**Supplementary Data Table S1. Rutile (inclusions within garnet) geochemistry for samples 17SD05, 17SD06 and 17SD07**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Spot** | **ppm** | | | | | | | | | | |  | **wt%** |  | **Tomkins et al. 2007** | |
| **Ti** | **Al** | **Si** | **Fe** | **Zr** | **Nb** | **Ta** | **W** | **Cr** | **V** | **O** |  | **Total** |  | ***P*** | ***T*** |
| 17SD05-1 | 588502 | 751 | 76 | 6025 | 1405 | 13335 | 1310 | 248 | 785 | 2623 | 403819 |  | 101.888 |  | 13 | 807 |
| 17SD05-2 | 590923 | 759 | 30 | 4845 | 1515 | 13560 | 1396 | 289 | 700 | 2534 | 405137 |  | 102.169 |  | 13 | 815 |
| 17SD05-3 | 590842 | 744 | 31 | 4730 | 1578 | 13653 | 1435 | 322 | 779 | 2517 | 405146 |  | 102.178 |  | 13 | 819 |
| 17SD05-4 | 587507 | 728 | 38 | 4657 | 1527 | 13583 | 1417 | 341 | 702 | 2549 | 402823 |  | 101.587 |  | 13 | 816 |
| 17SD05-5 | 591306 | 753 | 32 | 4633 | 1439 | 13950 | 1385 | 341 | 637 | 2531 | 405451 |  | 102.246 |  | 13 | 810 |
| 17SD05-6 | 595288 | 194 | 236 | 4508 | 1102 | 1782 | 177 | 208 | 220 | 2766 | 398751 |  | 100.523 |  | 13 | 782 |
| 17SD05-7 | 593213 | 244 | 122 | 3976 | 2098 | 3092 | 186 | 392 | 233 | 2757 | 398092 |  | 100.441 |  | 13 | 851 |
| 17SD05-8 | 598350 | 184 | 195 | 5135 | 295 | 2085 | 199 | 300 | 226 | 2651 | 397406 |  | 100.703 |  | 13 | 664 |
| 17SD05-9 | 598860 | 192 | 219 | 5785 | 1962 | 1948 | 82 | 293 | 307 | 2478 | 396415 |  | 100.854 |  | 13 | 844 |
| 17SD05-10 | 599574 | 198 | 212 | 4337 | 2300 | 2442 | 202 | 441 | 182 | 2934 | 395693 |  | 100.852 |  | 13 | 862 |
| 17SD05-11 | 585047 | 291 | 171 | 7082 | 1806 | 11316 | 188 | 604 | 346 | 4004 | 401079 |  | 101.193 |  | 13 | 834 |
| 17SD05-12 | 597112 | 270 | 182 | 4752 | 1195 | 4256 | 185 | 637 | 419 | 2945 | 394711 |  | 100.666 |  | 13 | 790 |
| 17SD05-13 | 590514 | 181 | 201 | 4496 | 698 | 1612 | 113 | 328 | 62 | 3052 | 398691 |  | 99.995 |  | 13 | 738 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17SD06-1 | 590542 | 183 | 266 | 6626 | 2068 | 1883 | 110 | 297 | 90 | 2746 | 399852 |  | 100.466 |  | 13 | 850 |
| 17SD06-2 | 589400 | 259 | 262 | 4183 | 1716 | 2216 | 80 | 307 | 400 | 3109 | 398747 |  | 100.068 |  | 13 | 829 |
| 17SD06-3 | 591529 | 240 | 267 | 4140 | 1768 | 2204 | 102 | 329 | 483 | 2966 | 400177 |  | 100.421 |  | 13 | 832 |
| 17SD06-4 | 592051 | 202 | 236 | 4997 | 2267 | 2067 | 141 | 427 | 293 | 2615 | 400598 |  | 100.589 |  | 13 | 860 |
| 17SD06-5 | 590388 | 407 | 615 | 3208 | 998 | 1753 | 72 | 364 | 182 | 2795 | 399011 |  | 99.979 |  | 13 | 772 |
| 17SD06-6 | 596284 | 192 | 219 | 5067 | 263 | 3237 | 206 | 566 | 273 | 2407 | 398163 |  | 100.688 |  | 13 | 655 |
| 17SD06-7 | 580904 | 756 | 75 | 5293 | 1678 | 16009 | 1636 | 441 | 1215 | 2980 | 400274 |  | 101.126 |  | 13 | 826 |
| 17SD06-8 | 594168 | 126 | 130 | 6052 | 1953 | 1280 | 169 | 239 | 304 | 2590 | 401629 |  | 100.864 |  | 13 | 843 |
| 17SD06-9 | 595795 | 154 | 172 | 4956 | 1703 | 1534 | 120 | 161 | 233 | 2201 | 402248 |  | 100.928 |  | 13 | 828 |
| 17SD06-10 | 600010 | 176 | 170 | 4750 | 448 | 1446 | 84 | 147 | 276 | 2304 | 404601 |  | 101.441 |  | 13 | 699 |
| 17SD06-11 | 589868 | 218 | 197 | 6585 | 2343 | 2128 | 118 | 349 | 209 | 2847 | 399662 |  | 100.452 |  | 13 | 864 |
| 17SD06-12 | 596369 | 157 | 163 | 3450 | 1211 | 1684 | 30 | 268 | 380 | 2729 | 402409 |  | 100.885 |  | 13 | 792 |
| 17SD06-13 | 589368 | 507 | 699 | 7584 | 1640 | 5962 | 537 | 357 | 291 | 2868 | 401990 |  | 101.180 |  | 13 | 824 |
| 17SD06-14 | 597605 | 185 | 129 | 5418 | 2439 | 1855 | 170 | 327 | 275 | 2430 | 404146 |  | 101.498 |  | 13 | 869 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17SD07-1 | 595791 | 158 | 165 | 4386 | 2089 | 1265 | 250 | 205 | 304 | 2530 | 402257 |  | 100.940 |  | 13 | 851 |
| 17SD07-2 | 588422 | 379 | 188 | 5294 | 371 | 7383 | 52 | 529 | 330 | 3466 | 400410 |  | 100.682 |  | 13 | 683 |
| 17SD07-3 | 592101 | 291 | 177 | 5540 | 496 | 6809 | 194 | 500 | 266 | 3236 | 402530 |  | 101.214 |  | 13 | 707 |
| 17SD07-4 | 598631 | 166 | 142 | 5657 | 285 | 2374 | 163 | 173 | 348 | 2554 | 404417 |  | 101.491 |  | 13 | 661 |
| 17SD07-5 | 598017 | 150 | 135 | 4794 | 328 | 1587 | 30 | 173 | 363 | 2446 | 403340 |  | 101.136 |  | 13 | 673 |
| 17SD07-6 | 598076 | 151 | 128 | 6294 | 1832 | 1894 | 160 | 416 | 265 | 2348 | 404463 |  | 101.603 |  | 13 | 836 |
| 17SD07-7 | 592344 | 236 | 698 | 7045 | 882 | 3470 | 211 | 400 | 346 | 2375 | 401976 |  | 100.998 |  | 13 | 760 |
| 17SD07-8 | 589552 | 465 | 200 | 8846 | 2333 | 8084 | 427 | 597 | 223 | 2946 | 403069 |  | 101.674 |  | 13 | 863 |
