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Supplemental Material

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Table S2. Whole-rock geochemical compositions of the Neoarchean and Paleoproterozoic igneous rocks in the Longjiang area.

Text S1. Detailed analytical methods.

1. Secondary Ion Mass Spectrometry (SIMS) Zircon U-Pb Dating

U, Th, and Pb were measured using the Cameca IMS-1280 SIMS at the Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China (IGGCAS). Analytical procedures are the same as those described by [Li et al. \(2009\)](#). The ellipsoidal spot is about $10 \times 15 \mu\text{m}$ in size. Pb/U fractionation was calibrated with the power relationship between $^{206}\text{Pb}/^{238}\text{U}$ and $^{238}\text{U}^{16}\text{O}_2/^{238}\text{U}$ against zircon standard Plešovice ([Sláma et al., 2008](#)); calibration of U and Th abundance was performed relative to the zircon standard 91500 ([Wiedenbeck et al., 1995](#)). Measured compositions were corrected for common Pb using non-radiogenic ^{204}Pb . Corrections are sufficiently small to be insensitive to the choice of common Pb composition, and an average of present-day crustal composition ([Stacey and Kramers, 1975](#)) is used for the common Pb, assuming that the common Pb is largely surface contamination introduced during sample preparation. For more details on calibration methods, refer to [Li et al. \(2010b\)](#). Analytical results are listed in [Table S1](#), and uncertainties for individual isotopic data analyses are reported as 1σ . Data processing was carried out using the Isoplot 4.15 program ([Ludwig, 2012](#)). To ascertain the veracity of measurements calibrated against the Plešovice standard, Qinghu was alternately analyzed as an unknown. Nine measurements on Qinghu yield a Concordia age of $159.6 \pm 1.6 \text{ Ma}$, identical within errors to the recommended value of $159.5 \pm 0.2 \text{ Ma}$ ([Li et al., 2013](#)).

2. Whole-Rock Major and Trace Elements

The samples for whole-rock analyses were crushed in an agate mill to 200 mesh after removing weathered surfaces. X-ray fluorescence (XRF; Rigaku RIX 2100 spectrometer) using fused-glass disks and ICP-MS (Agilent 7500a with a shield torch) were used to measure the major and trace elements compositions, respectively, at the Wuhan Sample Solution Analytical Technology Co., Ltd, Hubei Province, China. The samples were digested in Teflon bombs with a mixture of $\text{HF} + \text{HNO}_3$ for ICP-MS analyses. Analytical uncertainties are in the range of 1–3%. The detailed procedures are the same as the descriptions by [Liu et al. \(2008\)](#). The analytical results for the reference materials, GBW07103 (granite), GBW07105 (basalt), GBW07111 (granodiorite), AGV-2 (andesite), BCR-2 (basalt), BHVO-2 (basalt), and RGM-2 (rhyolite), indicate that the analytical precision for major elements is better than 5%, and for trace elements, generally better than 10%. The whole-rock geochemical results and international standards are listed in [Table S2](#).

3. Zircon Hf Isotope

In situ zircon Hf isotope analyses were performed using a Neptune MC-ICP-MS with an ArF excimer laser ablation system (193 nm) at the Wuhan Sample Solution Analytical Technology Co., Ltd, Hubei Province, China. This laser ablation system includes a “wire” signal smoothing device, producing smooth signals even at very low laser repetition rates down to 1 Hz ([Hu et al., 2012b](#)). Helium was used as the carrier gas within the ablation cell and was merged with argon (makeup gas) after the ablation cell. Small amounts of nitrogen were added to the argon makeup gas flow to improve the sensitivity of Hf isotopes ([Hu et al., 2008](#)). Compared with the standard arrangement, the addition of nitrogen in combination with a newly designed X-skimmer cone and Jet sample cone in Neptune Plus improved the signal intensities of Hf, Yb,

and Lu by factors of 5.3, 4.0, and 2.4, respectively. All data were acquired on zircon in single-spot ablation mode with a spot size of 44 μm . Each measurement consisted of 20 seconds of acquisition of the background signal followed by 50 seconds of acquisition of the ablation signal. For details of the operating conditions for the laser ablation system, the MC-ICP-MS instrument, and the analytical method, see [Hu et al. \(2012a\)](#). The results of Hf isotopic analyses are presented in [Table S1](#).

