

Peng Feng, Lu Wang<sup>†</sup>, Timothy Kusky, Zhe Chen, Wei Hu, and Xiandeng Yang, 2023, Slab breakoff diorite porphyries derived from two cratons in a continental subduction zone, Sulu orogen, China: GSA Bulletin, <https://doi.org/10.1130/B36964.1>.

## Supplemental Material

**Table S1.** Major element compositions (wt %) of minerals in the diorite porphyries from Lishan, Sulu orogen.

**Table S2.** Whole-rock major and trace element compositions of diorite porphyries.

**Table S3.** Whole-rock Sr–Nd isotope compositions of diorite porphyries.

**Table S4.** LA-ICP-MS U–Pb isotope compositions of zircon in diorite porphyries.

**Table S5.** trace element compositions (ppm) of zircon grains in diorite porphyries.

**Table S6.** Lu–Hf isotope compositions of zircon grains in diorite porphyries.

**Figure S1.** (A) An–Ab–Kfs triangular diagram (after [Deer et al., 1997](#)) showing variation in the composition of plagioclase phenocrysts, plagioclase and K-feldspar in the matrix of the diorite porphyries. (B) Plot of amphibole phenocrysts and amphibole rims around the clinopyroxene in classification of calcic amphiboles (after [Leake, 1997](#)). The plagioclase phenocrysts plot into the andesine field in the diagram after [Deer et al. \(1997\)](#) (Fig. S1), with  $X_{Ab}$  [= atomic Na/(Na + Ca + K)] values of 0.53–0.62; whereas  $X_{Ab}$  of plagioclase in the matrix ranging from 0.55 to 0.88, corresponding to fields of andesine and oligoclase (Fig. S1). The matrix preserves K-feldspar with  $X_{Or}$  [= atomic K/(Na + Ca + K)] values of 0.89–0.98. The amphibole phenocrysts have high Si contents of 7.76–7.97 per formula unit (based on 23 O) and fall into the actinolite field (Fig. S1) based on the classification of [Leake \(1997\)](#). By contrast, amphibole rims around clinopyroxene phenocrysts show a tendency of lower Si contents (7.20–7.82 per formula unit) and are categorized as actinolite or magnesiohornblende (Fig. S1).

## ANALYTICAL METHODS

## Electron Probe Micro-Analysis

Major element compositions of minerals were determined at the Center for Global Tectonics, School of Earth Sciences, China University of Geosciences, Wuhan, using a JEOL JXA-8230 electron probe micro-analyzer. The detailed procedures were described in [Wang et al. \(2019\)](#). The following operating conditions were applied: 15 kV accelerating voltage, 20 nA beam current, and a 1–5 mm micron beam diameter and 15–20 s account time. Raw X-ray intensities were corrected using a ZAF (atomic number, absorption, fluorescence) correction procedure. A series of natural and synthetic SPI standards were utilized according to the analyzing minerals.

## Whole-Rock Major and Trace Element Analysis

Before determining whole-rock major and trace element concentrations at the Wuhan Sample Solution Analytical Technology Co. Ltd., Wuhan, China, fresh whole-rock samples were pulverized to powders less than 200 mesh using an agate ring mill. Major element concentrations were determined by X-ray fluorescence spectrometer (Rigaku-Primus II) on fused glass discs, following the procedure described by [Ma et al. \(2012\)](#). Whole-rock trace element concentrations were determined using an Agilent 7700e ICP-MS. The detailed sample-digestion procedure is described by [Liu et al. \(2008\)](#).

## Whole-Rock Sr–Nd Isotope Analysis

Whole-rock Sr–Nd isotope ratios were obtained using a Finnigan Triton thermal ionization mass spectrometer at Wuhan Sample Solution Analytical Technology Co. Ltd. The sample preparation, chemical separation and analytical procedures for Sr and Nd isotope analysis are similar to those given by [Ling et al. \(2009\)](#). The  $^{87}\text{Rb}/^{86}\text{Sr}$  and  $^{147}\text{Sm}/^{144}\text{Nd}$  ratios of the samples were calculated from Rb, Sr, Sm and Nd concentrations measured using an Agilent 7500a ICP-MS. The total analytical blanks were 200–500 pg for Rb and Sr, and 50 pg for Sm and Nd. The measured Sr and Nd isotope ratios were normalized to  $^{86}\text{Sr}/^{88}\text{Sr} = 0.1194$  and  $^{146}\text{Nd}/^{144}\text{Nd} = 0.7219$ , respectively. During the course of analysis, results obtained for the Sr isotope standard SRM NBS987 ([Thirlwall, 1991](#)) gave an average  $^{87}\text{Sr}/^{86}\text{Sr}$  value of  $0.710238 \pm 0.00011$  ( $2\sigma$ ,  $N = 17$ ) and for the Nd isotope standard JNdi-1 ([Tanaka et al., 2000](#)) gave an average  $^{143}\text{Nd}/^{144}\text{Nd}$  of  $0.512122 \pm 0.000007$  ( $2\sigma$ ,  $N = 16$ ).

