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Detrital zircon U–Pb geochronology, Hf isotopes and geochemistry constraints on crustal growth and Mesozoic tectonics of southeastern China

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ABSTRACT

In situ U–Pb geochronological, Hf isotopic and REE geochemical analyses of detrital zircons from Mesozoic sandstones in central Jiangxi and east Hunan of the South China Block (SCB) are used to provide not only information about crustal evolution process, but more importantly new constraints on sedimentary provenances as well as Mesozoic basin evolutions in central SCB. A total of 417 concordant zircon analyses define five U–Pb age populations at ca. 2.6–2.3 Ga, ca. 2.0–1.7 Ga, ca. 1.0–0.7 Ga, ca. 500–400 Ma and ca. 300–200 Ma. Integrated analyses of zircon U–Pb ages and Hf isotopes of detrital zircons reveal five episodes of juvenile continental crust growth: ca. 2.5 Ga, ca. 1.7 Ga, ca. 850 Ma, ca. 440 Ma and ca. 230 Ma, with all but the ca. 2.5 Ga episode likely represent that of the SCB.

None of the three samples from T_3–J_1 strata showed strong ca. 1850 Ma and ca. 230 Ma peaks suggesting that the T_3–J_1 sediments probably sourced from the Yangtze Block. In contrast, stronger peaks of ca. 1850 Ma and ca. 250–230 Ma in post-J_1 strata relative to that of T_3–J_1 strata suggest a dominantly local Cathaysian provenance. In addition, the distinct low εHf(T) values for zircons of ca. 430 Ma from T_3–J_1 strata in comparison with higher εHf(T) values for that from post-J_1 strata also support aforementioned viewpoint. Such sharp changes between the pre-J_1 and post-J_1 strata coincide with the remarkable change in regional palaeogeography from a broad shallow marine basin in the Late Triassic–Early Jurassic time to a basin-and-range-style province in the Middle Jurassic. The characteristics and time evolution of detrital zircons from the studied area are consistent with the flat-slab subduction model which involves the development of a broad sag basin during the T_3–J_1 time, and a rapid regional uplift in the Cathaysia Block caused by the reinitiating of normal subduction along the coastal region at ca. 190 Ma.

1. Introduction

Detrital zircons in clastic sedimentary rocks have been proved to be a good recorder of source region characteristics (e.g., Taylor and McLennan, 1985; Turner et al., 1993; Gehrels et al., 1995; Lee et al., 1997; Rubatto et al., 2001; Amidon et al., 2005; Kemp et al., 2006; Hawkesworth and Kemp, 2006; Hawkesworth et al., 2010). In particular, *in situ* U–Pb dating and Lu–Hf isotope analysis, combined with trace element data, of detrital zircons from sedimentary basins constitute a powerful tool for understanding the basin histories and reconstructing the tectonic evolution of the continental crust (e.g., Griffin et al., 2004; Veevers and Saeed, 2009; Kuznetsov et al., 2010; Sevastjanova et al., 2011).

The South China Block (SCB) experienced complex tectonism during the Mesozoic Era, including the collision between the South China and North China blocks (e.g., Li et al., 1993; Meng and Zhang, 2000), the possible amalgamation of the Sibumasu terrane and the Indochina Block (e.g., Carter et al., 2001), a proposed collision between the Indochina and South China blocks (e.g., Lepvrier et al., 2004; Shu et al., 2008; Nakano et al., 2010), and the subduction of the Palaeo-Pacific plate (eg., Zhou and Li, 2000; Li and Li, 2007). These tectonic events left significant imprints on the SCB, such as the widespread Mesozoic magmatism and the syntectonic basins. In contrast to the intensive research on the Mesozoic

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magmatism in the SCB, the Mesozoic basins there are still poorly studied, and provide a new source of information for probing the tectonic evolution of the Western Pacific region.

