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Supplemental Material

Text: Methods

Figure S1. Lithostratigraphic column of borehole L35 drilled in the Chaoshan Depression of the Pearl River Mouth Basin (modified from Shao et al., 2007).

Figure S2. Geological map of the Palawan continental terrane (PCT) showing lithostratigraphic units of main islands (modified from Dimalanta et al., 2009; Knittel et al., 2017; Mines and Geosciences Bureau, 2010; Shao et al., 2017a; Walia et al., 2013; Yumul et al., 2009; Zamoras and Matsuoka, 2004) and sample localities. Samples analyzed in this study and previous studies (Knittel et al., 2017; Padrones et al., 2017; Shao et al., 2017a; Suggate et al., 2014; Walia et al., 2012; 2013; Yan et al., 2018b) are marked by black and gray italic letters, respectively.

Figure S3. Cathodoluminescence (CL) images of representative concordant zircon grains from Palawan samples, showing analytical spots and associated U-Pb ages. Previous samples reported by Shao et al. (2017a) are also shown for comparison. Zircon grains in each sample are arranged in an order of increasing ages toward the right and the leftmost is the youngest grain.

Figure S4. Distribution of Th/U ratios and U-Pb ages of zircons from Palawan samples analyzed in this study and previous studies (Padrones et al., 2017; Shao et al., 2017a; Suggate et al., 2014; Walia et al., 2012; Yan et al., 2018b).

Figure S5. Kernel density estimation (KDE) spectra and histograms for detrital zircon U-Pb ages of samples analyzed in this study. *n*—number of concordant analyses, *YSG*—zircon age (Ma) of the youngest single grain.

Table S1. Geographic location and stratigraphic context of samples analyzed in this study.

Table S2. A compilation of detrital zircon U-Pb age data of the Jurassic to Eocene strata from the northern South China Sea margin and the Jurassic to Miocene strata from the Palawan continental terrane, shown as a summary of sampling information and a list of U-Pb ages of each sample. The original published age data (Chen et al., 2017; Chen et al., 2016; Knittel et al., 2017; Lan et al., 2016; Li et al., 2012; Liu et al., 2017; Padrones et al., 2017; Shao et al., 2016; Shao et al., 2017a; Shao et al., 2018; Shao et al., 2017b; Suggate et al., 2014; Walia et al., 2012; Walia et al., 2013; Wang et al., 2017; Wang et al., 2016; Yan et al., 2018a; Yan et al., 2018b; Yui et al., 2012; Zhao, 2015), if available, are filtered with a cutoff criterion of both 10% discordance and 10% uncertainty (1σ). Ages of stratigraphic boundaries followed the International Chronostratigraphic Chart v2018/08.

Table S3. Compiled detrital zircon U-Pb age data from potential source terranes of the northern South China Sea region. Age data are acquired from modern drainage sediments and, if available, are filtered with a cutoff criterion of both 10% discordance and 10% uncertainty (1σ). Data for East Cathaysia are from (Liu et al., 2017; Xu et al., 2007; Xu et al., 2014b; Zhang et al.,

2017; Zhao, 2015). Data for West Cathaysia are from (Liu et al., 2017; Zhao, 2015). Data for Hainan are from (Cao et al., 2015; Wang et al., 2015; Xu et al., 2014a). Data for the Red River are from (Clift et al., 2006; Fyhn et al., 2019; Hoang et al., 2009; Wang et al., 2018). Data for East Vietnam are (Fyhn et al., 2019; Jonell et al., 2017; Usuki et al., 2013; Wang et al., 2018).

Table S4. Major and trace element concentrations of Palawan samples analyzed in this study.

Table S5. Relative abundances (wt%) of non-opaque detrital heavy minerals of Palawan samples analyzed in this study, along with other published data (Shao et al., 2017a; Suggate et al., 2014) from this area marked with italic font.

Table S6. Detrital zircon U-Pb geochronological results of samples analyzed in this study. Ages with more than 10% discordance and 10% uncertainty (1σ) are shown in red. Discordance tests for zircons older and younger than 1000 Ma are calculated by $[1 - (^{206}\text{Pb}/^{238}\text{U}_{\text{age}} / ^{207}\text{Pb}/^{206}\text{Pb}_{\text{age}})] * 100$ and $[1 - (^{206}\text{Pb}/^{238}\text{U}_{\text{age}} / ^{207}\text{Pb}/^{235}\text{U}_{\text{age}})] * 100$, respectively.