| 17SD07-9 | 597393 | 159 | 183 | 3864 | 2336 | 3993 | 235 | 616 | 395 | 3241 | 405009 |  | 101.742 |  | 13 | 864 |
| 17SD07-10 | 592844 | 333 | 214 | 5852 | 2238 | 6110 | 317 | 835 | 440 | 2694 | 403446 |  | 101.532 |  | 13 | 859 |

**Supplementary Data Table S2. Garnet geochemistry (ppm) for samples 17SD06 and 17SD07**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Spot** | **P** | **Ca** | **Sc** | **Y** | **La** | **Ce** | **Pr** | **Nd** | **Sm** | **Eu** | **Gd** | **Tb** | **Dy** | **Ho** | **Er** | **Tm** | **Yb** | **Lu** | **Hf** | **Ta** |
| 17SD06-01 | 140.26 | 6692.83 | 76.17 | 58.01 | 0.17 | 0.14 | 0.10 | 0.93 | 1.57 | 0.27 | 8.66 | 2.17 | 14.02 | 2.49 | 5.32 | 0.58 | 3.02 | 0.42 | 0.35 | 0.15 |
| 17SD06-02 | 138.85 | 7816.87 | 72.37 | 77.95 | 0.17 | 0.17 | 0.14 | 0.88 | 2.23 | 0.19 | 8.36 | 2.25 | 17.12 | 3.33 | 8.10 | 0.81 | 4.31 | 0.45 | 0.38 | 0.14 |
| 17SD06-03 | 158.19 | 9283.43 | 71.19 | 96.14 | 0.16 | 0.13 | 0.14 | 0.88 | 1.89 | 0.24 | 8.86 | 2.44 | 19.75 | 3.62 | 7.79 | 0.78 | 4.44 | 0.46 | 0.44 | 0.08 |
| 17SD06-04 | 169.61 | 9001.21 | 71.92 | 132.15 | 0.21 | 0.15 | 0.14 | 0.71 | 2.46 | 0.24 | 9.51 | 2.74 | 22.74 | 4.22 | 9.87 | 1.18 | 6.38 | 0.70 | 0.43 | 0.15 |
| 17SD06-05 | 179.01 | 10198.74 | 69.48 | 177.04 | 0.18 | 0.17 | 0.15 | 0.71 | 2.37 | 0.22 | 10.32 | 2.98 | 25.14 | 5.62 | 15.27 | 2.15 | 13.33 | 1.35 | 0.42 | 0.19 |
| 17SD06-06 | 202.63 | 8000.35 | 50.08 | 182.06 | 0.12 | 0.15 | 0.13 | 0.72 | 1.72 | 0.18 | 7.41 | 2.04 | 21.76 | 5.79 | 20.31 | 3.26 | 22.10 | 2.77 | 0.48 | 0.13 |
| 17SD06-07 | 231.76 | 10135.04 | 61.05 | 300.77 | 0.17 | 0.14 | 0.11 | 0.70 | 2.08 | 0.26 | 8.76 | 2.82 | 28.18 | 9.73 | 38.66 | 6.46 | 44.58 | 5.19 | 0.51 | 0.14 |
| 17SD06-08 | 230.78 | 10832.03 | 61.86 | 372.98 | 0.24 | 0.14 | 0.16 | 0.62 | 1.71 | 0.21 | 9.35 | 3.14 | 34.30 | 12.22 | 56.45 | 10.01 | 78.98 | 10.04 | 0.38 | 0.13 |
| 17SD06-09 | 288.28 | 10106.49 | 57.24 | 382.58 | 0.20 | 0.12 | 0.16 | 0.94 | 1.99 | 0.20 | 8.79 | 2.63 | 31.63 | 12.54 | 61.23 | 11.96 | 95.04 | 14.76 | 0.32 | 0.22 |
| 17SD06-10 | 320.45 | 10154.21 | 58.54 | 411.60 | 0.22 | 0.13 | 0.15 | 0.92 | 1.91 | 0.20 | 8.60 | 2.90 | 32.06 | 13.61 | 70.72 | 14.31 | 116.98 | 17.87 | 0.49 | 0.16 |
| 17SD06-11 | 285.37 | 8038.59 | 44.94 | 313.23 | 0.15 | 0.12 | 0.12 | 0.67 | 1.21 | 0.16 | 6.29 | 1.97 | 25.17 | 10.67 | 55.54 | 11.78 | 97.24 | 15.35 | 2.46 | 0.12 |
| 17SD06-12 | 427.45 | 10516.64 | 62.77 | 408.68 | 0.16 | 0.20 | 0.11 | 0.76 | 1.28 | 0.22 | 8.25 | 2.90 | 34.88 | 13.96 | 70.47 | 14.47 | 117.74 | 18.39 | 0.46 | 0.16 |
| 17SD06-13 | 485.39 | 10263.58 | 60.08 | 418.20 | 0.24 | 0.19 | 0.14 | 0.87 | 1.77 | 0.23 | 10.40 | 2.96 | 35.82 | 14.43 | 69.65 | 13.73 | 111.22 | 17.08 | 0.44 | 0.19 |
| 17SD06-14 | 578.88 | 10823.18 | 60.94 | 396.10 | 0.18 | 0.14 | 0.16 | 1.09 | 2.17 | 0.20 | 9.09 | 2.93 | 36.51 | 13.41 | 66.39 | 12.38 | 105.45 | 15.76 | 0.42 | 0.16 |
| 17SD06-15 | 126.58 | 13385.85 | 68.37 | 443.59 | 0.25 | 0.17 | 0.14 | 0.92 | 1.91 | 0.26 | 10.98 | 3.10 | 36.82 | 13.76 | 58.55 | 9.78 | 78.09 | 9.94 | 0.93 | 0.20 |
| 17SD06-16 | 811.17 | 10806.01 | 69.22 | 293.02 | 0.17 | 0.21 | 0.12 | 1.09 | 2.70 | 0.25 | 9.77 | 3.21 | 35.51 | 10.02 | 34.70 | 5.84 | 42.16 | 5.36 | 0.63 | 0.12 |
| 17SD06-17 | 1012.20 | 11032.58 | 62.16 | 207.66 | 0.21 | 0.19 | 0.15 | 0.96 | 2.09 | 0.29 | 10.63 | 2.99 | 29.86 | 6.66 | 20.24 | 2.61 | 18.19 | 2.26 | 0.46 | 0.15 |
| 17SD06-18 | 114.22 | 11197.29 | 78.37 | 184.83 | 0.19 | 0.19 | 0.16 | 0.96 | 1.97 | 0.24 | 12.30 | 3.43 | 28.93 | 6.11 | 14.26 | 1.68 | 10.21 | 1.25 | 0.57 | 0.17 |
| 17SD06-19 | 229.00 | 11324.94 | 84.23 | 113.67 | 2.29 | 3.38 | 0.31 | 1.44 | 2.58 | 0.44 | 12.27 | 3.30 | 23.50 | 3.69 | 9.08 | 1.05 | 6.15 | 0.71 | 49.22 | 126.87 |
| 17SD06-20 | 83.74 | 9981.04 | 72.00 | 69.58 | 0.21 | 0.15 | 0.14 | 1.00 | 2.74 | 0.30 | 9.94 | 2.38 | 18.38 | 3.01 | 6.64 | 0.73 | 3.95 | 0.56 | 0.40 | 0.16 |
| 17SD06-21 | 99.07 | 7837.74 | 68.71 | 49.38 | 0.22 | 0.14 | 0.15 | 1.15 | 1.88 | 0.22 | 9.26 | 2.10 | 12.43 | 2.15 | 4.32 | 0.54 | 2.40 | 0.34 | 0.58 | 0.20 |
| 17SD06-22 | 106.72 | 6618.59 | 69.18 | 38.55 | 0.14 | 0.19 | 0.13 | 0.91 | 1.26 | 0.26 | 8.25 | 1.74 | 10.92 | 1.33 | 2.92 | 0.31 | 1.78 | 0.24 | 0.44 | 0.22 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17SD07-01 | 478.58 | 6552.11 | 85.98 | 29.13 | 0.11 | 0.08 | 0.05 | 0.51 | 1.42 | 0.10 | 8.79 | 1.75 | 8.06 | 0.85 | 1.87 | 0.25 | 1.48 | 0.24 | 0.26 | 0.08 |
| 17SD07-02 | 532.16 | 8415.18 | 72.83 | 19.81 | 0.11 | 0.11 | 0.07 | 0.46 | 2.07 | 0.15 | 7.37 | 1.38 | 6.24 | 0.79 | 1.29 | 0.14 | 0.82 | 0.12 | 0.18 | 0.07 |
