**GSA DATA REPOSITORY 2019063**

# Biotic responses to volatile volcanism and environmental stresses over Guadalupian-Lopingian (Permian) transition

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## DR1. Laboratory methods

Carbon and oxygen isotope: Weathered surfaces and large veins were trimmed and each sample was cut into small pieces in the laboratory. The rock chips were then ground to fine powder (< 200 mesh) using a stainless-steel puck mill that was cleaned between samples by grinding with red quartz sand. Under vacuum, the sample powder was reacted offline with 100% $H_3PO_4$ for 24h at 25℃. The carbon isotope composition of the generated $CO_2$ was measured on a Finnigan MAT 251 mass spectrometer. All isotopic data are reported as per mil (‰) relative to Vienna Pee Dee belemnite (V-PDB) standard, based on duplicate analyses of national standards GBW04416 ($\delta^{13}C$ = +1.61‰, $\delta^{18}O$ = –11.59‰) and GBW04417 ($\delta^{13}C$ = +6.06‰, $\delta^{18}O$ = –24.12‰). The analytical precision is better than ±0.1‰ for $\delta^{13}C$ and ±0.2‰ for $\delta^{18}O$ based on duplicate analyses. The microscope, MAT 251, and EDS equipped-SEM reside at the State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences (Wuhan).

Mercury concentrations: Mercury content was measured using a LECO AMA254 mercury analyzer at the State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences (Wuhan). Prior to analysis, all samples were freeze-dried to prevent decomposition of Hg. About 100 mg of mudstone or shale and 150–200 mg of limestone were analyzed. Data reliability was ensured by use of LECO standard 502-685 with a certified value of 0.04 ± 0.008 ppm Hg (laboratory QC data range from 0.0362 to 0.0433 ppm Hg), which was analyzed after every 12 unknowns then followed by a repeat. Reproducibility of sample concentrations was better than 10%.

Total organic carbon (TOC) measurement: TOC content measurement was conducted in the State Key Laboratory of Geological Processes and Mineral Resources by a vario macro cube elemental analyzer. About 10 g powdered sample was put into the 50 mL tube, then 50 % HCl was injected to dissolve carbonate minerals until there was no further bubbling. After multiple centrifugal and lyophilization, the residue was analyzed for total organic carbon (TOC). Data quality was assessed through multiple analyses of standard sample DP-1 (65.44±0.33 %). A standard sample and a repeat were analyzed after every 12 unknowns, yielding an analytical accuracy of 5 % of the reported values.

Hg isotopes: Hg isotopic compositions of samples from the three sections were analyzed at the Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, China. Approximately 0.5 g of ground sample and ~0.1 g of standard reference materials (GSS-4, soil) were digested (95 ˚C for 90 mins) using 5 mL of aqua regia ($HCl/HNO_3$ = 3, v/v). After digestion, the solution was centrifuged (3000 rpm for 10 mins) at room temperature and then decanted to obtain the supernatant. Before conducting Hg isotope analysis, the digested sample solutions were diluted to 2 and 1 ng $mL^{-1}$ using Milli-Q water based on total Hg values. All the acid concentrations of the diluted solutions were <20%. Similarly, NIST SRM 3133 and 3177 Hg standard solutions with Hg concentrations of 2 and 1 ng $mL^{-1}$ were also prepared.

Isotopic values were measured using a Neptune MC-ICP-MS with high sensitivity

X skimmer cone. NIST SRM 997 Tl was the internal standard used for simultaneous instrumental mass bias correction of Hg. $SnCl_2$ (4 ng $mL^{-1}$) was used to generate elemental $Hg^{(0)}$ before being introduced into the plasma. The stability of the instrument and measurement precision were monitored using NIST SRM 3133 and 3177 Hg standard solutions, respectively. Sample-standard bracketing was based on NIST 3133. Digest recovery of the samples was monitored by MC-ICP-MS using $\delta^{202}$Hg signals. The sensitivity for $\delta^{202}$Hg during Hg isotope analysis was ~1.2 V per ng $mL^{-1}$ Hg.

Hg isotopic variations are reported in $\delta^{202}$Hg notation in units of per mil (%) referenced to the NIST-3133 Hg standard (once every 3 samples):

$$\delta^{202}Hg\ (‰) = [(^{202}Hg/^{198}Hg_{sample})/(^{202}Hg/^{198}Hg_{standard}) - 1] \times 1000 \qquad (1)$$

Mass independent fractionation (MIF) of Hg isotopes is expressed in Δ-notation ($\Delta^{xxx}$Hg), which describes the difference between the measured $\delta^{xxx}$Hg and the theoretically predicted $\delta^{xxx}$Hg value, using the following equations:

$$\Delta^{199}Hg \approx \delta^{199}Hg - (\delta^{202}Hg \times 0.2520) \qquad (2)$$

$$\Delta^{200}Hg \approx \delta^{200}Hg - (\delta^{202}Hg \times 0.5024) \qquad (3)$$

$$\Delta^{201}Hg \approx \delta^{201}Hg - (\delta^{202}Hg \times 0.7520) \qquad (4)$$

Replicate analysis of the NIST 3177 Hg intra lab isotope reference standard (n = 4 analytical sessions) were as follows: $\delta^{202}$Hg = -0.42 ± 0.06‰ (2 sd); $\Delta^{199}$Hg = -0.04 ± 0.02‰ (2 sd); $\Delta^{200}$Hg = 0.01 ± 0.04‰ (2 sd); $\Delta^{201}$Hg = 0.01 ± 0.04‰ (2 sd).