4. Zircon O Isotope

Zircon oxygen isotopes were measured using the same Cameca IMS1280 ion microprobe at IGGCAS. The Cs^+ primary ion beam was accelerated at 10 kV, with an intensity of *ca.* 2 nA. The Gaussian mode was applied with a primary beam aperture of 200 μm to reduce aberrations. The analytical spot is 10 \times 15 μm in size. In order to compensate for sample charging during analysis, a normal incidence electron flood gun was applied with homogeneous electron density over a 100 μm elliptical area. A 10 kV potential was used to extract negative secondary ions. A multicollection mode was adopted to measure oxygen isotope compositions. A mass resolution of *ca.* 2500 can be obtained to measure oxygen isotopes. Each analysis comprises 20 cycles, with an internal precision better than 0.2‰ (1 σ). Detailed analytical procedures and calibration of instrumental mass fractionation refer to [Li et al. \(2010a\)](#). Measured $^{18}\text{O}/^{16}\text{O}$ is normalized using the Vienna Standard Mean Ocean Water compositions (VSMOW; $^{18}\text{O}/^{16}\text{O} = 0.0020052$) and reported in standard per mil notation. The instrumental mass fraction factor (IMF) is accounted for using the Penglai zircon standard with $\delta^{18}\text{O}_{\text{VSMOW}} = 5.31\text{‰} \pm 0.10\text{‰}$ (2 σ ; [Li et al., 2010b](#)). Analytical results are listed in [Table S1](#). Qinghu was analyzed as an unknown to monitor the external precision during analysis. Ten measurements of Qinghu yielded a mean $\delta^{18}\text{O} = 5.41\text{‰} \pm 0.10\text{‰}$ (2 σ), which is within uncertainty indistinguishable from the reported value of $\delta^{18}\text{O} = 5.4\text{‰} \pm 0.2\text{‰}$ (2 σ ; [Li et al., 2013](#)).

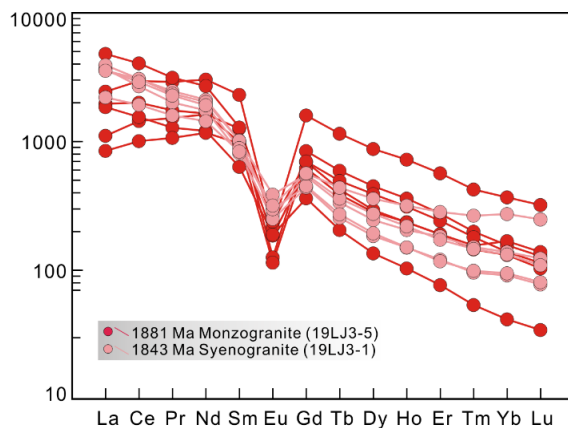


Figure S1. Apatite chondrite-normalized REE patterns for 1881 Ma monzogranites and 1843 Ma syenogranites. Chondrite values after [Boynton \(1984\)](#).