| 17SD07-03 | 233.75 | 11071.14 | 79.75 | 60.59 | 0.12 | 0.07 | 0.07 | 0.74 | 2.14 | 0.32 | 12.50 | 2.98 | 18.33 | 2.70 | 5.18 | 0.66 | 2.94 | 0.36 | 0.23 | 0.09 |
| 17SD07-04 | 194.95 | 10968.50 | 72.66 | 143.94 | 0.11 | 0.07 | 0.06 | 0.84 | 2.53 | 0.19 | 15.57 | 4.73 | 34.06 | 5.41 | 11.05 | 1.24 | 8.01 | 1.14 | 0.29 | 0.06 |
| 17SD07-05 | 224.54 | 11151.87 | 68.10 | 260.29 | 0.09 | 0.06 | 0.05 | 0.44 | 1.49 | 0.21 | 14.49 | 5.72 | 47.68 | 8.79 | 21.50 | 2.81 | 19.04 | 2.42 | 0.36 | 0.07 |
| 17SD07-06 | 150.86 | 11235.75 | 57.31 | 462.69 | 0.07 | 0.07 | 0.07 | 0.53 | 1.96 | 0.27 | 16.04 | 6.43 | 69.20 | 15.94 | 47.30 | 6.94 | 43.72 | 5.57 | 0.21 | 0.08 |
| 17SD07-07 | 130.50 | 11437.76 | 50.35 | 674.14 | 0.18 | 0.34 | 0.06 | 0.51 | 2.05 | 0.25 | 16.87 | 6.94 | 87.71 | 25.21 | 86.96 | 12.91 | 88.59 | 12.45 | 10.28 | 0.07 |
| 17SD07-08 | 126.73 | 11033.41 | 51.69 | 769.61 | 0.11 | 0.10 | 0.08 | 0.43 | 1.26 | 0.18 | 15.92 | 7.28 | 92.87 | 28.89 | 106.26 | 17.16 | 117.40 | 18.31 | 0.21 | 0.07 |
| 17SD07-09 | 107.33 | 11487.39 | 51.65 | 814.16 | 0.09 | 0.08 | 0.07 | 0.67 | 2.05 | 0.16 | 15.49 | 7.14 | 93.72 | 30.49 | 113.38 | 18.58 | 130.97 | 20.12 | 0.22 | 0.06 |
| 17SD07-10 | 86.32 | 11094.15 | 52.42 | 802.23 | 0.11 | 0.13 | 0.07 | 0.39 | 1.66 | 0.16 | 14.85 | 6.82 | 92.02 | 29.55 | 112.57 | 19.18 | 137.58 | 21.67 | 0.32 | 0.06 |
| 17SD07-11 | 84.95 | 11089.27 | 53.44 | 813.68 | 0.07 | 0.09 | 0.07 | 0.67 | 1.48 | 0.26 | 15.32 | 6.92 | 94.39 | 30.27 | 114.26 | 19.31 | 142.25 | 23.74 | 0.23 | 0.05 |
| 17SD07-12 | 78.82 | 11355.26 | 51.05 | 753.69 | 0.10 | 0.09 | 0.06 | 0.39 | 1.47 | 0.23 | 14.68 | 6.44 | 87.61 | 27.73 | 108.66 | 18.36 | 137.82 | 22.60 | 0.18 | 0.08 |
| 17SD07-13 | 118.24 | 11452.41 | 55.44 | 409.15 | 0.06 | 0.09 | 0.07 | 0.51 | 1.53 | 0.28 | 14.77 | 5.84 | 57.52 | 13.50 | 39.48 | 5.34 | 35.76 | 4.62 | 0.22 | 0.06 |
| 17SD07-14 | 90.76 | 11107.88 | 62.71 | 238.22 | 0.08 | 0.10 | 0.07 | 0.91 | 1.75 | 0.34 | 15.63 | 5.35 | 40.58 | 7.46 | 16.98 | 2.00 | 14.02 | 1.74 | 0.13 | 0.07 |
| 17SD07-15 | 72.73 | 11206.02 | 67.05 | 74.44 | 0.06 | 0.09 | 0.05 | 1.06 | 2.06 | 0.19 | 14.62 | 3.92 | 21.65 | 2.76 | 5.39 | 0.72 | 4.04 | 0.69 | 0.23 | 0.09 |
| 17SD07-16 | 80.36 | 11016.16 | 72.21 | 32.46 | 0.09 | 0.13 | 0.06 | 0.53 | 2.12 | 0.35 | 14.13 | 2.69 | 11.18 | 1.07 | 2.08 | 0.27 | 2.22 | 0.28 | 0.26 | 0.07 |
| 17SD07-17 | 217.61 | 8806.28 | 77.98 | 13.82 | 0.08 | 0.08 | 0.06 | 0.64 | 1.88 | 0.25 | 8.23 | 1.37 | 5.66 | 0.55 | 1.11 | 0.12 | 1.17 | 0.16 | 0.16 | 0.05 |
| 17SD07-18 | 417.14 | 7917.53 | 83.88 | 22.69 | 0.10 | 0.06 | 0.07 | 0.41 | 1.99 | 0.13 | 8.31 | 1.48 | 6.82 | 0.86 | 1.69 | 0.21 | 1.61 | 0.18 | 0.19 | 0.04 |

Note: The analyzed traverses are shown in Fig. 7h and l: C-D and E-F.

**Supplementary Data Table S3. SIMS monazite U-Pb results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **spot #** | **U(wt%)** | **Th(wt%)** | **Th/U** | **206Pb/204Pbm** | **f206%** | **207Pb/206Pb** | **±s(%)** | **207Pb/235U** | **±s(%)** | **206Pb/238U** | **±s(%)** | **r** | **207Pb/206Pb (age/Ma)** | **±s** | **207Pb/235U (age/Ma)** | **±s** | **206Pb/238U (age/Ma)** | **±s** | **Dis**  **%** |
| **17SD06** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0.22 | 3.8 | 17 | 32354 | 0.06 | 0.11289 | 0.42 | 5.16532 | 1.56 | 0.3319 | 1.50 | 0.96312 | 1846.4 | 7.6 | 1846.9 | 13.3 | 1847.4 | 24.2 | 0.06 |
| 2 | 0.94 | 5.0 | 5 | 39440 | 0.05 | 0.11435 | 0.43 | 5.25523 | 1.57 | 0.3333 | 1.51 | 0.96143 | 1869.7 | 7.8 | 1861.6 | 13.5 | 1854.4 | 24.4 | 0.94 |
| 3 | 0.18 | 4.2 | 24 | 17158 | 0.11 | 0.11255 | 0.44 | 5.16611 | 1.56 | 0.3329 | 1.50 | 0.96030 | 1841.0 | 7.9 | 1847.1 | 13.4 | 1852.4 | 24.2 | 0.71 |
| 4 | 0.17 | 4.1 | 24 | 16909 | 0.11 | 0.11227 | 0.48 | 5.20087 | 1.58 | 0.3360 | 1.50 | 0.95153 | 1836.5 | 8.8 | 1852.8 | 13.5 | 1867.3 | 24.4 | 1.93 |
| 5 | 0.21 | 3.8 | 18 | 23195 | 0.08 | 0.11265 | 0.44 | 5.17981 | 1.57 | 0.3335 | 1.51 | 0.96022 | 1842.6 | 7.9 | 1849.3 | 13.5 | 1855.3 | 24.4 | 0.79 |
| 6 | 0.23 | 4.7 | 20 | 23607 | 0.08 | 0.11340 | 0.41 | 5.20188 | 1.57 | 0.3327 | 1.52 | 0.96476 | 1854.6 | 7.5 | 1852.9 | 13.5 | 1851.4 | 24.5 | 0.20 |
| 7 | 0.21 | 5.3 | 26 | 15579 | 0.12 | 0.11356 | 0.42 | 5.25052 | 1.57 | 0.3353 | 1.51 | 0.96342 | 1857.2 | 7.6 | 1860.9 | 13.5 | 1864.1 | 24.5 | 0.43 |
| 8 | 0.18 | 4.6 | 25 | 20399 | 0.09 | 0.11313 | 0.49 | 5.18880 | 1.60 | 0.3326 | 1.52 | 0.95181 | 1850.3 | 8.8 | 1850.8 | 13.7 | 1851.2 | 24.6 | 0.05 |