Analytical results of Hg concentrations, TOC contents, Hg isotopes, carbon and oxygen isotopes (**Tables DR1**). Field and petrographic photos of giant bivalve Alatoconchid (**Fig. DR1**), field photos of *Skolithos* piperock (**Fig. DR2**), all the TOC and Hg concentrations data from Penglaitan section (**Fig. DR3**), and correlation between Hg concentration and total organic carbon (TOC) content (**Fig. DR4**).

**Table DR1.** Hg concentrations and TOC contents, $\delta^{13}$C and $\delta^{18}$O values and Hg isotopic compositions.

**Figure DR1.** (A-C) Alatoconchid shells (write arrows), the coin is 2 cm in diameter. (D-F) Photomicrograph showing alatoconchid shell microstructure, valves show a double-layered texture, consisting of prismatic calcite aligned perpendicularly to shell surface, and inner mosaic granular calcite, Bed 3. The red scale bar is 500 μm.

**Figure DR2.** (A) Profile view of *Skolithos* burrows (arrows) of piperock. The filler of the burrows is siliceous mudstone, which is more weather-resistance than the surrounding limestone. Bed 6k. (B) Plane view of *Skolithos* burrows (arrows) of piperock, Bed 6k. (C) Polished slab showing vertical burrows of *Skolithos*.

**Figure DR3.** TOC and Hg concentrations from Penglaitan section. Red horizon line illustrates the base of Laibin Limestone. Note that most of the TOC values are <0.1 wt.%, most of the Hg concentrations are < 10 ppb. Red points represent samples with TOC value < 0.02 wt.% (below detectable limit).

**Figure DR4.** Cross plots of Hg concentration vs. total organic carbon (TOC) content. There is no statistically significant correlation between Hg content and TOC ($R^2$=0.12, correlation test: $p$ value = 0.0138, estimate = -0.4066), indicating that Hg/TOC ratios are controlled primarily by temporal variations in environmental Hg concentration.

Table DR1. Key geochemical parameters of all samples

| Sample Number | Stratigraphy | Lithology | Conodont zones | Depth (m) | $\delta^{13}C$‰ (V-PDB) | $\delta^{18}O$‰ (V-PDB) | Hg (p.p.b.) | TOC (wt.%) | Hg/TOC (p.p.b/wt.%) | $\delta^{202}Hg$ (‰) | $\Delta^{199}Hg$ (‰) | $\Delta^{200}Hg$ (‰) | $\Delta^{201}Hg$ (‰) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLT-36 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 11.05 | NA | NA | 13.28 | 1.31 | 10.13 | -0.90 | -0.05 | 0.04 | -0.02 |
| PLT-35 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.89 | NA | NA | 10.54 | 0.55 | 19.16 | -0.66 | -0.07 | 0.13 | -0.04 |
| PLT-34 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.76 | NA | NA | 3.87 | 0.24 | 16.1 | NA | NA | NA | NA |
| PLT-33 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.68 | 3.2 | -6.73 | 15.08 | 0.47 | 32.08 | NA | NA | NA | NA |
| PLT-32 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.58 | NA | NA | 18.77 | 0.56 | 33.52 | -0.97 | 0.03 | 0.05 | -0.01 |
| PLT-31 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.5 | NA | NA | 19.5 | 0.18 | 108.31 | NA | NA | NA | NA |
| PLT-30 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.43 | NA | NA | 22.3 | 0.17 | 135.06 | NA | NA | NA | NA |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLT-29 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.24 | 1.77 | -7.96 | 19.4 | 0.12 | 165.19 | -1.34 | 0.03 | 0.06 | 0.01 |
| PLT-28 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 10.13 | 2.54 | -7.3 | 16.4 | 0.14 | 117.51 | NA | NA | NA | NA |
| PLT-27 | Heshan Fm. | siliceous limestone | *Clarkina dukouensis* | 9.84 | NA | NA | 19.26 | 0.16 | 122.07 | -0.43 | 0.03 | 0.07 | -0.04 |
| PLT-26 | Heshan Fm. | siliceous limestone | *C. postbitteri postbitteri* | 9.49 | 3.71 | -5.52 | 18.8 | 0.17 | 109.97 | -0.36 | 0.01 | 0.05 | 0.02 |
| PLT-25 | Heshan Fm. | siliceous limestone | *C. postbitteri postbitteri* | 9.18 | 2.99 | -6.4 | 26.6 | 0.19 | 139.69 | -1.30 | 0.07 | 0.05 | 0.05 |
| PLT-24 | Heshan Fm. | siliceous limestone | *C. postbitteri postbitteri* | 9.02 | NA | NA | 23.35 | 0.17 | 138.8 | -1.11 | 0.08 | 0.10 | 0.08 |
| PLT-23 | Maokou Fm. | limestone | *C. postbitteri postbitteri* | 8.87 | 2.54 | -5.73 | 18.5 | 0.42 | 43.67 | NA | NA | NA | NA |
| PLT-22 | Maokou Fm. | limestone | *C. postbitteri hongshuiensis* | 8.6 | 4.61 | -4.36 | 13.1 | 0.25 | 51.96 | -0.41 | 0.03 | 0.10 | 0.10 |
| PLT-21 | Maokou Fm. | limestone | *Jinogondolella* | 8.36 | 4.76 | -4.09 | 17.1 | 0.55 | 31.11 | NA | NA | NA | NA |

