**Table S1.** The (234U/238U) activity ratio of the 20-25 μm detrital particles extracted from the terrace samples

|  |  |  |  |
| --- | --- | --- | --- |
| Sample No. | Terrance heights (m)\* | (234U/238U) | SE |
| 2019LST44 | 13 | 0.896 | 0.001 |
| 2019LST62 | 8.5 | 0.897 | 0.001 |

\*Height above the present-day river bed.

**Table S2.** The (234U/238U) activity ratio and comminution age of the 20-25 μm detrital particles in a soil profile

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample No. | Depth (m)\* | (234U/238U) | 2SE | *T*20-2 (kyr)\* | SE |
| 2018LST33P-0.2 | 0.2 | 0.905 | 0.001 | 867 | 41 |
| 2018LST33P-0.55 | 0.55 | 0.937 | 0.001 | 331 | 8 |
| 2018LST33P-0.85 | 0.85 | 0.976 | 0.001 | 91 | 2 |
| 2018LST33P-2 | 2 | 0.978 | 0.001 | 83 | 3 |

\*Comminution age is calculated from Eq. (1) using a f value of 0.104±0.001;

**Table S3.** The (234U/238U) activity ratio and comminution age of the 20-25 μm detrital particles of topsoil and river sediment

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample No. | Latitude  (°S) | Longitude  (°E) | Altitude  (m) | Slope  (°) | (234U/238U) | 2SE | *T*20-2 (kyr)\* | SE |
| River sediment | | | | | | | | |
| 2018LST01 | -28.7375 | 28.4194 | 2120 | 16.7 | 0.918 | 0.001 | 546 | 16 |
| 2018LST04 | -29.2906 | 28.9900 | 2784 | 14.2 | 0.924 | 0.001 | 464 | 11 |
| 2018LST25 | -29.5533 | 29.2350 | 2999 | 9.5 | 0.908 | 0.001 | 768 | 30 |
| 2018LST27 | -29.5953 | 28.7117 | 2664 | 13.9 | 0.964 | 0.001 | 152 | 3 |
| 2018LST28 | -29.5950 | 28.7136 | 1913 | 9.4 | 0.918 | 0.001 | 546 | 15 |
| 2019LST02 | -28.7699 | 28.5075 | 2397 | 19.5 | 0.917 | 0.001 | 567 | 16 |
| 2019LST14 | -29.2284 | 28.9094 | 2376 | 17.5 | 0.944 | 0.001 | 274 | 5 |
| 2019LST37 | -28.8396 | 28.7544 | 3184 | 7.7 | 0.933 | 0.001 | 366 | 8 |
| 2019LST40 | -28.7645 | 28.5836 | 2730 | 24.9 | 0.922 | 0.001 | 491 | 12 |
| 2019LST41 | -28.7626 | 28.5487 | 2478 | 22.5 | 0.925 | 0.001 | 453 | 11 |
| 2019LST59 | -29.0479 | 28.3126 | 2408 | 23.1 | 0.922 | 0.001 | 491 | 12 |
| 2019LST61 | -29.0202 | 28.5480 | 2855 | 14.2 | 0.930 | 0.001 | 396 | 9 |
| 2019LST63 | -29.0535 | 28.5152 | 2591 | 17.7 | 0.923 | 0.001 | 478 | 12 |
| **AVERAGE** |  |  |  |  | **0.927** |  | **461** |  |
| **SE** |  |  |  |  | **0.004** |  | **41** |  |
| Topsoil：Surface soil of profile | | | | | | | | |
| 2018LST31P | -29.5219 | 29.191 | 3482 |  | 0.913 | 0.001 | 648 | 20 |