| 9 | 0.52 | 5.4 | 10 | 18312 | 0.10 | 0.11409 | 0.40 | 5.22985 | 1.55 | 0.3325 | 1.50 | 0.96565 | 1865.5 | 7.3 | 1857.5 | 13.3 | 1850.4 | 24.2 | 0.93 |
| 10 | 0.19 | 3.5 | 19 | 24386 | 0.08 | 0.11236 | 0.43 | 5.13877 | 1.59 | 0.3317 | 1.53 | 0.96266 | 1837.9 | 7.8 | 1842.5 | 13.6 | 1846.6 | 24.6 | 0.55 |
| 11 | 0.16 | 4.0 | 25 | 14009 | 0.13 | 0.11232 | 0.49 | 5.15196 | 1.58 | 0.3327 | 1.51 | 0.95176 | 1837.4 | 8.8 | 1844.7 | 13.6 | 1851.2 | 24.3 | 0.87 |
| 12 | 0.20 | 3.5 | 17 | 21622 | 0.09 | 0.11202 | 0.45 | 5.11702 | 1.58 | 0.3313 | 1.52 | 0.95864 | 1832.5 | 8.1 | 1838.9 | 13.5 | 1844.6 | 24.4 | 0.76 |
| 13 | 0.21 | 3.7 | 18 | 21213 | 0.09 | 0.11223 | 0.46 | 5.09657 | 1.57 | 0.3293 | 1.50 | 0.95613 | 1835.9 | 8.3 | 1835.5 | 13.4 | 1835.2 | 24.1 | 0.04 |
| 14 | 0.31 | 4.1 | 13 | 31761 | 0.06 | 0.11402 | 0.49 | 5.26750 | 1.58 | 0.3351 | 1.50 | 0.95056 | 1864.5 | 8.8 | 1863.6 | 13.6 | 1862.8 | 24.4 | 0.10 |
| 15 | 0.21 | 3.4 | 16 | 22437 | 0.08 | 0.11212 | 0.37 | 5.10278 | 1.55 | 0.3301 | 1.50 | 0.97150 | 1834.1 | 6.6 | 1836.6 | 13.2 | 1838.8 | 24.1 | 0.29 |
| 16 | 0.18 | 3.7 | 21 | 19242 | 0.10 | 0.11282 | 0.44 | 5.13167 | 1.59 | 0.3299 | 1.52 | 0.96103 | 1845.3 | 7.9 | 1841.4 | 13.6 | 1837.9 | 24.4 | 0.46 |
| 17 | 0.26 | 5.0 | 19 | 17830 | 0.10 | 0.11421 | 0.41 | 5.30440 | 1.56 | 0.3368 | 1.50 | 0.96441 | 1867.5 | 7.4 | 1869.6 | 13.4 | 1871.4 | 24.4 | 0.24 |
| 18 | 0.33 | 4.8 | 14 | 22428 | 0.08 | 0.11313 | 0.45 | 5.18181 | 1.60 | 0.3322 | 1.54 | 0.96066 | 1850.3 | 8.0 | 1849.6 | 13.7 | 1849.0 | 24.8 | 0.08 |
| 19 | 0.20 | 4.9 | 24 | 12501 | 0.15 | 0.11341 | 0.49 | 5.12736 | 1.65 | 0.3279 | 1.58 | 0.95462 | 1854.7 | 8.9 | 1840.7 | 14.1 | 1828.3 | 25.2 | 1.64 |
| 20 | 0.18 | 3.9 | 22 | 22781 | 0.08 | 0.11245 | 0.44 | 5.14456 | 1.58 | 0.3318 | 1.52 | 0.96088 | 1839.4 | 7.9 | 1843.5 | 13.5 | 1847.1 | 24.4 | 0.48 |
| **17SD07** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 0.21 | 4.0 | 19 | 21383 | 0.09 | 0.11224 | 0.44 | 5.15329 | 1.56 | 0.3330 | 1.50 | 0.95924 | 1836.0 | 8.0 | 1844.9 | 13.4 | 1852.9 | 24.2 | 1.06 |
| 2 | 0.26 | 4.9 | 19 | 21032 | 0.09 | 0.11382 | 0.41 | 5.14854 | 1.58 | 0.3281 | 1.52 | 0.96500 | 1861.3 | 7.5 | 1844.2 | 13.5 | 1829.0 | 24.3 | 1.99 |
| 3 | 0.42 | 4.7 | 11 | 29274 | 0.06 | 0.11500 | 0.46 | 5.29704 | 1.57 | 0.3341 | 1.50 | 0.95614 | 1879.8 | 8.3 | 1868.4 | 13.5 | 1858.1 | 24.3 | 1.33 |
| 4 | 0.19 | 4.0 | 22 | 16597 | 0.11 | 0.11274 | 0.44 | 5.15970 | 1.56 | 0.3319 | 1.50 | 0.95896 | 1844.1 | 8.0 | 1846.0 | 13.4 | 1847.7 | 24.1 | 0.23 |
| 5 | 0.53 | 5.0 | 9 | 22615 | 0.08 | 0.11429 | 0.41 | 5.26768 | 1.55 | 0.3343 | 1.50 | 0.96501 | 1868.7 | 7.3 | 1863.6 | 13.4 | 1859.1 | 24.3 | 0.59 |
| 6 | 0.56 | 2.1 | 4 | 41394 | 0.05 | 0.11454 | 0.43 | 5.26483 | 1.57 | 0.3334 | 1.51 | 0.96241 | 1872.7 | 7.7 | 1863.2 | 13.5 | 1854.6 | 24.4 | 1.11 |
| 7 | 0.25 | 5.0 | 20 | 14043 | 0.13 | 0.11423 | 0.48 | 5.21891 | 1.57 | 0.3314 | 1.50 | 0.95299 | 1867.7 | 8.6 | 1855.7 | 13.5 | 1845.0 | 24.1 | 1.40 |
| 8 | 0.16 | 4.0 | 25 | 18117 | 0.10 | 0.11251 | 0.49 | 5.09857 | 1.59 | 0.3287 | 1.51 | 0.95035 | 1840.4 | 8.9 | 1835.9 | 13.6 | 1831.9 | 24.1 | 0.53 |
| 9 | 0.21 | 5.4 | 25 | 20378 | 0.09 | 0.11364 | 0.41 | 5.19410 | 1.55 | 0.3315 | 1.50 | 0.96537 | 1858.3 | 7.3 | 1851.7 | 13.3 | 1845.7 | 24.1 | 0.78 |
| 10 | 0.17 | 5.2 | 31 | 12597 | 0.15 | 0.11361 | 0.45 | 5.23133 | 1.65 | 0.3340 | 1.58 | 0.96192 | 1857.9 | 8.1 | 1857.7 | 14.1 | 1857.6 | 25.6 | 0.02 |
| 11 | 0.21 | 5.0 | 24 | 14443 | 0.13 | 0.11391 | 0.50 | 5.18281 | 1.58 | 0.3300 | 1.50 | 0.94942 | 1862.6 | 8.9 | 1849.8 | 13.5 | 1838.4 | 24.0 | 1.50 |
| 12 | 0.51 | 5.1 | 10 | 29037 | 0.06 | 0.11400 | 0.48 | 5.23528 | 1.59 | 0.3331 | 1.52 | 0.95430 | 1864.1 | 8.6 | 1858.4 | 13.7 | 1853.3 | 24.5 | 0.67 |
| 13 | 0.31 | 4.9 | 16 | 20735 | 0.09 | 0.11429 | 0.41 | 5.15542 | 1.56 | 0.3272 | 1.50 | 0.96400 | 1868.7 | 7.4 | 1845.3 | 13.3 | 1824.6 | 23.9 | 2.71 |
| 14 | 0.62 | 5.2 | 8 | 22142 | 0.08 | 0.11409 | 0.44 | 5.25637 | 1.58 | 0.3341 | 1.52 | 0.95989 | 1865.6 | 8.0 | 1861.8 | 13.6 | 1858.4 | 24.5 | 0.45 |
| 15 | 0.46 | 5.2 | 11 | 46802 | 0.04 | 0.11314 | 0.40 | 5.15459 | 1.58 | 0.3304 | 1.52 | 0.96665 | 1850.4 | 7.3 | 1845.2 | 13.5 | 1840.5 | 24.5 | 0.62 |
| 16 | 0.42 | 5.0 | 12 | 29358 | 0.06 | 0.11346 | 0.39 | 5.19957 | 1.55 | 0.3324 | 1.50 | 0.96797 | 1855.6 | 7.0 | 1852.5 | 13.3 | 1849.9 | 24.2 | 0.35 |
| 17 | 0.34 | 4.8 | 14 | 24033 | 0.08 | 0.11447 | 0.44 | 5.29706 | 1.56 | 0.3356 | 1.50 | 0.95883 | 1871.5 | 8.0 | 1868.4 | 13.5 | 1865.6 | 24.3 | 0.37 |
| 18 | 0.17 | 4.8 | 28 | 14974 | 0.12 | 0.11193 | 0.45 | 5.09223 | 1.57 | 0.3300 | 1.51 | 0.95866 | 1831.0 | 8.1 | 1834.8 | 13.4 | 1838.2 | 24.1 | 0.45 |
