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Research paper

Changing provenance of late Cenozoic sediments in the Jianghan Basin

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ABSTRACT

The Yangtze River is one of the most important components of the East Asia river system. In this study, sediments in the Jianghan Basin, middle Yangtze River, were selected for trace element and rare earth element (REE) measurements, in order to decipher information on the change of sediment provenance and evolution of the Yangtze River. According to the elemental variations, the late Cenozoic sediments of the Jianghan Basin could be divided into four parts. During 2.68–2.28 Ma and 1.25–0 Ma, provenance of the sediments was consistent, whereas sediments were derived from variable sources during 2.28–1.25 Ma. Comparison of the elemental compositions between the Pliocene and Quaternary sediments revealed a change in sediment source from a more felsic source area to a more basic source area around the Pliocene–Quaternary boundary. Input from the Emeishan LIP should account for this provenance change. Based on the provenance analysis of sediments in the Jianghan Basin, we infer that the Yangtze River developed into a large river with its drainage basin extended to the Emeishan LIP no later than the Pliocene–Quaternary boundary.

1. Introduction

Research of large rivers has been highlighted in recent years, especially the rivers draining the southeastern Tibetan Plateau (Brookfield, 1998; Clark et al., 2004; Clift et al., 2006, 2008a, b; Yang et al., 2006, 2007a; Liang et al., 2008; Kong et al., 2009; Shao et al., 2012). These large rivers transport large amount of terrestrial materials to the marginal seas and thus are considered as important linkage between the continents and oceans (Clift et al., 2004; Zheng and Jia, 2009). Evolution of these large rivers can be correlated to the uplift of the mountains and plateaus where these large rivers originate. The process of orogeny is proposed to profoundly affect the global climate system (An et al., 2001). So reconstructing the "Source to Sink" process of sediments from these rivers plays an important role in understanding the global change and its regional response.

The Yangtze River (Fig. 1) is typical not only because of its large drainage area but also the complicated geological background. Its drainage basin consists of complex strata from Archean to Quaternary. The Emeishan Large Igneous Province is the typical basic source in the upper Yangtze especially in the Jinshajiang valley. Quaternary loose sediments and Paleozoic sedimentary rocks widely outcrop in the middle–lower reaches of the Yangtze River (Fig. 2). The Emeishan Large Igneous Province widely distributes at the west margin of the Yangtze Craton. It occupies an area over 250,000 km^2 and is one of the most important igneous provinces in the world (Xiao et al., 2004). As pointed by Yang et al. (2007a), it is suffered strongly chemical weathering under the influence of humid and warm climate and thus should have much influence on the

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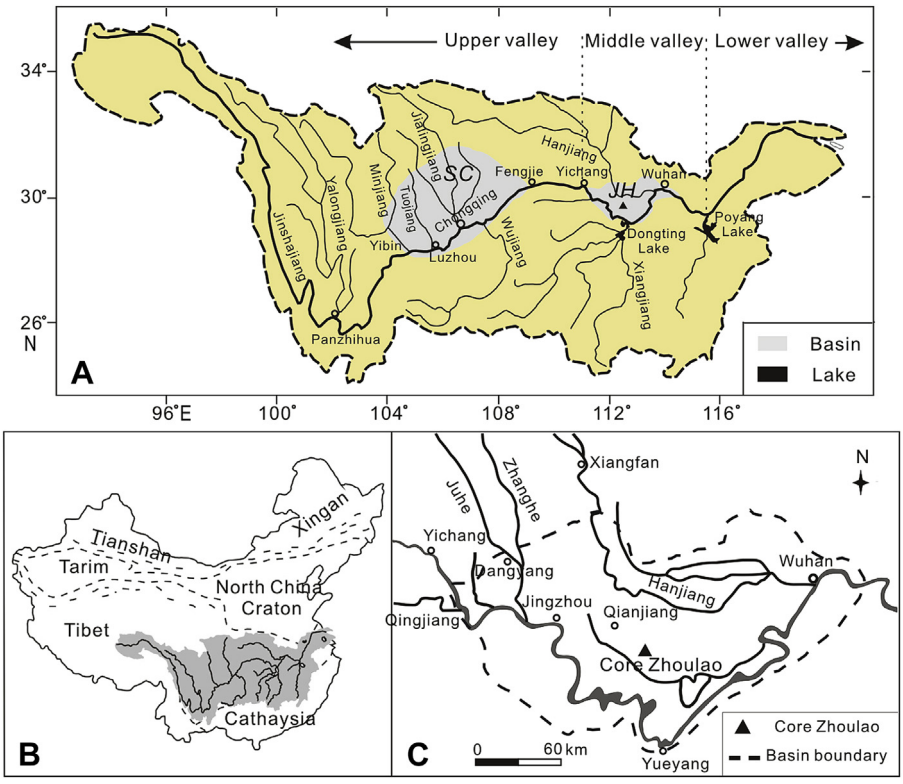

