arc-related magma production represented by the Houhe gneiss in the northern part of the craton could be the source of the 2.2–2.1 Ga inherited zircons, because of the similarities of whole-rock geochemical compositions and zircon U–Pb–Hf isotopic signatures between the investigated metapelitic rocks and the gneiss. The 2.4–2.2 Ga zircons have Hf model ages (T_{DM2}) of ~3.5–2.6 Ga, and the >2.5 Ga zircons have T_{DM2} ages varying from 3.3 Ga to 2.9 Ga. Our data support previous knowledge that there were three episodes of growth and reworking events of the Archean Yangtze continental crust, ca. 3.3–3.2 Ga, 2.9 Ga, 2.7–2.6 Ga, and show that the Yangtze Craton has experienced Paleoproterozoic reworking during 2.4–2.2 Ga and the growth and reworking during 2.2–2.1 Ga.

Combined with available data, the new results in this study suggest a continent–arc–continent evolution model to explain the tectonic history of the Yangtze Craton during the Paleoproterozoic time. The western and eastern parts of Yangtze Craton were originally two individual continents with Archean basements. The western part of Yangtze Craton had undergone the crustal re-melting event during 2.4–2.2 Ga and growth and reworking event caused by arc generation during 2.2–2.1 Ga. It subsequently collided with the eastern part of Yangtze Craton at ~2.0 Ga and experienced later ~1.85 Ga extension.

1. Introduction

There is a general consensus that a Paleo-Mesoproterozoic supercontinent, named as “Nuna” (Hoffman, 1997), “Hudson” (Zhao, 2000), “Columbia” (Rogers and Santosh, 2002), or “Hudsonland” (Pesonen et al., 2003), might have been amalgamated along global 2.1–1.8 Ga collisional orogens (Zhao et al., 2002a,b,c). South China was considered to be part of this Paleo-Mesoproterozoic supercontinent based on age distributions of detrital zircons (Wang et al., 2011a) and sedimentary sequences (Chen et al., 2013a; Zhou et al., 2014; Wang et al., 2014; Wang and Zhou, 2014).

Being an important part of South China, the Yangtze Craton has been suggested to be involved in the assembly of the Nuna supercontinent, due to ~2.0 Ga continent–continent collision event (e.g., Yin et al., 2013). A clear knowledge of the tectonic role of the Yangtze Craton in the evolution of the Nuna supercontinent

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requires better understanding of how the Archean Yangtze nucleus evolved in the Paleoproterozoic time. Although the Archean basement was supposed to be widespread beneath the Yangtze Craton (Zheng et al., 2006a; Zhang and Zheng, 2013), it is mainly exposed in the Kongling Complex (Gao et al., 1999, 2011; Qiu et al., 2000; Zhang et al., 2006a,b,c; Chen et al., 2013b; Li et al., 2014; Guo et al., 2014).

Previous studies have shown that the Archean Kongling Complex contains 3.45 Ga old rocks (Guo et al., 2014), and detrital-zircon data imply that the crust relic of the Yangtze Craton is as old as 3.8 Ga (Zhang et al., 2006b). The growth of continental nucleus was suggested by formation of abundant Trondhjemite–Tonalite–Granitic (TTG) gneisses during 3.5–2.9 Ga (Zhang and Zheng, 2013). The Kongling Complex has been supposed to be an oceanic island arc at ~2.95 Ga, and experienced earliest metamorphism at ca. 2.87 Ga (Qiu et al., 2000; Li et al., 2014). After that, 2.7–2.6 Ga TTG gneisses were generated through a significant period of crust growth and reworking event (Chen et al., 2013b). Hence, the Yangtze cratonic nucleus has experienced multiple crustal growth and reworking events during 3.3–3.2 Ga, 2.9 Ga and 2.7–2.6 Ga in Archean (Gao et al., 1999, 2011; Qiu et al., 2000; Zhang et al., 2006a,b,c; Zheng et al., 2006a; Jiao et al., 2009; Wu et al., 2009; Chen et al., 2013b; Guo et al., 2014; Li et al., 2014). However, the Paleoproterozoic tectonic processes of the Kongling Complex have been rarely constrained, except for the identified collision-extension event at 2.1–1.85 Ga (Wu et al., 2008, 2009, 2012; Xiong et al., 2009; Peng et al., 2012; Yin et al., 2013). Until now, it is still unclear about the tectonic evolution in early Paleoproterozoic from 2.5 Ga to 2.1 Ga and the nature of the ~2.0 Ga collision event.