| 19 | 0.40 | 5.2 | 13 | 42282 | 0.04 | 0.11426 | 0.39 | 5.24893 | 1.55 | 0.3332 | 1.51 | 0.96829 | 1868.3 | 7.0 | 1860.6 | 13.3 | 1853.7 | 24.3 | 0.90 |
| 20 | 0.55 | 5.5 | 10 | 31331 | 0.06 | 0.11433 | 0.44 | 5.28852 | 1.56 | 0.3355 | 1.50 | 0.95885 | 1869.4 | 8.0 | 1867.0 | 13.4 | 1864.9 | 24.3 | 0.28 |
| 21 | 0.69 | 5.6 | 8 | 24485 | 0.08 | 0.11430 | 0.38 | 5.25731 | 1.57 | 0.3336 | 1.53 | 0.97097 | 1868.9 | 6.8 | 1862.0 | 13.5 | 1855.7 | 24.7 | 0.81 |
| 22 | 0.42 | 4.7 | 11 | 31281 | 0.06 | 0.11521 | 0.43 | 5.30633 | 1.57 | 0.3340 | 1.51 | 0.96226 | 1883.2 | 7.7 | 1869.9 | 13.5 | 1857.9 | 24.4 | 1.54 |
| 23 | 0.33 | 4.9 | 15 | 28224 | 0.07 | 0.11438 | 0.40 | 5.21396 | 1.56 | 0.3306 | 1.51 | 0.96681 | 1870.1 | 7.2 | 1854.9 | 13.4 | 1841.4 | 24.2 | 1.76 |
| 24 | 0.38 | 4.5 | 12 | 29848 | 0.06 | 0.11458 | 0.39 | 5.27595 | 1.55 | 0.3339 | 1.50 | 0.96784 | 1873.3 | 7.0 | 1865.0 | 13.3 | 1857.5 | 24.3 | 0.97 |
| 25 | 0.45 | 5.1 | 11 | 21933 | 0.09 | 0.11409 | 0.41 | 5.24471 | 1.56 | 0.3334 | 1.51 | 0.96508 | 1865.5 | 7.4 | 1859.9 | 13.4 | 1854.9 | 24.4 | 0.66 |

Note: the spot number is the same to that shown in Fig. 12. The 206Pb/204Pbm is the measured value; f206 is the percentage of common 206Pb in total 206Pb; r is the error correlation. Dis means discordance.

**Supplementary Data Table S4. LA-ICP-MS zircon U-Pb results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **spot #** | **Th (ppm)** | **U (ppm)** | **Th/U** | **Pb\*** | **207Pb/206Pb** | **±s** | **207Pb/235U** | **±s** | **206Pb/238U** | **±s** | **207Pb/206Pb (age/Ma)** | **±s** | **207Pb/235U (age/Ma)** | **±s** | **206Pb/238U (age/Ma)** | **±s** | **Dis (%)** |
| **17SD06** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1-core | 8 | 200 | 0.04 | 93.10 | 0.11207 | 0.00171 | 5.15981 | 0.08543 | 0.33390 | 0.00429 | 1833.2 | 27.5 | 1846.0 | 14.1 | 1857.3 | 20.7 | 1.30 |
| 2 | 7 | 267 | 0.03 | 71.26 | 0.11272 | 0.00160 | 5.08128 | 0.07920 | 0.32693 | 0.00414 | 1843.7 | 25.4 | 1833.0 | 13.2 | 1823.5 | 20.1 | 1.11 |
| 3 | 11 | 172 | 0.07 | 60.96 | 0.11314 | 0.00182 | 5.09264 | 0.08762 | 0.32644 | 0.00424 | 1850.4 | 28.8 | 1834.9 | 14.6 | 1821.1 | 20.6 | 1.61 |
| 4 | 13 | 710 | 0.02 | 248.13 | 0.11385 | 0.00135 | 5.14591 | 0.06998 | 0.32780 | 0.00404 | 1861.7 | 21.2 | 1843.7 | 11.6 | 1827.7 | 19.6 | 1.86 |
| 5-core | 8 | 644 | 0.01 | 215.97 | 0.11355 | 0.00138 | 4.92948 | 0.06826 | 0.31483 | 0.00389 | 1857.0 | 21.8 | 1807.3 | 11.7 | 1764.4 | 19.1 | 5.25 |
| 6 | 7 | 532 | 0.01 | 182.75 | 0.11331 | 0.00141 | 5.02797 | 0.07071 | 0.32181 | 0.00398 | 1853.2 | 22.3 | 1824.0 | 11.9 | 1798.5 | 19.4 | 3.04 |
| 7 | 7 | 139 | 0.05 | 48.47 | 0.11344 | 0.00194 | 5.07104 | 0.09185 | 0.32419 | 0.00426 | 1855.3 | 30.6 | 1831.3 | 15.4 | 1810.2 | 20.8 | 2.49 |
| 8 | 7 | 323 | 0.02 | 111.44 | 0.11367 | 0.00155 | 5.06027 | 0.07631 | 0.32285 | 0.00405 | 1858.9 | 24.4 | 1829.5 | 12.8 | 1803.7 | 19.8 | 3.06 |
| 9 | 8 | 632 | 0.01 | 223.23 | 0.11463 | 0.00138 | 5.22824 | 0.07169 | 0.33077 | 0.00407 | 1874.1 | 21.5 | 1857.2 | 11.7 | 1842.1 | 19.7 | 1.74 |
| 10 | 11 | 624 | 0.02 | 214.06 | 0.11281 | 0.00136 | 4.99526 | 0.06882 | 0.32115 | 0.00396 | 1845.1 | 21.7 | 1818.5 | 11.7 | 1795.3 | 19.3 | 2.77 |
| 11-core | 8 | 386 | 0.02 | 133.49 | 0.11197 | 0.00147 | 4.99913 | 0.07330 | 0.32380 | 0.00404 | 1831.6 | 23.6 | 1819.2 | 12.4 | 1808.2 | 19.7 | 1.29 |
| 12 | 9 | 645 | 0.01 | 223.03 | 0.11286 | 0.00135 | 5.03927 | 0.06900 | 0.32381 | 0.00398 | 1846.0 | 21.5 | 1825.9 | 11.6 | 1808.3 | 19.4 | 2.08 |
| 13 | 7 | 475 | 0.02 | 166.02 | 0.11250 | 0.00140 | 5.07078 | 0.07129 | 0.32688 | 0.00404 | 1840.3 | 22.4 | 1831.2 | 11.9 | 1823.2 | 19.6 | 0.94 |
| 14-core | 8 | 329 | 0.02 | 115.82 | 0.11262 | 0.00150 | 5.10154 | 0.07531 | 0.32853 | 0.00410 | 1842.1 | 23.9 | 1836.4 | 12.5 | 1831.3 | 19.9 | 0.59 |
| 15 | 8 | 542 | 0.02 | 188.83 | 0.11281 | 0.00138 | 5.06966 | 0.07022 | 0.32593 | 0.00401 | 1845.1 | 21.9 | 1831.0 | 11.8 | 1818.6 | 19.5 | 1.46 |
| 16 | 7 | 172 | 0.04 | 60.56 | 0.11242 | 0.00182 | 5.08104 | 0.08772 | 0.32778 | 0.00424 | 1839.0 | 29.0 | 1832.9 | 14.7 | 1827.6 | 20.6 | 0.62 |
| 17 | 18 | 540 | 0.03 | 189.88 | 0.11455 | 0.00140 | 5.14505 | 0.07143 | 0.32575 | 0.00401 | 1872.8 | 21.9 | 1843.6 | 11.8 | 1817.7 | 19.5 | 3.03 |
| 18-core | 7 | 347 | 0.02 | 124.57 | 0.11346 | 0.00149 | 5.23573 | 0.07651 | 0.33469 | 0.00416 | 1855.5 | 23.5 | 1858.5 | 12.5 | 1861.1 | 20.1 | 0.30 |
| 19 | 8 | 607 | 0.01 | 212.47 | 0.11337 | 0.00136 | 5.10989 | 0.06989 | 0.32689 | 0.00401 | 1854.1 | 21.6 | 1837.8 | 11.6 | 1823.3 | 19.5 | 1.69 |
