**Supplementary Table S2**

**Zircon U-Pb isotopes and Ti-in-zircon temperatures of the Taolin intrusion**

**Zircon U-Pb isotopes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Spot** | **Content (ppm)** | | | **Ratios** | | | | | | **Age (Ma)** | | | |
| **Th** | **U** | **Th/U** | **207Pb/235U** | **1σ** | **206Pb/238U** | **1σ** | **207Pb/206Pb** | **1σ** | **207Pb/235U** | **1σ** | **206Pb/238U** | **1σ** |
| 18TL01-02 | 268 | 198 | 1.36 | 0.14601 | 0.01469 | 0.02165 | 0.00065 | 0.04892 | 0.00465 | 138 | 13 | 138 | 4 |
| 18TL01-03 | 126 | 115 | 1.09 | 0.10769 | 0.01634 | 0.01955 | 0.00067 | 0.03995 | 0.00573 | 104 | 15 | 125 | 4 |
| 18TL01-04 | 87 | 92 | 0.94 | 0.14845 | 0.02586 | 0.02062 | 0.00081 | 0.05222 | 0.00860 | 141 | 23 | 132 | 5 |
| 18TL01-06 | 91 | 99 | 0.92 | 0.16258 | 0.02347 | 0.02180 | 0.00082 | 0.05410 | 0.00803 | 153 | 21 | 139 | 5 |
| 18TL01-07 | 136 | 130 | 1.04 | 0.14412 | 0.02154 | 0.02152 | 0.00079 | 0.04858 | 0.00725 | 137 | 19 | 137 | 5 |
| 18TL01-08 | 105 | 115 | 0.91 | 0.12252 | 0.02079 | 0.01920 | 0.00081 | 0.04628 | 0.00784 | 117 | 19 | 123 | 5 |
| 18TL01-09 | 135 | 138 | 0.98 | 0.13348 | 0.02152 | 0.02154 | 0.00079 | 0.04494 | 0.00722 | 127 | 19 | 137 | 5 |
| 18TL01-10 | 154 | 153 | 1.00 | 0.12841 | 0.01824 | 0.01958 | 0.00078 | 0.04757 | 0.00677 | 123 | 16 | 125 | 5 |
| 18TL01-12 | 221 | 311 | 0.71 | 0.12353 | 0.01229 | 0.02018 | 0.00060 | 0.04440 | 0.00415 | 118 | 11 | 129 | 4 |
| 18TL01-16 | 178 | 147 | 1.22 | 0.12369 | 0.01773 | 0.02001 | 0.00070 | 0.04483 | 0.00660 | 118 | 16 | 128 | 4 |
| 18TL01-17 | 145 | 133 | 1.09 | 0.15504 | 0.02081 | 0.02095 | 0.00075 | 0.05367 | 0.00735 | 146 | 18 | 134 | 5 |
| 18TL01-19 | 131 | 115 | 1.14 | 0.11968 | 0.02999 | 0.01852 | 0.00081 | 0.04687 | 0.01102 | 115 | 27 | 118 | 5 |
| 18TL01-20 | 1253 | 550 | 2.28 | 0.15391 | 0.01195 | 0.01941 | 0.00051 | 0.05751 | 0.00416 | 145 | 11 | 124 | 3 |
| 18TL01-21 | 649 | 340 | 1.91 | 0.14340 | 0.01390 | 0.02023 | 0.00059 | 0.05142 | 0.00457 | 136 | 12 | 129 | 4 |
| 18TL01-23 | 262 | 401 | 0.65 | 0.15045 | 0.02474 | 0.02112 | 0.00059 | 0.05167 | 0.00770 | 142 | 22 | 135 | 4 |
| 18TL01-24 | 153 | 172 | 0.89 | 0.12648 | 0.01479 | 0.02006 | 0.00063 | 0.04572 | 0.00530 | 121 | 13 | 128 | 4 |