## **X-ray Energy Dispersive Spectroscopy Analysis and Zircon Cathodoluminescence Imaging**

Backscattered electron (BSE) imaging, X-ray energy dispersive spectroscopy for mineral identification and zircon cathodoluminescence (CL) imaging were conducted at the State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan, using a FEI Quanta 450 field emission gun scanning electron microscope (SEM) with an attached Oxford SDD inca X-Max 50 energy dispersive spectroscopy (EDS) and Gatan Mono CL4+ system. The working conditions for SEM imaging were set at a voltage of 20 kV with a spot size of ~6.0 mm and a working distance of ~12 mm. For zircon CL imaging, the working conditions were set to be voltage of 10 kV with a spot size of ~5 mm and a working distance of ~14 mm.

## **Zircon U–Pb Isotope and Trace Element Analysis**

U–Pb isotope and trace element analysis of zircon by LA-ICP-MS was conducted at the Wuhan Sample Solution Analytical Technology Co. Ltd., following the same operating conditions and data reduction protocols as those described by [Zong et al. \(2017\)](#). This laboratory uses a GeolasPro laser ablation system, comprising a COMpexPro 102 ArF excimer laser and a MicroLas optical system, coupled with an Agilent 7700e ICP-MS instrument to acquire ion-signal intensities. In this study, the spot size and frequency of the laser were set to 24  $\mu\text{m}$  and 5Hz, respectively. Each analysis incorporated a background acquisition of approximately 20–30 s followed by 50 s of data acquisition from the zircon. For U–Pb analysis, zircon standard 91500 was used as an external standard, and zircon standards GJ-1 and Ple were used as unknown samples to monitor the stability and accuracy of the age data. For calibration of the trace element analyses, we used glass NIST610 as an external standard and Si as an internal standard; zircon standards 91500 and GJ-1 were used to monitor the quality of the analyses. The software ICPMSDataCal was used to perform off-line selection and integration of background and analyte signals, time-drift correction and quantitative calibration for U–Pb geochronology and trace element concentrations ([Liu et al., 2008](#)).

## **Zircon Lu–Hf Isotope Analysis**

Zircon Lu–Hf isotope analysis was undertaken using LA-MC-ICP-MS at Wuhan Sample Solution Analytical Technology Co. Ltd. Sampling was performed on the same locations analyzed for U–Pb isotope ratios and trace element concentrations using an excimer laser ablation system (GeoLas 2005) with a spot size and frequency set to 44  $\mu\text{m}$  and 8 Hz, respectively. Helium was used as a carrier gas. A Plasma HR MC-ICP-MS instrument (Nu instruments Ltd., UK) was used to acquire time-resolved signals following the same instrumental parameters for the laser-ablation system and analytical protocols for the MC-ICP-MS as described by Yuan et al. (2008). Each of the 91500 ( $^{176}\text{Hf}/^{177}\text{Hf} = 0.282308 \pm 0.000006$  ( $2\sigma$ ); Blichert-Toft, 2008), GJ-1 ( $^{176}\text{Hf}/^{177}\text{Hf} = 0.282000 \pm 0.000006$  ( $2\sigma$ ); Morel et al., 2008) and Monastery ( $^{176}\text{Hf}/^{177}\text{Hf} = 0.282739 \pm 0.000026$  ( $2\sigma$ ); Woodhead and Hergt, 2005) zircon standards were analyzed after every ten unknowns; 91500 was used as an external standard, whereas GJ-1 and Monastery were analyzed as unknowns. The Hf isotope compositions obtained in this study are:  $0.282307 \pm 0.000007$  ( $2\sigma$ ,  $N = 12$ ) for 91500,  $0.282007 \pm 0.000024$  ( $2\sigma$ ,  $N = 6$ ) for GJ-1 and  $0.282721 \pm 0.000022$  ( $2\sigma$ ,  $N = 6$ ) for Monastery, respectively. Data reduction followed the protocol summarized by Liu et al. (2010). The software ICPMSDataCal was used to perform off-line selection and integration of background and analyte signals, interference and mass fractionation corrections and external calibration of Lu–Hf isotope ratios (Liu et al., 2010).

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