METHODS

Geochemistry

Geochemical analyses were performed on 34 sandstone and mudstone samples from the Bacuit, Guinlo, Boayan, Panas, and Isugod formations of Palawan (Table S1). All sample preparation and chemical analyses were carried out at the State Key Laboratory of Marine Geology, Tongji University, China. The bulk samples were dried and then hand-crushed in an agate mortar. Approximately 3 g of dry samples were heated to 600 °C for 2 h to remove organic matter and interlayer water. Next, the samples were dissolved in a HF-HNO₃ mixture, and major and trace elements were measured using inductively coupled plasma-atomic emission spectrometry (ICP-AES; Thermo ICP-IRIS Intrepid II) and inductively coupled plasma-mass spectrometry (ICP-MS; Thermo X-Series), respectively. Certified materials GSR-5, GSR-6, and GSD-9 were repeatedly analyzed as unknown samples to assess the precision and accuracy of the measurements. Detailed analytical procedures are described in Cao et al. (2017).

Heavy Minerals

Six new sandstone samples from the Bacuit and Isugod formations as well as three supplementary samples from the Boayan and Panas formations were analyzed for heavy mineral composition in the laboratory of the Institute of Regional Geology and Mineral Resources, Hebei, China (Table S1). Samples were heated to dryness and then gently disaggregated using a pestle and mortar. Following disaggregation, the samples were sieved through a 420 µm mesh. Detrital heavy mineral components were separated from bulk samples by centrifugal elutriation. The further mineral separation was achieved by magnetic and electrostatic filters and heavy liquids. Non-opaque detrital grains were identified and counted under the binocular microscope. The data were calculated in weight percentage (wt%) following the method of Zhang et al. (1982).

Detrital Zircon Ages

Detrital zircons were extracted from four sandstone samples from the Bacuit Formation, two from the Isugod Formation, one from borehole C16 in the Tainan Basin, as well as one from borehole L35 in the Pearl River Mouth Basin (Table S1). About 200 random grains were mounted in epoxy resin under the binocular microscope and then polished. U-Pb dating was performed by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and cathodoluminescence (CL) images were used to locate analytical spots (20–30 µm) in zircon oscillatory zoning. Zircons from borehole samples were analyzed in the Department of Earth and Environmental Sciences (National Chung Cheng University, Taiwan) following the methods described in Knittel et al. (2014). The instrumentation comprises an Agilent 7500a ICP-MS coupled to a New Wave 213 nm LA system. Zircons from Palawan samples were dated in the State Key Laboratory of Marine Geology (Tongji University, China) using a Thermo Elemental X-Series ICP-MS coupled to a New Wave 213 nm LA system (Shao et al., 2016). Zircon standards including 91500 (Wiedenbeck et al., 1995), GJ-1 (Jackson et al., 2004), and Plešovice (Sláma et al., 2008) were used for data calibration and accuracy assessment. U-Th-Pb isotopic ratios were calculated using ICPMSDataCal (Liu et al., 2009) followed by the common Pb

correction method of Andersen (2002). The accepted ages were selected from a subset of both $\leq 10\%$ discordance and $\leq 10\%$ uncertainty (1σ), wherein the $^{206}\text{Pb}/^{238}\text{U}$ and $^{207}\text{Pb}/^{206}\text{Pb}$ ages were adopted for zircons younger and older than 1000 Ma, respectively. Visualization of U-Pb age distributions as histograms and kernel density estimation (KDE) spectra (adaptive bandwidth ≤ 30 Ma) was achieved using DensityPlotter (Vermeesch, 2012).

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Figure S1

Figure S2

Figure S3

Bacuit Fm., North Palawan

Guinlo Fm., North Palawan

Panas Fm., South Palawan

Guinlo Fm., North Palawan

Boayan Fm., North Palawan

Isugod Fm., South Palawan

Figure S4

Figure S5