| 18TL01-25 | 417 | 297 | 1.40 | 0.13035 | 0.01254 | 0.01999 | 0.00052 | 0.04729 | 0.00437 | 124 | 11 | 128 | 3 |
| 18TL01-27 | 276 | 247 | 1.12 | 0.11190 | 0.01457 | 0.01931 | 0.00059 | 0.04203 | 0.00523 | 108 | 13 | 123 | 4 |
| 18TL01-28 | 174 | 179 | 0.97 | 0.13980 | 0.01860 | 0.01991 | 0.00066 | 0.05092 | 0.00661 | 133 | 17 | 127 | 4 |
| 18TL01-29 | 476 | 310 | 1.53 | 0.13605 | 0.01225 | 0.02023 | 0.00056 | 0.04878 | 0.00414 | 130 | 11 | 129 | 4 |
| 18TL02-02 | 747 | 865 | 0.86 | 0.12569 | 0.01030 | 0.01928 | 0.00058 | 0.04728 | 0.00374 | 120 | 9 | 123 | 4 |
| 18TL02-03 | 1016 | 905 | 1.12 | 0.13516 | 0.00785 | 0.02028 | 0.00051 | 0.04833 | 0.00273 | 129 | 7 | 129 | 3 |
| 18TL02-04 | 1619 | 1179 | 1.37 | 0.14159 | 0.00806 | 0.02010 | 0.00050 | 0.05109 | 0.00285 | 134 | 7 | 128 | 3 |
| 18TL02-05 | 655 | 616 | 1.06 | 0.13805 | 0.00911 | 0.02022 | 0.00053 | 0.04951 | 0.00328 | 131 | 8 | 129 | 3 |
| 18TL02-06 | 1238 | 1131 | 1.09 | 0.13180 | 0.00867 | 0.01914 | 0.00051 | 0.04993 | 0.00313 | 126 | 8 | 122 | 3 |
| 18TL02-07 | 462 | 579 | 0.80 | 0.14814 | 0.00806 | 0.01997 | 0.00052 | 0.05379 | 0.00271 | 140 | 7 | 127 | 3 |
| 18TL02-08 | 2524 | 1527 | 1.65 | 0.13349 | 0.00601 | 0.01991 | 0.00049 | 0.04862 | 0.00198 | 127 | 5 | 127 | 3 |
| 18TL02-09 | 911 | 942 | 0.97 | 0.13521 | 0.00685 | 0.02024 | 0.00049 | 0.04846 | 0.00227 | 129 | 6 | 129 | 3 |
| 18TL02-10 | 868 | 811 | 1.07 | 0.14322 | 0.00770 | 0.02261 | 0.00056 | 0.04595 | 0.00235 | 136 | 7 | 144 | 4 |
| 18TL02-11 | 1400 | 1334 | 1.05 | 0.14062 | 0.00664 | 0.02101 | 0.00053 | 0.04853 | 0.00205 | 134 | 6 | 134 | 3 |
| 18TL02-12 | 820 | 874 | 0.94 | 0.14482 | 0.00831 | 0.01951 | 0.00051 | 0.05384 | 0.00293 | 137 | 7 | 125 | 3 |
| 18TL02-13 | 1259 | 1269 | 0.99 | 0.14367 | 0.00732 | 0.02128 | 0.00052 | 0.04896 | 0.00228 | 136 | 6 | 136 | 3 |
| 18TL02-14 | 1589 | 1386 | 1.15 | 0.14854 | 0.00703 | 0.02122 | 0.00052 | 0.05078 | 0.00217 | 141 | 6 | 135 | 3 |
| 18TL02-15 | 983 | 989 | 0.99 | 0.13434 | 0.00764 | 0.02020 | 0.00050 | 0.04824 | 0.00264 | 128 | 7 | 129 | 3 |
| 18TL02-16 | 1804 | 1719 | 1.05 | 0.13707 | 0.00992 | 0.01868 | 0.00052 | 0.05322 | 0.00374 | 130 | 9 | 119 | 3 |
| 18TL02-17 | 1725 | 1261 | 1.37 | 0.14546 | 0.00679 | 0.02029 | 0.00050 | 0.05199 | 0.00216 | 138 | 6 | 129 | 3 |