The geodynamic processes that drove the complex tectonic history of the SCB have long attracted researchers' attention. For the Mesozoic tectonics, there are a number of challenging questions, such as: (1) what is the major driving force for the Mesozoic orogenic events: was it the closure of the paleo-Tethyan ocean (e.g., Lepvrier et al., 2004; Zhou et al., 2006; Shu et al., 2008; Cai and Zhang, 2009) or the subduction of the Paleo-Pacific plate (e.g., Jahn et al., 1990; Zhou and Li, 2000; Li et al., 2006; Li and Li, 2007)? (2) if the subduction of the Paleo-Pacific plate played a role, when did the subduction start and was there indeed flat-slab subduction?

In this paper, we present 480 analyses (with 417 of them are concordant) of U–Pb age, Hf isotope and trace element results from detrital zircons of Late Triassic–Early Cretaceous clastic sedimentary rocks in central Jiangxi and east Hunan provinces of central southeastern South China (Fig. 1A). These data can provide new constraint not only on the provenance of the sediments but also on Mesozoic tectonic evolution of South China Block.

2. Geological setting and sampling

The South China Block (SCB) is composed of the Yangtze Block to the northwest and the Cathaysia Block to the southeast (Fig. 1A). The Precambrian basement of the Yangtze Block consists of Archean and Proterozoic rocks (e.g., Qiu et al., 2000; Zhang et al., 2006; Greentree and Li, 2008), whereas that of the Cathaysia block is mainly of Paleoproterozoic age (e.g., Chen and Jahn, 1998; Li et al., 2010; Yu et al., 2010) with minor Mesoproterozoic igneous rocks (e.g., Li et al., 2008) (Fig. 1A).

Since the amalgamation of the Yangtze and Cathaysia blocks at the early Neoproterozoic (e.g., Ye et al., 2007; Li et al., 2002, 2009), the SCB experienced numerous tectonic events, including events related to the breakup of the Neoproterozoic supercontinent Rodinia starting at ca. 830 Ma, featuring widespread granitic intrusions, bimodal igneous rocks, and continental rifting (Li et al., 1999, 2005) (Fig. 1A), an early Paleozoic orogenic event recorded by the angular unconformity between post-Silurian strata and the strongly-deformed pre-Devonian sediments with widespread granitic intrusions (e.g., Huang et al., 1980; Ren, 1964, 1991; Li, 1998; Li et al., 2010) (Fig. 1A), a late Paleozoic to early Mesozoic orogenic events which resulted in the transition from a stable carbonate platform to clastic facies, orogenic uplift, and the formation of a basin-and-range style magmatic province (Liu and Xü, 1994; Li, 1998; Zhou et al., 2006; Li and Li, 2007).

It has long been recognized that Mesozoic basins in southeast China formed on a pre-Late Triassic basement (Shu et al., 2009). According to a recent stratigraphic analysis of Pang et al. (2014) and previous work (e.g., JXBGMR, 1984; FJBGMR, 1985; Wang, 1985; GDBGMR, 1988; ZJBGMR, 1989; HNBGMR, 1990; Liu and Xü, 1994), the residual late Triassic to early Jurassic strata have a thickness of 600–>2000 m with a possible depocenter around Lianping county, northern Guangdong Province. During Late Triassic,