| 20 | 10 | 442 | 0.02 | 154.59 | 0.11146 | 0.00141 | 5.01424 | 0.07113 | 0.32626 | 0.00403 | 1823.4 | 22.8 | 1821.7 | 12.0 | 1820.3 | 19.6 | 0.17 |
| 21 | 7 | 527 | 0.01 | 184.03 | 0.11428 | 0.00139 | 5.12520 | 0.07075 | 0.32525 | 0.00400 | 1868.6 | 21.8 | 1840.3 | 11.7 | 1815.3 | 19.4 | 2.94 |
| 22 | 17 | 256 | 0.06 | 99.19 | 0.12148 | 0.00166 | 5.90321 | 0.08864 | 0.35243 | 0.00442 | 1978.1 | 24.1 | 1961.7 | 13.0 | 1946.2 | 21.1 | 1.64 |
| 23 | 9 | 150 | 0.06 | 52.93 | 0.11113 | 0.00179 | 4.97704 | 0.08554 | 0.32481 | 0.00419 | 1818.0 | 29.0 | 1815.4 | 14.5 | 1813.2 | 20.4 | 0.26 |
| 24 | 6 | 446 | 0.01 | 159.29 | 0.11471 | 0.00143 | 5.25699 | 0.07355 | 0.33237 | 0.00409 | 1875.3 | 22.2 | 1861.9 | 11.9 | 1849.9 | 19.8 | 1.37 |
| **17SD07** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1-core | 11 | 482 | 0.02 | 171.51 | 0.11282 | 0.00140 | 5.14903 | 0.07200 | 0.33101 | 0.00407 | 1845.3 | 22.3 | 1844.2 | 11.9 | 1843.3 | 19.7 | 0.11 |
| 2 | 6 | 318 | 0.02 | 113.76 | 0.11210 | 0.00152 | 5.15046 | 0.07676 | 0.33323 | 0.00415 | 1833.6 | 24.3 | 1844.5 | 12.7 | 1854.0 | 20.1 | 1.10 |
| 3 | 5 | 134 | 0.04 | 47.60 | 0.11250 | 0.00192 | 5.09309 | 0.09168 | 0.32834 | 0.00429 | 1840.1 | 30.6 | 1835.0 | 15.3 | 1830.3 | 20.8 | 0.54 |
| 4 | 8 | 919 | 0.01 | 328.67 | 0.11348 | 0.00129 | 5.21019 | 0.06816 | 0.33298 | 0.00404 | 1855.9 | 20.4 | 1854.3 | 11.1 | 1852.8 | 19.6 | 0.17 |
| 5-core | 6 | 329 | 0.02 | 121.01 | 0.11770 | 0.00158 | 5.44452 | 0.08051 | 0.33550 | 0.00418 | 1921.5 | 23.9 | 1891.9 | 12.7 | 1865.0 | 20.2 | 3.03 |
| 6-core | 8 | 471 | 0.02 | 167.02 | 0.11266 | 0.00141 | 5.11168 | 0.07167 | 0.32908 | 0.00405 | 1842.7 | 22.5 | 1838.0 | 11.9 | 1833.9 | 19.6 | 0.48 |
| 7 | 7 | 168 | 0.04 | 59.16 | 0.11124 | 0.00179 | 4.99152 | 0.08540 | 0.32545 | 0.00418 | 1819.7 | 28.9 | 1817.9 | 14.5 | 1816.3 | 20.4 | 0.19 |
| 8 | 11 | 801 | 0.01 | 279.73 | 0.11126 | 0.00129 | 4.98092 | 0.06607 | 0.32467 | 0.00394 | 1820.1 | 20.9 | 1816.1 | 11.2 | 1812.5 | 19.2 | 0.42 |
| 9 | 9 | 690 | 0.01 | 246.08 | 0.11148 | 0.00131 | 5.09381 | 0.06811 | 0.33138 | 0.00403 | 1823.7 | 21.2 | 1835.1 | 11.4 | 1845.1 | 19.5 | 1.16 |
| 10 | 19 | 203 | 0.09 | 73.15 | 0.11199 | 0.00168 | 5.06347 | 0.08156 | 0.32791 | 0.00415 | 1832.0 | 26.9 | 1830.0 | 13.7 | 1828.2 | 20.1 | 0.21 |
| 11 | 7 | 714 | 0.01 | 249.91 | 0.11069 | 0.00130 | 4.96731 | 0.06646 | 0.32545 | 0.00396 | 1810.8 | 21.2 | 1813.8 | 11.3 | 1816.3 | 19.3 | 0.30 |
| 12 | 8 | 484 | 0.02 | 172.40 | 0.11287 | 0.00140 | 5.13985 | 0.07153 | 0.33025 | 0.00405 | 1846.2 | 22.3 | 1842.7 | 11.8 | 1839.6 | 19.6 | 0.36 |
| 13 | 7 | 549 | 0.01 | 196.30 | 0.11259 | 0.00137 | 5.14367 | 0.07051 | 0.33132 | 0.00405 | 1841.7 | 21.9 | 1843.3 | 11.7 | 1844.8 | 19.6 | 0.17 |
| 14 | 15 | 483 | 0.03 | 174.02 | 0.11533 | 0.00143 | 5.26700 | 0.07300 | 0.33121 | 0.00406 | 1885.0 | 22.1 | 1863.5 | 11.8 | 1844.3 | 19.6 | 2.21 |
| 15 | 12 | 130 | 0.09 | 46.50 | 0.11208 | 0.00194 | 5.04129 | 0.09176 | 0.32622 | 0.00426 | 1833.4 | 31.1 | 1826.3 | 15.4 | 1820.0 | 20.7 | 0.74 |
| 16 | 7 | 331 | 0.02 | 120.30 | 0.11292 | 0.00149 | 5.23568 | 0.07655 | 0.33627 | 0.00416 | 1847.0 | 23.7 | 1858.4 | 12.5 | 1868.7 | 20.1 | 1.16 |
| 17-core | 13 | 807 | 0.02 | 284.74 | 0.11280 | 0.00130 | 5.07800 | 0.06717 | 0.32649 | 0.00396 | 1845.0 | 20.8 | 1832.4 | 11.2 | 1821.3 | 19.2 | 1.30 |
| 18-core | 43 | 1055 | 0.04 | 384.34 | 0.11530 | 0.00143 | 5.28969 | 0.07365 | 0.33271 | 0.00407 | 1884.6 | 22.1 | 1867.2 | 11.9 | 1851.5 | 19.7 | 1.79 |
| 19-core | 14 | 729 | 0.02 | 263.85 | 0.11337 | 0.00132 | 5.22716 | 0.06958 | 0.33440 | 0.00406 | 1854.1 | 20.9 | 1857.1 | 11.4 | 1859.7 | 19.6 | 0.30 |
| 20 | 15 | 943 | 0.02 | 330.92 | 0.11269 | 0.00128 | 5.04204 | 0.06597 | 0.32449 | 0.00392 | 1843.3 | 20.4 | 1826.4 | 11.1 | 1811.6 | 19.1 | 1.75 |
| 21 | 10 | 334 | 0.03 | 120.36 | 0.11437 | 0.00151 | 5.22216 | 0.07650 | 0.33116 | 0.00409 | 1869.9 | 23.7 | 1856.2 | 12.5 | 1844.0 | 19.8 | 1.40 |
| 22 | 8 | 164 | 0.05 | 59.32 | 0.11168 | 0.00179 | 5.10674 | 0.08701 | 0.33163 | 0.00424 | 1827.0 | 28.7 | 1837.2 | 14.5 | 1846.3 | 20.6 | 1.05 |
| 23 | 6 | 221 | 0.03 | 77.97 | 0.11270 | 0.00166 | 5.03440 | 0.08012 | 0.32398 | 0.00408 | 1843.3 | 26.4 | 1825.1 | 13.5 | 1809.1 | 19.9 | 1.89 |
| 24 | 6 | 358 | 0.02 | 129.38 | 0.11173 | 0.00147 | 5.13651 | 0.07490 | 0.33342 | 0.00411 | 1827.7 | 23.7 | 1842.2 | 12.4 | 1854.9 | 19.9 | 1.47 |

Note: the Pb\* is the radioactive Pb and the spot number is the same to that shown in Fig. 12.