| 18TL02-18 | 846 | 894 | 0.95 | 0.13791 | 0.00798 | 0.02015 | 0.00051 | 0.04964 | 0.00280 | 131 | 7 | 129 | 3 |
| 18TL02-19 | 755 | 889 | 0.85 | 0.13322 | 0.01147 | 0.01874 | 0.00055 | 0.05155 | 0.00451 | 127 | 10 | 120 | 3 |
| 18TL02-20 | 1302 | 1155 | 1.13 | 0.13810 | 0.00685 | 0.02086 | 0.00051 | 0.04802 | 0.00218 | 131 | 6 | 133 | 3 |
| 18TL02-21 | 1160 | 1085 | 1.07 | 0.14575 | 0.00821 | 0.02034 | 0.00052 | 0.05198 | 0.00285 | 138 | 7 | 130 | 3 |
| 18TL02-23 | 767 | 843 | 0.91 | 0.13849 | 0.00714 | 0.01989 | 0.00049 | 0.05049 | 0.00236 | 132 | 6 | 127 | 3 |
| 18TL02-25 | 1107 | 1107 | 1.00 | 0.15373 | 0.00762 | 0.02034 | 0.00051 | 0.05481 | 0.00254 | 145 | 7 | 130 | 3 |
| 18TL02-26 | 1213 | 1108 | 1.09 | 0.13806 | 0.00693 | 0.02012 | 0.00051 | 0.04976 | 0.00226 | 131 | 6 | 128 | 3 |
| 18TL02-28 | 886 | 799 | 1.11 | 0.12353 | 0.00863 | 0.01910 | 0.00054 | 0.04691 | 0.00320 | 118 | 8 | 122 | 3 |
| 18TL02-29 | 1727 | 1015 | 1.70 | 0.14057 | 0.00894 | 0.02021 | 0.00053 | 0.05044 | 0.00329 | 134 | 8 | 129 | 3 |
| 18TL03-02 | 333 | 290 | 1.15 | 0.16168 | 0.01853 | 0.02141 | 0.00073 | 0.05478 | 0.00645 | 152 | 16 | 137 | 5 |
| 18TL03-03 | 1656 | 1472 | 1.13 | 0.13719 | 0.01026 | 0.02055 | 0.00048 | 0.04843 | 0.00373 | 131 | 9 | 131 | 3 |
| 18TL03-09 | 1144 | 1054 | 1.09 | 0.13838 | 0.01990 | 0.02033 | 0.00058 | 0.04936 | 0.00648 | 132 | 18 | 130 | 4 |
| 18TL03-11 | 736 | 822 | 0.90 | 0.13778 | 0.01080 | 0.02100 | 0.00051 | 0.04758 | 0.00387 | 131 | 10 | 134 | 3 |
| 18TL03-12 | 954 | 948 | 1.01 | 0.14805 | 0.01059 | 0.02097 | 0.00048 | 0.05121 | 0.00381 | 140 | 9 | 134 | 3 |
| 18TL03-13 | 221 | 177 | 1.25 | 0.14763 | 0.02279 | 0.01956 | 0.00068 | 0.05473 | 0.00860 | 140 | 20 | 125 | 4 |
| 18TL03-15 | 743 | 435 | 1.71 | 0.12198 | 0.01146 | 0.02032 | 0.00054 | 0.04353 | 0.00421 | 117 | 10 | 130 | 3 |
| 18TL03-18 | 938 | 1094 | 0.86 | 0.16704 | 0.03172 | 0.02094 | 0.00063 | 0.05786 | 0.01047 | 157 | 28 | 134 | 4 |
| 18TL03-19 | 1730 | 1836 | 0.94 | 0.15412 | 0.02783 | 0.01955 | 0.00067 | 0.05718 | 0.00964 | 146 | 24 | 125 | 4 |
| 18TL03-20 | 892 | 1017 | 0.88 | 0.16050 | 0.02337 | 0.02106 | 0.00058 | 0.05527 | 0.00738 | 151 | 20 | 134 | 4 |