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| | | | *granti* | | | | | | | | | | |
| PLT-20 | Maokou Fm. | limestone | *Jinogondolella granti* | 8.23 | 4.94 | -3.72 | 6.05 | 1.63 | 3.71 | NA | NA | NA | NA |
| PLT-19 | Maokou Fm. | limestone | *Jinogondolella granti* | 8.03 | 5.11 | -3.97 | 5.6 | 0.5 | 11.2 | NA | NA | NA | NA |
| PLT-18 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.9 | 5.1 | -3.81 | 6.9 | 0.46 | 15.14 | NA | NA | NA | NA |
| PLT-17 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.74 | 5.03 | -4.03 | 5 | 0.43 | 11.6 | -1.17 | 0.05 | 0.11 | 0.10 |
| PLT-16 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.59 | 4.54 | -4.18 | 14.7 | 0.34 | 42.69 | NA | NA | NA | NA |
| PLT-15 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.42 | 4.4 | -4.96 | 24.1 | 0.38 | 64.1 | -1.28 | 0.05 | 0.08 | 0.16 |
| PLT-14 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.28 | 4.69 | -4.5 | 9.3 | 0.31 | 30.09 | NA | NA | NA | NA |
| PLT-13 | Maokou Fm. | limestone | *Jinogondolella granti* | 7.12 | 4.9 | -4.38 | 6.6 | 0.24 | 27.19 | -0.86 | 0.03 | 0.14 | 0.00 |

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| PLT-12 | Maokou Fm. | limestone | *Jinogondolella granti* | 6.82 | 4.8 | -4.29 | 9.1 | 0.52 | 17.41 | NA | NA | NA | NA |
| PLT-11 | Maokou Fm. | limestone | *Jinogondolella granti* | 6.56 | 4.84 | -4.52 | 10.6 | 1.08 | 9.81 | -0.66 | 0.03 | 0.11 | 0.12 |
| PLT-10 | Maokou Fm. | muddy limestone | *Jinogondolella granti* | 5.5 | 4.5 | -3.59 | 5.8 | 2.76 | 2.1 | -0.03 | -0.06 | 0.07 | 0.08 |
| PLT-9 | Maokou Fm. | muddy limestone | *Jinogondolella granti* | 4.69 | NA | NA | 6.12 | 0.32 | 19.12 | NA | NA | NA | NA |
| PLT-8 | Maokou Fm. | muddy limestone | *J. xuanhanensis* | 3.92 | NA | NA | 8.92 | 0.37 | 24.12 | 0.15 | -0.10 | 0.09 | 0.00 |
| PLT-7 | Maokou Fm. | muddy limestone | *J. xuanhanensis* | 3.11 | 4.27 | -5.73 | 6.3 | 0.6 | 10.58 | NA | NA | NA | NA |
| PLT-6 | Maokou Fm. | muddy limestone | *J. xuanhanensis* | 2.31 | NA | NA | 3.37 | 0.5 | 6.73 | NA | NA | NA | NA |
| PLT-5 | Maokou Fm. | muddy limestone | *J. xuanhanensis* | 1.71 | NA | NA | 22.12 | 0.59 | 37.48 | -0.20 | -0.08 | 0.05 | -0.02 |
| PLT-4 | Maokou Fm. | muddy | *J. xuanhanensis* | 1.11 | 4.03 | -5.96 | 6.9 | 0.28 | 24.29 | NA | NA | NA | NA |