| 2018LST35P | -29.4683 | 29.2692 | 3470 |  | 0.920 | 0.001 | 520 | 14 |
| **AVERAGE** |  |  |  |  | **0.917** |  | **584** |  |
| **SE** |  |  |  |  | **0.004** |  | **64** |  |
| Topsoil：Low elevation hillslope | | | | | | | | |
| 2019LST48 | -29.3507 | 28.4927 | 2419 | 3.5 | 0.918 | 0.001 | 583 | 16 |
| 2019LST49 | -29.3514 | 28.4920 | 2399 | 11.3 | 0.917 | 0.001 | 567 | 15 |
| 2019LST50 | -29.3513 | 28.4911 | 2382 | 12 | 0.933 | 0.001 | 366 | 7 |
| 2019LST51 | -29.3508 | 28.4906 | 2362 | 14.8 | 0.936 | 0.001 | 339 | 8 |
| 2019LST52 | -29.3503 | 28.4900 | 2333 | 15.3 | 0.928 | 0.001 | 418 | 9 |
| 2019LST53 | -29.3497 | 28.4897 | 2310 | 22.9 | 0.914 | 0.001 | 622 | 20 |
| 2019LST55 | -29.3500 | 28.4886 | 2281 | 20.9 | 0.926 | 0.001 | 441 | 10 |
| **AVERAGE** |  |  |  |  | **0.925** |  | **477** |  |
| **SE** |  |  |  |  | **0.003** |  | **43** |  |
| Topsoil：High elevation hillslope | | | | | | | | |
| 2019LST65 | -28.8244 | 28.7445 | 3055 | 3.4 | 0.905 | 0.001 | 867 | 41 |
| 2019LST66 | -28.8231 | 28.7477 | 3080 | 8.9 | 0.920 | 0.001 | 520 | 13 |
| 2019LST67 | -28.8228 | 28.7505 | 3130 | 16.3 | 0.927 | 0.001 | 429 | 10 |
| 2019LST68 | -28.8241 | 28.7544 | 3142 | 6.4 | 0.933 | 0.001 | 366 | 7 |
| 2019LST69 | -28.8249 | 28.7604 | 3211 | 6.2 | 0.904 | 0.001 | 909 | 45 |
| 2019LST70 | -28.8207 | 28.7740 | 3282 | 1.3 | 0.911 | 0.001 | 686 | 26 |
| 2019LST71 | -28.8191 | 28.7693 | 3222 | 5.0 | 0.930 | 0.001 | 396 | 8 |
| 2019LST72-1 | -28.8192 | 28.7671 | 3194 | 8.9 | 0.910 | 0.001 | 711 | 24 |
| 2019LST72-2 | -28.8169 | 28.7621 | 3194 | 8.9 | 0.900 | 0.001 | 1154 | 96 |
| 2019LST73 | -28.8169 | 28.7594 | 3173 | 10.2 | 0.910 | 0.001 | 711 | 24 |
| 2019LST74 | -28.8196 | 28.7546 | 3163 | 15.2 | 0.915 | 0.001 | 602 | 18 |
| 2019LST75 | -28.8217 | 28.7456 | 3097 | 8.5 | 0.918 | 0.001 | 550 | 15 |
| 2019LST77 | -28.8238 | 28.7440 | 3054 | 2.5 | 0.914 | 0.002 | 621 | 24 |
| **AVERAGE** |  |  |  |  | **0.915** |  | **656** |  |
| **SE** |  |  |  |  | **0.003** |  | **62** |  |
| **Totally：** | | | | | | | | |
| **AVERAGE** |  |  |  |  | **0.921** |  | **543** |  |
| **SE** |  |  |  |  | **0.002** |  | **32** |  |

\*Comminution age is calculated from Eq. (1) using a f value of 0.104±0.001;

**Table S4.** The (234U/238U) activity ratio of groundwater, river water, and reserivor water, and the exchangeable fraction of topsoil