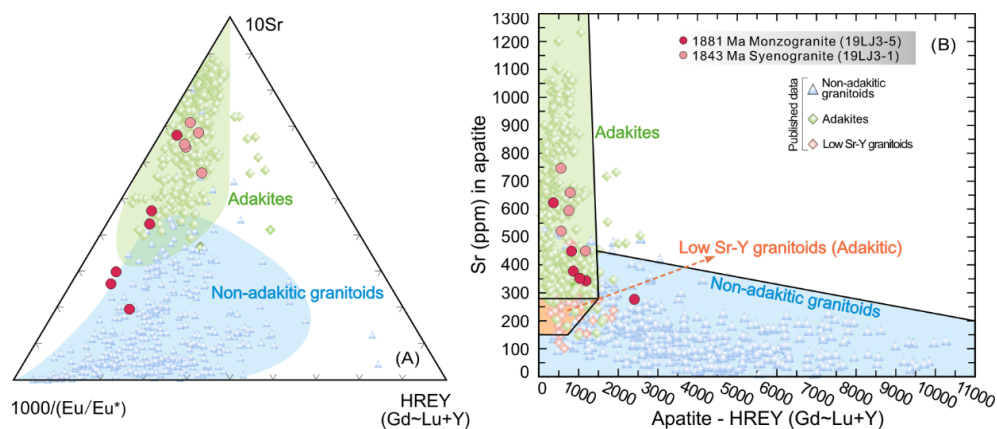


Figure S2. Apatite-based adakite discrimination diagrams (after Sun et al., 2022).

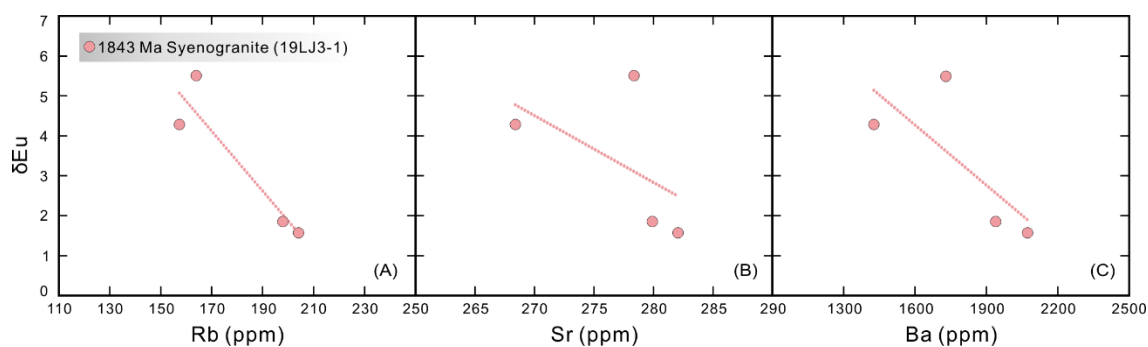


Figure S3. Correlations among δEu and Rb, Sr, and Ba.

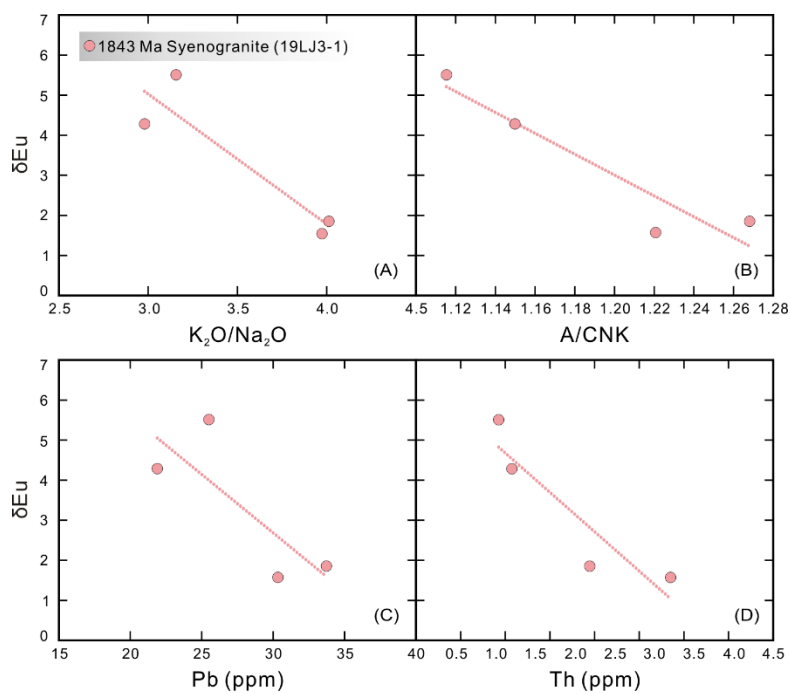


Figure S4. Correlations between δEu and typical supracrust indicators.

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