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| | | limestone | | | | | | | | | | | |
| PLT-3 | Maokou Fm. | limestone | *J. xuanhanensis* | 0.44 | 3.01 | -6.4 | 15 | 0.72 | 20.83 | -0.48 | -0.02 | 0.00 | -0.02 |
| PLT-2 | Maokou Fm. | limestone | *J. xuanhanensis* | 0.26 | 3.39 | -6.64 | 6.4 | 0.92 | 6.94 | NA | NA | NA | NA |
| PLT-1 | Maokou Fm. | limestone | *J. xuanhanensis* | 0 | NA | NA | 7.9 | 0.44 | 17.96 | NA | NA | NA | NA |
| GSS-4 (Soil) | NA | NA | NA | NA | NA | NA | NA | NA | NA | -1.65 | -0.28 | -0.03 | -0.30 |
| GSS-4 (Soil) | NA | NA | NA | NA | NA | NA | NA | NA | NA | -1.41 | -0.30 | 0.00 | -0.30 |
| NIST 3177 | NA | NA | NA | NA | NA | NA | NA | NA | NA | -0.48 | -0.03 | -0.01 | -0.01 |
| NIST 3177 | NA | NA | NA | NA | NA | NA | NA | NA | NA | -0.56 | -0.03 | -0.03 | -0.07 |
| PLT-100 | Maokou Fm. | limestone | *J. xuanhanensis* | -0.1 | NA | NA | 10.11 | 0.09 | 112.33 | NA | NA | NA | NA |
| PLT-101 | Maokou Fm. | limestone | *J. xuanhanensis* | -0.45 | NA | NA | 7 | 0.09 | 77.8 | NA | NA | NA | NA |
| PLT-102 | Maokou Fm. | limestone | *J. xuanhanensis* | -1.1 | NA | NA | 5.34 | 0.12 | 44.49 | NA | NA | NA | NA |
| PLT-103 | Maokou Fm. | limestone | *J. xuanhanensis* | -1.45 | NA | NA | 2.33 | 0.15 | 15.5 | NA | NA | NA | NA |
| PLT-104 | Maokou Fm. | limestone | *J. xuanhanensis* | -1.75 | NA | NA | 2.25 | 0 | 0 | NA | NA | NA | NA |
| PLT-105 | Maokou Fm. | limestone | *J. xuanhanensis* | -2.2 | NA | NA | 1.48 | 0 | 0 | NA | NA | NA | NA |
| PLT-106 | Maokou Fm. | limestone | *J. xuanhanensis* | -2.6 | NA | NA | 3.36 | 0.03 | 112.04 | NA | NA | NA | NA |

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| PLT-107 | Maokou Fm. | limestone | *J. xuanhanensis* | -2.9 | NA | NA | 4.31 | 0.02 | 215.6 | NA | NA | NA | NA |
| PLT-108 | Maokou Fm. | limestone | *J. xuanhanensis* | -3.3 | NA | NA | 5.78 | 0.03 | 192.52 | NA | NA | NA | NA |
| PLT-109 | Maokou Fm. | limestone | *J. xuanhanensis* | -3.55 | NA | NA | 5.8 | 0.02 | 290.22 | NA | NA | NA | NA |
| PLT-110 | Maokou Fm. | limestone | *J. xuanhanensis* | -4.05 | NA | NA | 8.71 | 0.03 | 290.18 | NA | NA | NA | NA |
| PLT-111 | Maokou Fm. | limestone | *J. xuanhanensis* | -4.4 | NA | NA | 11.12 | 0 | 0 | NA | NA | NA | NA |
| PLT-112 | Maokou Fm. | limestone | *J. xuanhanensis* | -4.75 | NA | NA | 6.05 | 0.06 | 100.86 | NA | NA | NA | NA |
| PLT-113 | Maokou Fm. | limestone | *J. xuanhanensis* | -5.6 | NA | NA | 8.83 | 0.02 | 441.46 | NA | NA | NA | NA |
| PLT-114 | Maokou Fm. | limestone | *J. xuanhanensis* | -6 | NA | NA | 11.65 | 0.15 | 77.65 | NA | NA | NA | NA |
| PLT-115 | Maokou Fm. | limestone | *J. xuanhanensis* | -6.4 | NA | NA | 13.34 | 0.06 | 222.28 | NA | NA | NA | NA |
| PLT-116 | Maokou Fm. | limestone | *J. xuanhanensis* | -6.75 | NA | NA | 7.72 | 0 | 0 | NA | NA | NA | NA |
| PLT-117 | Maokou Fm. | limestone | *J. xuanhanensis* | -7.5 | NA | NA | 10.02 | 0 | 0 | NA | NA | NA | NA |
| PLT-118 | Maokou Fm. | limestone | *J. xuanhanensis* | -7.8 | NA | NA | 5.6 | 0 | 0 | NA | NA | NA | NA |
| PLT-119 | Maokou Fm. | limestone | *J. xuanhanensis* | -8.1 | NA | NA | 5.07 | 0 | 0 | NA | NA | NA | NA |
| PLT-120 | Maokou Fm. | limestone | *J. xuanhanensis* | -8.4 | NA | NA | 6.64 | 0.08 | 82.98 | NA | NA | NA | NA |
| PLT-121 | Maokou Fm. | limestone | *J. xuanhanensis* | -8.7 | NA | NA | 3.93 | 0.04 | 98.33 | NA | NA | NA | NA |
| PLT-122 | Maokou Fm. | limestone | *J. xuanhanensis* | -9.1 | NA | NA | 5 | 0.27 | 18.52 | NA | NA | NA | NA |
| PLT-123 | Maokou Fm. | limestone | *J. xuanhanensis* | -9.5 | NA | NA | 4.25 | 0.05 | 84.98 | NA | NA | NA | NA |