Figure 1. The Yangtze drainage basin and location of the Jianghan Basin and the Core Zhoulao (modified after Yang et al., 2007a; Zhang et al., 2008). A: The Yangtze drainage basin with the location of the Sichuan Basin and Jianghan Basin. SC and JH denote the Sichuan Basin and Jianghan Basin respectively. B: A sketch of Chinese tectonic units. C: Simplified geological map of the Jianghan Basin and the location of the Core Zhoulao.

geochemical composition of the river sediments. Thus, the Emeishan LIP is important for discussing the provenance of the core sediments in the Jianghan Basin and the evolution of the Yangtze River. Study of the evolution of the Yangtze River has a long history of more than 100 years (Willis and Blackwelder, 1907; Li, 1933; Li and Zhang, 1997; Brookfield, 1998; Li et al., 2001; Yang and Li, 2001; Clark et al., 2004; Fan et al., 2005; Clift et al., 2006, 2008b; Yang et al., 2006; Xiang et al., 2007; Huang et al., 2009; Kang et al., 2009; Kong et al., 2009; van Hoang et al., 2009; Jia et al., 2010; Richardson et al., 2010; Shao et al., 2012). Clark et al. (2004) proposed that the Yangtze River was once the tributary of the so called “paleo-Red River” draining into the South China Sea and reorganized by sequential river capture and reversal events. The Nd evolution in the Hanoi Basin showed that the middle Yangtze (downstream of the first bend) was once important source to the paleo-Red River and was lost from the paleo-Red River

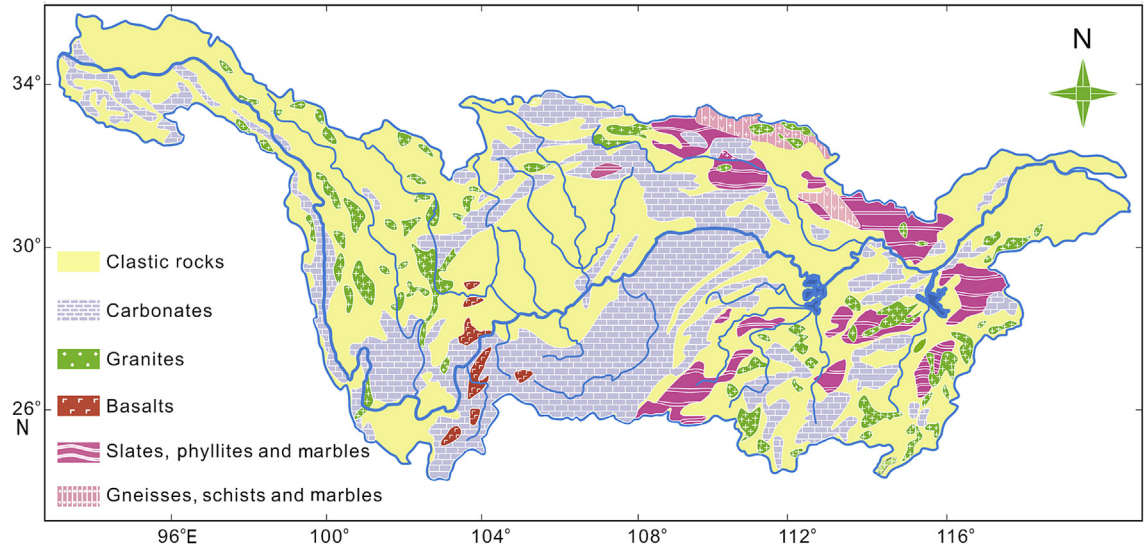

Figure 2. Regional geological map of the Yangtze River drainage basin (modified after Kang et al., 2009). It showed the complicated compositions of lithology in the Yangtze drainage and the location of the largely distributed Emeishan basalts.