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample No. | Latitude  (°S) | Longitude  (°E)\* | Sampling time | (234U/238U) | SE |
| Groundwater | | | | | |
| 2019LST47 | -29.3377 | 28.505 | JUN-2019 | 1.729 | 0.002 |
| 2019LST56 | -29.2322 | 28.5576 | JUN-2019 | 1.625 | 0.001 |
| 2019LST58 | -29.2275 | 28.5373 | JUN-2019 | 1.552 | 0.002 |
| **AVE** |  |  |  | **1.635** |  |
| **SE** |  |  |  | **0.051** |  |
| River water | | | | | |
| 2018LST03 | -28.7697 | 28.5067 | APRIL-2018 | 1.380 | 0.001 |
| 2018LST04 | -29.2906 | 28.9900 | APRIL-2018 | 1.504 | 0.001 |
| 2018LST05 | -29.2844 | 28.9672 | APRIL-2018 | 1.660 | 0.001 |
| 2018LST07 | -29.1067 | 28.8882 | APRIL-2018 | 1.473 | 0.001 |
| 2018LST09 | -29.1070 | 28.8606 | APRIL-2018 | 1.479 | 0.002 |
| 2018LST13 | -29.1695 | 28.8737 | APRIL-2018 | 1.564 | 0.001 |
| 2018LST15 | -29.3350 | 29.0350 | APRIL-2018 | 1.685 | 0.000 |
| 2018LST16 | -29.3733 | 29.0754 | APRIL-2018 | 1.558 | 0.000 |
| 2018LST18 | -29.4192 | 29.1169 | APRIL-2018 | 1.514 | 0.001 |
| 2018LST19 | -29.4672 | 29.1636 | APRIL-2018 | 1.476 | 0.001 |
| 2018LST20 | -29.4669 | 29.1649 | APRIL-2018 | 1.444 | 0.002 |
| 2018LST21 | -29.4655 | 29.1633 | APRIL-2018 | 1.430 | 0.003 |
| 2018LST27 | -29.5953 | 28.7117 | APRIL-2018 | 1.468 | 0.001 |
| 2018LST28 | -29.5950 | 28.7136 | APRIL-2018 | 1.756 | 0.001 |
| 2018LST30 | -29.5989 | 29.3086 | APRIL-2018 | 1.470 | 0.002 |
| 2018LST39 | -28.7381 | 28.6172 | APRIL-2018 | 1.487 | 0.005 |
| 2018LST41 | -28.7575 | 28.5470 | APRIL-2018 | 1.394 | 0.002 |
| 2018LST42 | -28.7537 | 28.5211 | APRIL-2018 | 1.404 | 0.001 |
| 2019LST02 | -28.7699 | 28.5075 | JUN-2019 | 1.434 | 0.002 |
| 2019LST03 | -28.7694 | 28.5079 | JUN-2019 | 1.383 | 0.001 |
| 2019LST04 | -29.2903 | 28.9900 | JUN-2019 | 1.473 | 0.002 |
| 2019LST05 | -29.2829 | 28.9668 | JUN-2019 | 1.532 | 0.001 |
| 2019LST07 | -29.2104 | 28.8892 | JUN-2019 | 1.453 | 0.002 |
| 2019LST14 | -29.2284 | 28.9094 | JUN-2019 | 1.443 | 0.002 |
| 2019LST27 | -29.5957 | 28.7119 | JUN-2019 | 1.442 | 0.002 |
| 2019LST28 | -29.5953 | 28.7143 | JUN-2019 | 1.778 | 0.010 |
| 2019LST37 | -28.8396 | 28.7544 | JUN-2019 | 1.436 | 0.002 |
| 2019LST39 | -28.7336 | 28.6186 | JUN-2019 | 1.452 | 0.004 |
| 2019LST40 | -28.7645 | 28.5836 | JUN-2019 | 1.438 | 0.002 |
| 2019LST41 | -28.7626 | 28.5487 | JUN-2019 | 1.412 | 0.002 |
| 2019LST46 | -29.5898 | 28.7135 | JUN-2019 | 1.451 | 0.001 |
| 2019LST57 | -29.2301 | 28.5615 | JUN-2019 | 1.416 | 0.002 |
| 2019LST59 | -29.0479 | 28.3126 | JUN-2019 | 1.392 | 0.003 |
| 2019LST61 | -29.0202 | 28.5480 | JUN-2019 | 1.442 | 0.002 |
| 2019LST63 | -29.0535 | 28.5152 | JUN-2019 | 1.566 | 0.001 |
| 2019LST64 | -28.8258 | 28.7424 | JUN-2019 | 1.404 | 0.002 |
| **AVE** |  |  |  | **1.486** |  |
| **SE** |  |  |  | **0.016** |  |
| Reservoir water | | | | | |
| 2019LST43 | -28.4397 | 28.7135 | JUN-2019 | 1.419 | 0.002 |
| 2019LST45 | -29.3446 | 28.5194 | JUN-2019 | 1.424 | 0.002 |
| 2019LST60 | -29.0007 | 28.6904 | JUN-2019 | 1.424 | 0.002 |
| 2018LST43 | -28.4394 | 28.3972 | APRIL-2018 | 1.417 | 0.001 |
| 2018LST26 | -29.3361 | 28.5014 | APRIL-2018 | 1.383 | 0.001 |
| **AVERAGE** |  |  |  | **1.413** |  |
| **SE** |  |  |  | **0.008** |  |
| **Totally:** | | | | | |
| **AVERAGE** |  |  |  | **1.488** |  |
| **SE** |  |  |  | **0.015** |  |