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| PLT-124 | Maokou Fm. | limestone | *J. xuanhanensis* | -9.9 | NA | NA | 12.51 | 0.05 | 250.21 | NA | NA | NA | NA |
| PLT-125 | Maokou Fm. | limestone | *J. xuanhanensis* | -10.6 | NA | NA | 3.66 | 0.09 | 40.69 | NA | NA | NA | NA |
| PLT-126 | Maokou Fm. | limestone | *J. xuanhanensis* | -10.9 | NA | NA | 11 | 0.04 | 275 | NA | NA | NA | NA |
| PLT-127 | Maokou Fm. | limestone | *J. xuanhanensis* | -11.5 | NA | NA | 2.26 | 0 | 0 | NA | NA | NA | NA |
| PLT-128 | Maokou Fm. | limestone | *J. xuanhanensis* | -11.8 | NA | NA | 8.97 | 0.09 | 99.69 | NA | NA | NA | NA |
| PLT-129 | Maokou Fm. | limestone | *J. xuanhanensis* | -12.15 | NA | NA | 5.02 | 0.06 | 83.69 | NA | NA | NA | NA |
| PLT-130 | Maokou Fm. | limestone | *J. prexuanhanensis* | -12.85 | NA | NA | 8.01 | 0.07 | 114.42 | NA | NA | NA | NA |
| PLT-131 | Maokou Fm. | limestone | *J. prexuanhanensis* | -13.15 | NA | NA | 7.34 | 0.11 | 66.75 | NA | NA | NA | NA |
| PLT-132 | Maokou Fm. | limestone | *J. prexuanhanensis* | -13.65 | NA | NA | 2.13 | 0.04 | 53.34 | NA | NA | NA | NA |
| PLT-133 | Maokou Fm. | limestone | *J. prexuanhanensis* | -14.15 | NA | NA | 2.91 | 0.12 | 24.28 | NA | NA | NA | NA |
| PLT-134 | Maokou Fm. | limestone | *J. prexuanhanensis* | -14.75 | NA | NA | 10.08 | 0.04 | 252.06 | NA | NA | NA | NA |
| PLT-135 | Maokou Fm. | limestone | *J. altudaensis* | -15.9 | NA | NA | 8.47 | 0.05 | 169.38 | NA | NA | NA | NA |
| PLT-136 | Maokou Fm. | limestone | *J. altudaensis* | -17.2 | NA | NA | 2.58 | 0.07 | 36.9 | NA | NA | NA | NA |
| PLT-137 | Maokou Fm. | limestone | *J. altudaensis* | -17.95 | NA | NA | 3.05 | 0 | 0 | NA | NA | NA | NA |
| PLT-138 | Maokou Fm. | limestone | *J. altudaensis* | -18.55 | NA | NA | 5.48 | 0 | 0 | NA | NA | NA | NA |
| PLT-139 | Maokou Fm. | limestone | *J. altudaensis* | -19.05 | NA | NA | 9.49 | 0 | 0 | NA | NA | NA | NA |
| PLT-140 | Maokou Fm. | limestone | *J. altudaensis* | -19.5 | NA | NA | 10.61 | 0.17 | 62.42 | NA | NA | NA | NA |