| 18TL03-23 | 537 | 666 | 0.81 | 0.14223 | 0.01091 | 0.01993 | 0.00050 | 0.05175 | 0.00413 | 135 | 10 | 127 | 3 |
| 18ML-01 | 446 | 387 | 1.15 | 0.13168 | 0.01157 | 0.01916 | 0.00053 | 0.04985 | 0.00423 | 126 | 10 | 122 | 3 |
| 18ML-02 | 439 | 389 | 1.13 | 0.14676 | 0.01467 | 0.02096 | 0.00062 | 0.05078 | 0.00504 | 139 | 13 | 134 | 4 |
| 18ML-03 | 484 | 493 | 0.98 | 0.12654 | 0.01099 | 0.02032 | 0.00052 | 0.04517 | 0.00391 | 121 | 10 | 130 | 3 |
| 18ML-04 | 334 | 237 | 1.41 | 0.16127 | 0.01479 | 0.02194 | 0.00061 | 0.05331 | 0.00489 | 152 | 13 | 140 | 4 |
| 18ML-05 | 1121 | 599 | 1.87 | 0.14998 | 0.01152 | 0.02091 | 0.00056 | 0.05201 | 0.00399 | 142 | 10 | 133 | 4 |
| 18ML-06 | 436 | 454 | 0.96 | 0.12189 | 0.00880 | 0.02011 | 0.00051 | 0.04396 | 0.00315 | 117 | 8 | 128 | 3 |
| 18ML-07 | 610 | 539 | 1.13 | 0.14174 | 0.01266 | 0.01943 | 0.00053 | 0.05290 | 0.00488 | 135 | 11 | 124 | 3 |
| 18ML-08 | 567 | 581 | 0.98 | 0.12202 | 0.00932 | 0.01945 | 0.00050 | 0.04549 | 0.00342 | 117 | 8 | 124 | 3 |
| 18ML-09 | 427 | 442 | 0.97 | 0.12344 | 0.00967 | 0.02016 | 0.00053 | 0.04442 | 0.00354 | 118 | 9 | 129 | 3 |
| 18ML-10 | 539 | 516 | 1.04 | 0.13508 | 0.01007 | 0.01982 | 0.00050 | 0.04942 | 0.00369 | 129 | 9 | 127 | 3 |
| 18ML-11 | 553 | 566 | 0.98 | 0.14967 | 0.01336 | 0.02068 | 0.00055 | 0.05249 | 0.00463 | 142 | 12 | 132 | 3 |
| 18ML-12 | 650 | 526 | 1.24 | 0.14532 | 0.01053 | 0.01991 | 0.00047 | 0.05294 | 0.00401 | 138 | 9 | 127 | 3 |
| 18ML-13 | 629 | 724 | 0.87 | 0.13554 | 0.01076 | 0.02036 | 0.00052 | 0.04829 | 0.00385 | 129 | 10 | 130 | 3 |
| 18ML-14 | 534 | 513 | 1.04 | 0.13832 | 0.01052 | 0.01985 | 0.00048 | 0.05053 | 0.00398 | 132 | 9 | 127 | 3 |
| 18ML-15 | 312 | 396 | 0.79 | 0.12568 | 0.01034 | 0.02077 | 0.00056 | 0.04390 | 0.00369 | 120 | 9 | 132 | 4 |
| 18ML-16 | 350 | 476 | 0.74 | 0.13820 | 0.01147 | 0.02041 | 0.00053 | 0.04910 | 0.00415 | 131 | 10 | 130 | 3 |
| 18ML-17 | 401 | 441 | 0.91 | 0.13099 | 0.01026 | 0.02015 | 0.00053 | 0.04716 | 0.00368 | 125 | 9 | 129 | 3 |
| 18ML-18 | 412 | 465 | 0.89 | 0.13427 | 0.01009 | 0.02026 | 0.00054 | 0.04807 | 0.00362 | 128 | 9 | 129 | 3 |
| 18ML-19 | 443 | 386 | 1.15 | 0.13945 | 0.01269 | 0.01950 | 0.00054 | 0.05185 | 0.00492 | 133 | 11 | 125 | 3 |