**Supplementary Data Table S5. LA-ICP-MS zircon REE data (ppm) and Ti-in-zircon thermometric results**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **spot #** | **Ti** | **Y** | **La** | **Ce** | **Pr** | **Nd** | **Sm** | **Eu** | **Gd** | **Tb** | **Dy** | **Ho** | **Er** | **Tm** | **Yb** | **Lu** | **Eu/Eu\*** | **LuN/GdN** | **LuN** | ***T(℃)*** |
| **17SD06** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1-core | 5.56 | 67.25 | 0.00 | 0.45 | 0.02 | 0.58 | 2.20 | 0.22 | 15.19 | 2.99 | 14.21 | 2.25 | 5.51 | 0.91 | 7.66 | 1.48 | 0.18 | 0.08 | 6.46 | 756 |
| 2 | 7.00 | 31.62 | 0.01 | 0.39 | 0.02 | 0.63 | 3.38 | 0.44 | 15.77 | 2.92 | 10.21 | 1.04 | 1.58 | 0.16 | 1.23 | 0.16 | 0.12 | 0.79 | 58.27 | 778 |
| 3 | 5.58 | 19.61 | 0.00 | 0.46 | 0.02 | 0.39 | 1.44 | 0.11 | 7.21 | 1.06 | 4.69 | 0.62 | 1.15 | 0.19 | 1.17 | 0.18 | 0.11 | 0.20 | 6.93 | 756 |
| 4 | 6.82 | 50.42 | 0.00 | 0.47 | 0.02 | 0.49 | 2.21 | 0.38 | 12.79 | 2.45 | 11.89 | 1.80 | 4.59 | 0.76 | 7.48 | 1.53 | 0.22 | 0.97 | 60.08 | 776 |
| 5-core | 4.07 | 29.62 | 0.00 | 0.54 | 0.01 | 0.34 | 1.39 | 0.20 | 9.42 | 1.87 | 8.20 | 0.99 | 1.74 | 0.22 | 1.86 | 0.31 | 0.17 | 0.27 | 12.20 | 727 |
| 6 | 6.09 | 35.05 | 0.02 | 0.50 | 0.01 | 0.51 | 2.31 | 0.26 | 9.16 | 2.09 | 9.56 | 1.22 | 2.25 | 0.26 | 1.90 | 0.38 | 0.17 | 0.34 | 15.08 | 765 |
| 7 | 4.31 | 33.99 | 0.00 | 0.24 | 0.01 | 0.42 | 1.69 | 0.12 | 9.13 | 1.63 | 8.02 | 1.13 | 2.18 | 0.32 | 1.76 | 0.29 | 0.10 | 0.25 | 11.22 | 732 |
| 8 | 3.91 | 60.46 | 0.06 | 1.28 | 0.17 | 1.48 | 2.56 | 0.93 | 11.77 | 2.56 | 12.52 | 1.93 | 4.19 | 0.52 | 3.89 | 0.62 | 0.52 | 0.43 | 24.45 | 723 |
| 9 | 3.57 | 174.43 | 0.00 | 0.39 | 0.01 | 0.30 | 2.01 | 0.87 | 12.56 | 4.09 | 30.03 | 5.80 | 13.77 | 1.96 | 16.01 | 3.08 | 0.53 | 1.98 | 121.26 | 715 |
| 10 | 6.17 | 33.02 | 0.01 | 0.44 | 0.02 | 0.38 | 2.42 | 0.49 | 14.16 | 2.52 | 10.34 | 1.15 | 1.59 | 0.22 | 1.35 | 0.22 | 0.26 | 0.13 | 8.74 | 766 |
| 11-core | 5.27 | 25.76 | 0.00 | 0.39 | 0.02 | 0.53 | 1.79 | 0.30 | 10.82 | 2.02 | 7.77 | 0.89 | 1.39 | 0.13 | 0.95 | 0.18 | 0.21 | 0.13 | 7.09 | 751 |
| 12 | 4.38 | 28.55 | 0.01 | 0.50 | 0.02 | 0.26 | 1.43 | 0.25 | 9.16 | 1.78 | 7.45 | 0.89 | 1.65 | 0.24 | 1.49 | 0.25 | 0.21 | 0.22 | 9.96 | 733 |
| 13 | 3.82 | 25.03 | 0.00 | 0.44 | 0.01 | 0.39 | 1.43 | 0.27 | 9.33 | 1.64 | 6.92 | 0.84 | 1.45 | 0.14 | 1.16 | 0.19 | 0.22 | 0.17 | 7.56 | 721 |
| 14-core | 5.87 | 25.82 | 0.00 | 0.42 | 0.02 | 0.53 | 2.40 | 0.33 | 13.30 | 2.11 | 8.57 | 0.88 | 1.30 | 0.14 | 0.85 | 0.15 | 0.18 | 0.09 | 5.75 | 761 |
| 15 | 5.89 | 30.78 | 0.01 | 0.46 | 0.04 | 0.50 | 1.75 | 0.32 | 10.78 | 2.07 | 9.04 | 1.07 | 1.86 | 0.21 | 1.55 | 0.31 | 0.22 | 0.23 | 12.28 | 761 |
| 16 | 5.07 | 44.72 | 0.00 | 0.32 | 0.01 | 0.56 | 1.76 | 0.13 | 10.71 | 2.15 | 10.06 | 1.38 | 2.84 | 0.37 | 2.63 | 0.38 | 0.09 | 0.29 | 14.88 | 747 |
| 17 | 4.54 | 43.67 | 0.01 | 0.86 | 0.07 | 0.97 | 4.06 | 0.92 | 21.15 | 3.69 | 13.57 | 1.36 | 2.33 | 0.27 | 1.84 | 0.29 | 0.30 | 0.11 | 11.50 | 737 |
| 18-core | 3.69 | 24.82 | 0.00 | 0.41 | 0.02 | 0.56 | 2.34 | 0.34 | 12.68 | 2.21 | 8.61 | 0.86 | 1.33 | 0.12 | 0.78 | 0.15 | 0.19 | 0.10 | 5.87 | 718 |
| 19 | 3.62 | 99.35 | 0.02 | 0.50 | 0.02 | 0.46 | 2.84 | 0.48 | 17.93 | 4.10 | 20.81 | 3.34 | 7.60 | 1.01 | 7.23 | 1.20 | 0.21 | 0.54 | 47.36 | 716 |
| 20 | 6.06 | 48.04 | 0.02 | 0.56 | 0.05 | 0.78 | 3.21 | 0.45 | 13.51 | 2.82 | 13.09 | 1.56 | 3.11 | 0.41 | 3.14 | 0.60 | 0.21 | 0.36 | 23.66 | 764 |
| 21 | 4.87 | 21.98 | 0.00 | 0.41 | 0.01 | 0.29 | 1.33 | 0.22 | 8.15 | 1.48 | 6.32 | 0.70 | 1.23 | 0.16 | 1.09 | 0.18 | 0.21 | 0.18 | 7.24 | 743 |
| 22 | 4.83 | 99.45 | 0.00 | 0.65 | 0.04 | 0.62 | 3.65 | 0.33 | 19.99 | 4.02 | 19.81 | 3.41 | 8.88 | 1.51 | 12.96 | 2.63 | 0.12 | 1.06 | 103.54 | 743 |
| 23 | 4.61 | 50.39 | 0.00 | 0.33 | 0.02 | 0.44 | 2.25 | 0.18 | 13.21 | 2.61 | 11.91 | 1.75 | 3.20 | 0.45 | 3.05 | 0.50 | 0.10 | 0.31 | 19.84 | 738 |
| 24 | 5.31 | 126.09 | 0.00 | 0.25 | 0.02 | 0.30 | 1.47 | 0.58 | 9.70 | 3.04 | 21.61 | 4.10 | 10.42 | 1.68 | 13.12 | 2.67 | 0.47 | 2.23 | 105.12 | 751 |