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| PLT-141 | Maokou Fm. | limestone | *J. shannoni* | -20.15 | NA | NA | 2.97 | 0.03 | 99.13 | NA | NA | NA | NA |
| PLT-142 | Maokou Fm. | limestone | *J. shannoni* | -21.5 | NA | NA | 9.53 | 0.04 | 238.37 | NA | NA | NA | NA |
| PLT-143 | Maokou Fm. | limestone | *J. shannoni* | -22.1 | NA | NA | 7.27 | 0 | 0 | NA | NA | NA | NA |
| PLT-144 | Maokou Fm. | limestone | *J. shannoni* | -23.3 | NA | NA | 10.24 | 0.04 | 256 | NA | NA | NA | NA |
| PLT-145 | Maokou Fm. | limestone | *J. shannoni* | -25.55 | NA | NA | 2.22 | 0.06 | 37.08 | NA | NA | NA | NA |
| PLT-146 | Maokou Fm. | limestone | *J. shannoni* | -26.15 | NA | NA | 10.17 | 0.2 | 50.83 | NA | NA | NA | NA |
| PLT-147 | Maokou Fm. | limestone | *J. shannoni* | -26.75 | NA | NA | 11.38 | 0.16 | 71.11 | NA | NA | NA | NA |
| PLT-148 | Maokou Fm. | limestone | *J. postserrata* | -29.25 | NA | NA | 0.75 | 0.12 | 6.22 | NA | NA | NA | NA |
| PLT-149 | Maokou Fm. | limestone | *J. postserrata* | -33.25 | NA | NA | 6.66 | 0.21 | 31.73 | NA | NA | NA | NA |
| PLT-150 | Maokou Fm. | limestone | *J. postserrata* | -36.75 | NA | NA | 7.62 | 0.26 | 29.29 | NA | NA | NA | NA |
| PLT-151 | Maokou Fm. | limestone | *J. postserrata* | -41 | NA | NA | 12.73 | 0 | 0 | NA | NA | NA | NA |
| PLT-152 | Maokou Fm. | limestone | *J. postserrata* | -42.3 | NA | NA | 7.03 | 0 | 0 | NA | NA | NA | NA |
| PLT-153 | Maokou Fm. | limestone | *J. postserrata* | -46.06 | NA | NA | 1.86 | 0.02 | 93.07 | NA | NA | NA | NA |
| PLT-154 | Maokou Fm. | limestone | *J. postserrata* | -47.2 | NA | NA | 4.64 | 0.03 | 154.58 | NA | NA | NA | NA |
| PLT-155 | Maokou Fm. | limestone | *J. postserrata* | -48.36 | NA | NA | 7 | 0 | 0 | NA | NA | NA | NA |
| PLT-156 | Maokou Fm. | limestone | *J. postserrata* | -50.43 | NA | NA | 5.5 | 0.02 | 274.89 | NA | NA | NA | NA |
| PLT-157 | Maokou Fm. | limestone | *J. postserrata* | -53.53 | NA | NA | 4.11 | 0.03 | 136.92 | NA | NA | NA | NA |

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| PLT-158 | Maokou Fm. | limestone | *J. postserrata* | -54.67 | NA | NA | 2.36 | 0.05 | 47.27 | NA | NA | NA | NA |
| PLT-159 | Maokou Fm. | limestone | *J. postserrata* | -55.76 | NA | NA | 2.83 | 0.02 | 141.46 | NA | NA | NA | NA |
| PLT-160 | Maokou Fm. | limestone | *J. postserrata* | -57.83 | NA | NA | 4.42 | 0.05 | 88.35 | NA | NA | NA | NA |
| PLT-161 | Maokou Fm. | limestone | *J. postserrata* | -59.67 | NA | NA | 5.18 | 0 | 0 | NA | NA | NA | NA |
| PLT-162 | Maokou Fm. | limestone | *J. postserrata* | -60.82 | NA | NA | 6.03 | 0.04 | 150.86 | NA | NA | NA | NA |
| PLT-163 | Maokou Fm. | limestone | *J. postserrata* | -61.96 | NA | NA | 3.23 | 0 | 0 | NA | NA | NA | NA |
| PLT-164 | Maokou Fm. | limestone | *J. postserrata* | -64.26 | NA | NA | 2.35 | 0 | 0 | NA | NA | NA | NA |
| PLT-165 | Maokou Fm. | limestone | *J. postserrata* | -65.4 | NA | NA | 3.41 | 0.03 | 113.74 | NA | NA | NA | NA |
| PLT-166 | Maokou Fm. | limestone | *J. postserrata* | -67.2 | NA | NA | 5.59 | 0.02 | 279.48 | NA | NA | NA | NA |
| PLT-167 | Maokou Fm. | limestone | *J. postserrata* | -68.3 | NA | NA | 8.08 | 0.03 | 269.38 | NA | NA | NA | NA |
| PLT-168 | Maokou Fm. | limestone | *J. postserrata* | -70 | NA | NA | 3.47 | 0.06 | 57.76 | NA | NA | NA | NA |