On the one hand, no 2.5–2.1 Ga exposed rocks have been found in the Kongling Complex. The absence leads us to consider that whether the 2.5–2.1 Ga crust growth and reworking events have occurred in the Yangtze Craton. If the craton remains stable and quiet during this period, the 2.5–2.1 Ga detrital zircons may be recognized as exotic sources and help to link Yangtze Craton with other continent blocks during the assembly of the Nuna supercontinent. If these crust growth and reworking events did exist in the Yangtze Craton, when and how did they occur? Why there are no such rocks remained in the Kongling Complex? On the other hand, the nature of the collision is still debatable. One thought proposed that the western and eastern parts of the Yangtze Craton collided together, but without specific collision belts (Wu et al., 2012). Others suggested that an unknown continent was accreted to the north margin of Yangtze Craton along a belt almost east-west

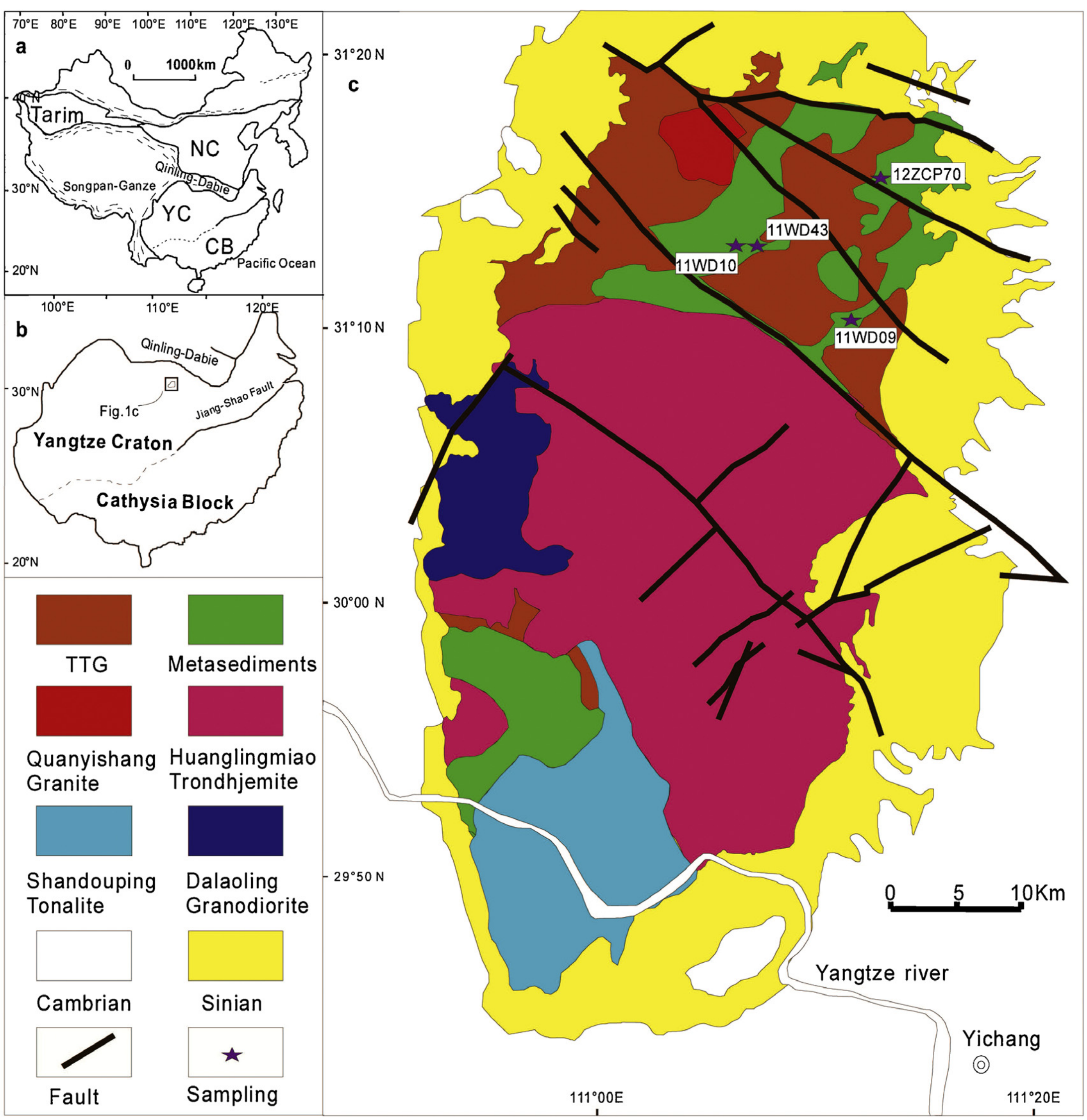

Fig. 1. Major tectonic units of China (a), location of the Kongling Complex (b), and the geological map of the Archean Kongling Complex (c). Filled stars indicate sample localities in this study. In (a), NC, YC and CB mean the North China Craton, the Yangtze Craton and the Cathaysia Block respectively (Zhao and Cawood, 2012).