**Table S5.** The (234U/238U) activity ratio of the exchangeable fraction of topsoil

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample No. | Latitude  (°S) | Longitude  (°E)\* | (234U/238U) | SE |
| Low elevation hillslope | | | | |
| 2019LST48 | -29.3507 | 28.4927 | 1.528 | 0.001 |
| 2019LST49 | -29.3514 | 28.4920 | 1.569 | 0.001 |
| 2019LST50 | -29.3513 | 28.4911 | 1.400 | 0.001 |
| 2019LST51 | -29.3508 | 28.4906 | 1.518 | 0.001 |
| 2019LST52 | -29.3503 | 28.4900 | 1.438 | 0.001 |
| 2019LST53 | -29.3497 | 28.4897 | 1.348 | 0.001 |
| 2019LST54 | -29.3490 | 28.4892 | 1.223 | 0.001 |
| 2019LST55 | -29.3500 | 28.4886 | 1.378 | 0.001 |
| **AVERAGE** |  |  | **1.425** |  |
| **SE** |  |  | **0.040** |  |
| 2019LST65 | -28.8244 | 28.7445 | 1.544 | 0.001 |
| 2019LST66 | -28.8231 | 28.7477 | 1.542 | 0.002 |
| 2019LST67 | -28.8228 | 28.7505 | 1.527 | 0.001 |
| 2019LST68 | -28.8240 | 28.7544 | 1.448 | 0.001 |
| 2019LST69 | -28.8249 | 28.7604 | 1.421 | 0.001 |
| 2019LST70 | -28.8207 | 28.7740 | 1.530 | 0.001 |
| 2019LST71 | -28.8191 | 28.7693 | 1.472 | 0.001 |
| 2019LST72-1 | -28.8192 | 28.7671 | 1.474 | 0.001 |
| 2019LST72-2 | -28.8169 | 28.7621 | 1.465 | 0.001 |
| 2019LST73 | -28.8169 | 28.7594 | 1.460 | 0.001 |
| 2019LST74 | -28.8196 | 28.7546 | 1.508 | 0.001 |
| 2019LST75 | -28.8217 | 28.7456 | 1.541 | 0.001 |
| 2019LST77 | -28.8238 | 28.7440 | 1.508 | 0.001 |
| **AVERAGE** |  |  | **1.495** |  |
| **SE** |  |  | **0.011** |  |
| **Totally:** | | | | |
| **AVERAGE** |  |  | **1.469** |  |
| **SE** |  |  | **0.018** |  |

**Table S6.** Average elemental compositions of soil, river water, and bedrock

|  |  |  |  |
| --- | --- | --- | --- |
| Samples | Average value | SE | n |
| Ca content |  |  |  |
| Soil | 33.2 mg/g | 2.2 mg/g | 30 |
| Bedrock | 58.3 mg/g | 4.0 mg/g | 6 |
| U/Ca ratio |  |  |  |
| River and reservoir water | 0.13μmol/mol | 0.03μmol/mol | 18 |
| Bedrock | 1.14μmol/mol | 0.44μmol/mol | 6 |
| U/Th ratio |  |  |  |
| Soil | 0.30 mol/mol | 0.04 mol/mol | 30 |
| Bedrock | 0.24 mol/mol | 0.01 mol/mol | 6 |