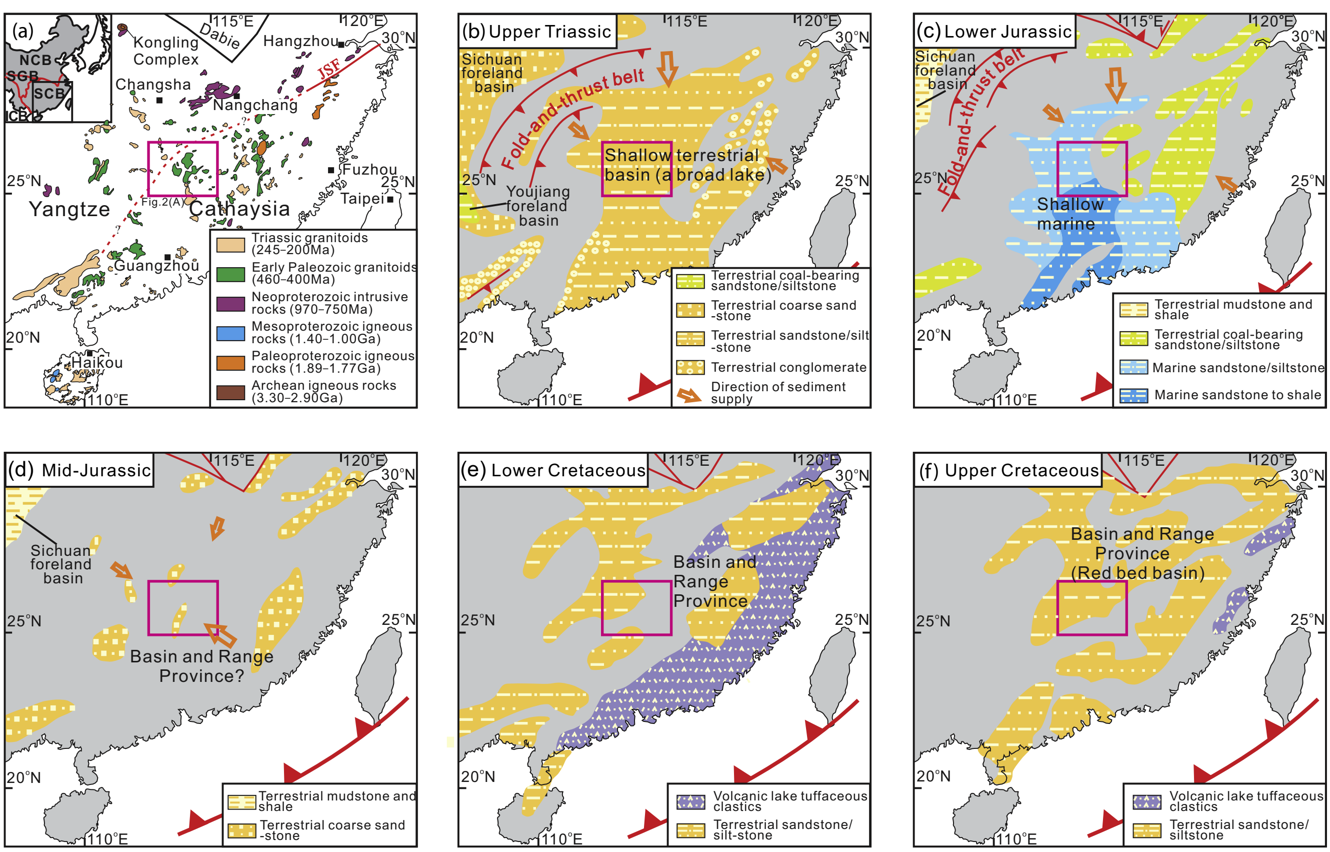

Fig. 1. (A) A simplified map showing the Precambrian, Early Paleozoic, and Triassic igneous rocks of the South China Block (modified after Li et al., 2002; Chen et al., 2008 and Wang et al., 2011a,b). (B)–(F): Paleogeography of eastern South China Block during the Late Triassic (B), the Early Jurassic (C), the Middle Jurassic (D), the Early Cretaceous (E), and the Late Cretaceous (F) (modified after Li and Li, 2007; Shi and Li, 2012). NCB = the North China Block; SCB = the South China Block; SGB = the Songpan-Ganzi Block; ICB = the Indochina Block; JSF = the Jiangshan–Shaoxing Fault. The direction of sediment supply of central southeastern South China is implied by this study, which grossly match that of Shu et al. (2009).