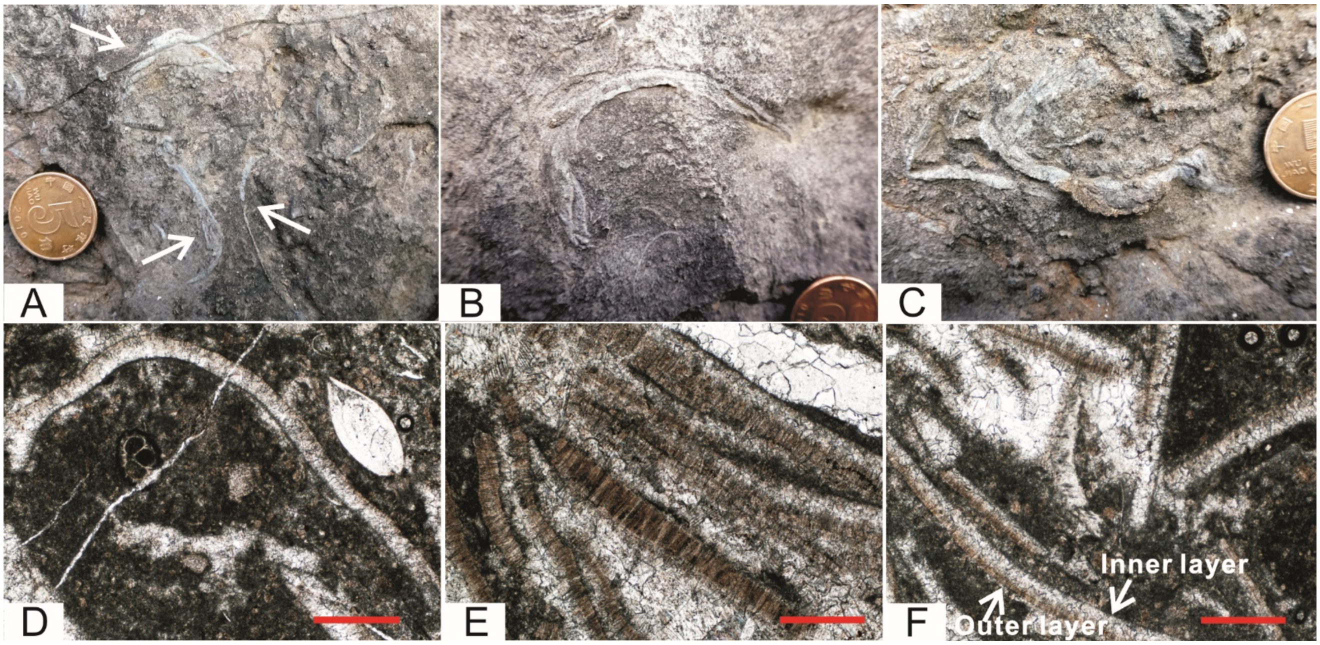


Figure DR1. (A-C) Alatoconchid shells (write arrows), the coin is 2 cm in diameter. (D-F) Photomicrograph showing alatoconchid shell microstructure, valves show a double-layered texture, consisting of prismatic calcite aligned perpendicularly to shell surface, and inner mosaic granular calcite, Bed 3. The red scale bar is 500 μm.

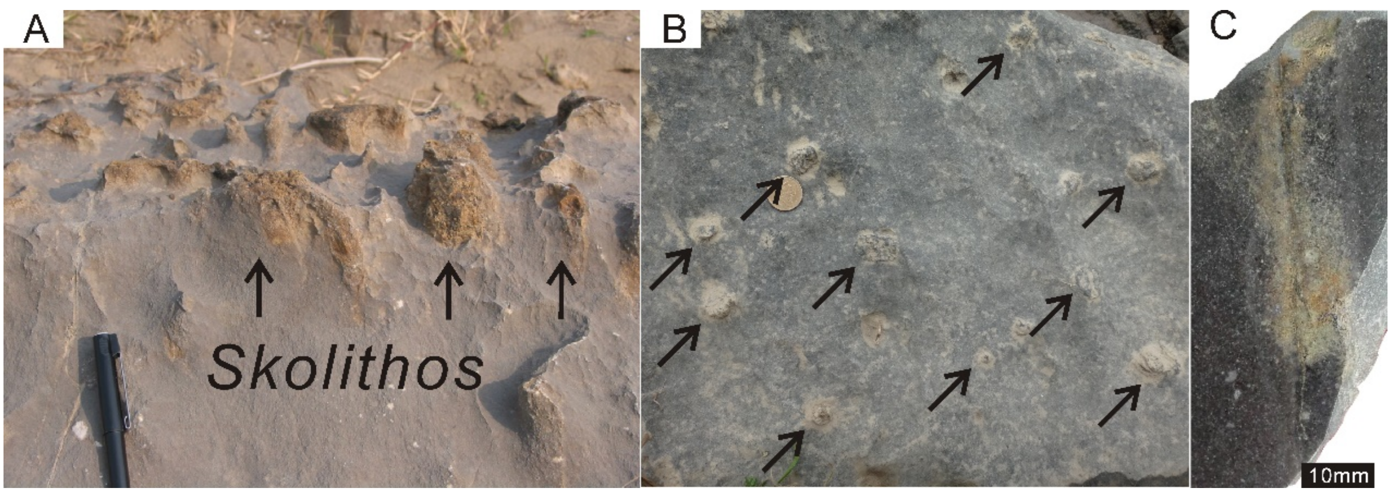


Figure DR2. (A) Profile view of *Skolithos* burrows (arrows) of piperock. The filler of the burrows is siliceous mudstone, which is more weather-resistance than the surrounding limestone. Bed 6k. (B) Plane view of *Skolithos* burrows (arrows) of piperock, Bed 6k. (C) Polished slab showing vertical burrows of *Skolithos*.