| **17SD07** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1-core | 4.81 | 30.48 | 0.00 | 0.42 | 0.01 | 0.42 | 2.38 | 0.36 | 12.75 | 2.30 | 9.34 | 0.99 | 1.48 | 0.17 | 1.21 | 0.20 | 0.20 | 0.13 | 8.03 | 742 |
| 2 | 6.89 | 77.45 | 0.03 | 0.46 | 0.05 | 0.49 | 2.04 | 0.69 | 12.15 | 2.68 | 15.33 | 2.54 | 6.28 | 0.97 | 8.34 | 1.68 | 0.42 | 1.12 | 66.14 | 777 |
| 3 | 4.76 | 31.32 | 0.00 | 0.24 | 0.01 | 0.31 | 1.43 | 0.14 | 8.18 | 1.64 | 7.01 | 1.07 | 2.27 | 0.28 | 2.24 | 0.34 | 0.13 | 0.34 | 13.46 | 741 |
| 4 | 4.91 | 95.08 | 0.01 | 0.29 | 0.01 | 0.22 | 1.10 | 0.70 | 7.38 | 1.93 | 14.46 | 2.96 | 7.29 | 1.22 | 9.76 | 1.74 | 0.75 | 1.91 | 68.58 | 744 |
| 5-core | 4.22 | 46.02 | 0.01 | 0.26 | 0.02 | 0.34 | 1.42 | 0.20 | 8.91 | 2.02 | 10.27 | 1.45 | 2.96 | 0.40 | 2.92 | 0.47 | 0.17 | 0.43 | 18.66 | 730 |
| 6-core | 5.24 | 39.55 | 0.02 | 0.50 | 0.03 | 0.57 | 2.23 | 0.39 | 12.87 | 2.35 | 9.98 | 1.41 | 2.92 | 0.45 | 4.14 | 0.75 | 0.22 | 0.47 | 29.37 | 750 |
| 7 | 4.70 | 45.37 | 0.01 | 0.34 | 0.02 | 0.41 | 1.82 | 0.12 | 11.26 | 2.47 | 10.36 | 1.41 | 2.70 | 0.33 | 2.02 | 0.32 | 0.08 | 0.23 | 12.76 | 740 |
| 8 | 4.99 | 77.53 | 0.01 | 1.06 | 0.07 | 1.09 | 3.26 | 1.46 | 17.98 | 3.97 | 19.34 | 2.72 | 5.27 | 0.63 | 5.07 | 0.96 | 0.58 | 0.43 | 37.64 | 746 |
| 9 | 5.15 | 38.93 | 0.00 | 0.44 | 0.01 | 0.54 | 2.42 | 0.41 | 14.08 | 2.76 | 11.78 | 1.24 | 2.13 | 0.24 | 1.42 | 0.23 | 0.22 | 0.13 | 9.21 | 749 |
| 10 | 8.72 | 58.16 | 0.01 | 0.53 | 0.04 | 0.81 | 3.12 | 0.20 | 16.01 | 2.79 | 12.38 | 1.92 | 3.83 | 0.55 | 3.19 | 0.48 | 0.09 | 0.24 | 18.70 | 801 |
| 11 | 6.60 | 28.80 | 0.01 | 0.43 | 0.03 | 0.39 | 1.96 | 0.34 | 9.69 | 2.04 | 8.01 | 0.98 | 1.60 | 0.17 | 1.27 | 0.23 | 0.24 | 0.19 | 9.13 | 773 |
| 12 | 4.78 | 38.58 | 0.00 | 0.50 | 0.01 | 0.44 | 2.83 | 0.46 | 15.78 | 2.95 | 12.40 | 1.38 | 2.16 | 0.23 | 1.82 | 0.25 | 0.21 | 0.13 | 10.00 | 742 |
| 13 | 6.46 | 150.08 | 0.01 | 0.30 | 0.01 | 0.26 | 1.56 | 0.81 | 10.74 | 3.38 | 24.54 | 4.50 | 11.61 | 1.71 | 14.39 | 2.55 | 0.60 | 1.92 | 100.39 | 770 |
| 14 | 5.88 | 120.98 | 0.00 | 0.63 | 0.02 | 0.46 | 1.72 | 0.37 | 10.74 | 2.62 | 15.81 | 4.15 | 16.03 | 3.48 | 34.57 | 7.12 | 0.26 | 5.36 | 280.31 | 761 |
| 15 | 9.15 | 38.30 | 0.00 | 0.47 | 0.03 | 0.75 | 2.52 | 0.16 | 10.30 | 1.73 | 8.34 | 1.27 | 2.63 | 0.33 | 2.28 | 0.32 | 0.10 | 0.25 | 12.68 | 806 |
| 16 | 4.00 | 33.80 | 0.01 | 0.34 | 0.03 | 0.39 | 2.14 | 0.36 | 12.08 | 2.26 | 9.31 | 1.13 | 2.14 | 0.23 | 1.75 | 0.27 | 0.22 | 0.18 | 10.63 | 725 |
| 17-core | 5.73 | 87.04 | 0.08 | 0.91 | 0.10 | 1.57 | 6.17 | 1.09 | 33.60 | 6.00 | 25.12 | 3.00 | 4.95 | 0.60 | 4.23 | 0.80 | 0.23 | 0.19 | 31.57 | 759 |
| 18-core | 3.96 | 253.32 | 1.20 | 7.05 | 1.31 | 9.01 | 9.43 | 9.43 | 37.38 | 8.97 | 47.01 | 7.75 | 20.73 | 3.87 | 38.15 | 7.07 | 1.54 | 1.53 | 278.35 | 724 |
| 19-core | 3.21 | 99.67 | 0.02 | 0.56 | 0.04 | 0.93 | 4.39 | 0.62 | 27.40 | 5.62 | 24.55 | 3.51 | 6.00 | 0.74 | 4.77 | 0.78 | 0.17 | 0.23 | 30.71 | 706 |
| 20 | 5.92 | 44.14 | 0.01 | 0.53 | 0.03 | 0.73 | 3.22 | 0.53 | 18.26 | 3.45 | 13.65 | 1.39 | 2.14 | 0.24 | 1.91 | 0.33 | 0.21 | 0.15 | 13.07 | 762 |
| 21 | 4.00 | 35.71 | 0.01 | 0.56 | 0.02 | 0.85 | 3.69 | 0.71 | 18.79 | 3.20 | 11.75 | 1.20 | 1.71 | 0.26 | 1.52 | 0.25 | 0.26 | 0.11 | 9.72 | 725 |
| 22 | 4.48 | 46.52 | 0.00 | 0.35 | 0.04 | 0.53 | 1.78 | 0.18 | 13.78 | 2.63 | 10.69 | 1.57 | 3.20 | 0.42 | 3.05 | 0.59 | 0.11 | 0.34 | 23.11 | 736 |
| 23 | 5.86 | 38.41 | 0.00 | 0.25 | 0.01 | 0.31 | 1.40 | 0.14 | 8.44 | 1.78 | 8.48 | 1.16 | 2.49 | 0.32 | 2.14 | 0.33 | 0.12 | 0.32 | 13.07 | 761 |
| 24 | 5.53 | 50.80 | 0.01 | 0.40 | 0.03 | 0.33 | 1.61 | 0.50 | 8.69 | 1.83 | 9.77 | 1.54 | 3.29 | 0.48 | 4.20 | 0.71 | 0.41 | 0.66 | 27.87 | 755 |

Note: the spot number is the same to that shown in Fig. 12 and in Table S4. Chondrite-normalization values after Sun and McDonough (1989). The Ti-in-zircon thermometer of Ferry and Watson, 2007 was used.