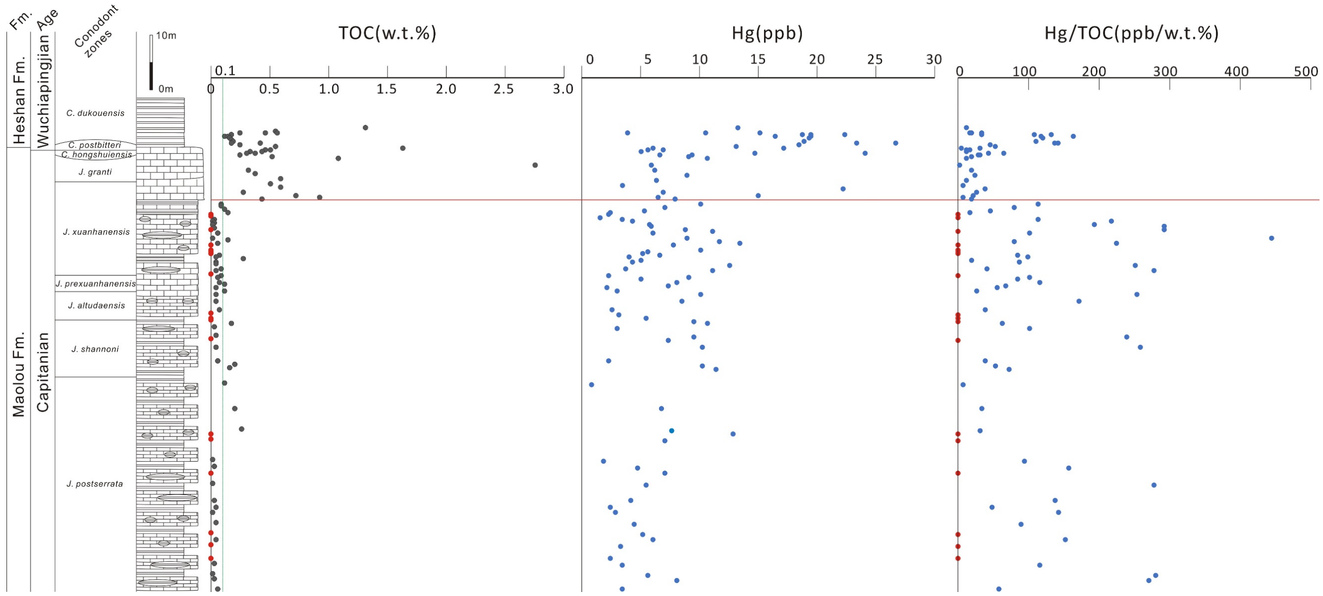


Figure DR3. TOC and Hg concentrations from Penglaitan section. Red horizon line illustrates the base of Laibin Limestone. Note that most of the TOC values are <0.1 wt.%, most of the Hg concentrations are < 10 ppb. Red points represent samples with TOC value < 0.02 wt.% (below detectable limit).

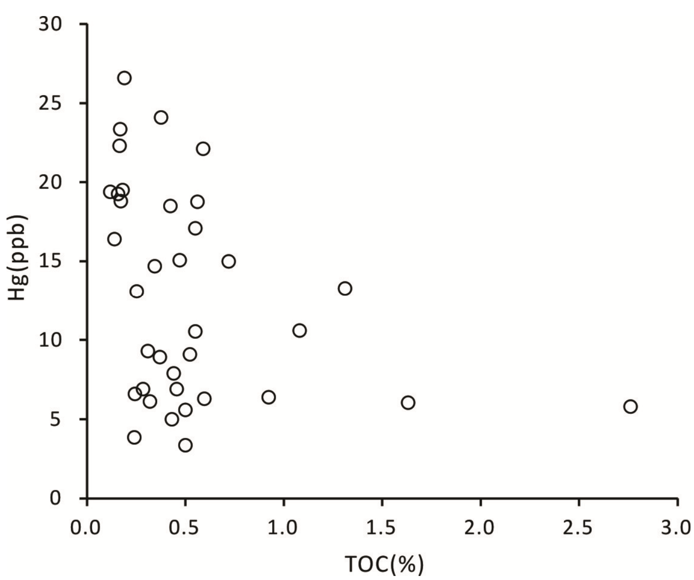


Figure DR4. Cross plots of Hg concentration vs. total organic carbon (TOC) content. There is no statistically significant correlation between Hg content and TOC ($r^2$=0.12, correlation test: p.value = 0.0138, estimate = -0.4066), indicating that Hg/TOC ratios are controlled primarily by temporal variations in environmental Hg concentration.