| 18ML-20 | 362 | 430 | 0.84 | 0.12173 | 0.01502 | 0.02073 | 0.00070 | 0.04258 | 0.00544 | 117 | 14 | 132 | 4 |
| 18ML-21 | 513 | 456 | 1.13 | 0.14557 | 0.01201 | 0.02057 | 0.00052 | 0.05132 | 0.00437 | 138 | 11 | 131 | 3 |
| 18ML-22 | 356 | 423 | 0.84 | 0.16417 | 0.01403 | 0.02073 | 0.00059 | 0.05743 | 0.00509 | 154 | 12 | 132 | 4 |
| 18ML-24 | 277 | 269 | 1.03 | 0.13333 | 0.01795 | 0.02165 | 0.00076 | 0.04466 | 0.00621 | 127 | 16 | 138 | 5 |
| 18ML-25 | 309 | 313 | 0.99 | 0.13321 | 0.01256 | 0.02084 | 0.00060 | 0.04636 | 0.00447 | 127 | 11 | 133 | 4 |
| 18ML-26 | 361 | 396 | 0.91 | 0.12834 | 0.01091 | 0.01974 | 0.00056 | 0.04715 | 0.00407 | 123 | 10 | 126 | 4 |
| 18ML-27 | 748 | 923 | 0.81 | 0.15996 | 0.01254 | 0.02117 | 0.00058 | 0.05479 | 0.00454 | 151 | 11 | 135 | 4 |
| 18ML-28 | 623 | 674 | 0.92 | 0.14167 | 0.01003 | 0.01987 | 0.00048 | 0.05172 | 0.00362 | 135 | 9 | 127 | 3 |
| 18ML-29 | 781 | 584 | 1.34 | 0.12903 | 0.01136 | 0.02037 | 0.00053 | 0.04593 | 0.00404 | 123 | 10 | 130 | 3 |
| 18ML-30 | 586 | 484 | 1.21 | 0.12961 | 0.01069 | 0.01942 | 0.00051 | 0.04841 | 0.00407 | 124 | 10 | 124 | 3 |

**Ti-in-zircon temperatures**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Spot** | **Ti(ppm)** | **T(°C)** | **Spot** | **Ti(ppm)** | **T(°C)** |
| 18TL01-02 | 5.76 | 742 | 18TL03-02 | 12.83 | 823 |
| 18TL01-03 | 4.55 | 720 | 18TL03-03 | 1.58 | 635 |
| 18TL01-04 | 7.61 | 769 | 18TL03-09 | 1.86 | 647 |
| 18TL01-06 | 5.45 | 737 | 18TL03-11 | 2.75 | 677 |
| 18TL01-07 | 6.65 | 756 | 18TL03-12 | 0.61 | 568 |
| 18TL01-08 | 5.71 | 741 | 18TL03-13 | 4.82 | 726 |
| 18TL01-09 | 5.11 | 731 | 18TL03-15 | 5.84 | 743 |
| 18TL01-10 | 5.87 | 744 | 18TL03-18 | 2.54 | 671 |
| 18TL01-12 | 3.60 | 700 | 18TL03-19 | 2.35 | 665 |
| 18TL01-16 | 11.84 | 814 | 18TL03-20 | 3.72 | 703 |
| 18TL01-17 | 7.00 | 761 | 18TL03-23 | 0.72 | 580 |
| 18TL01-19 | 6.60 | 755 | 18ML-01 | 1.79 | 644 |
| 18TL01-20 | 3.49 | 698 | 18ML-02 | 2.79 | 679 |
| 18TL01-21 | 2.86 | 681 | 18ML-03 | 1.83 | 645 |
| 18TL01-23 | 5.96 | 745 | 18ML-04 | 3.59 | 700 |
| 18TL01-24 | 3.67 | 702 | 18ML-05 | 7.85 | 772 |
| 18TL01-25 | 7.34 | 765 | 18ML-06 | 3.05 | 686 |
| 18TL01-27 | 4.64 | 722 | 18ML-07 | 0.85 | 590 |
| 18TL01-28 | 8.90 | 784 | 18ML-08 | 1.49 | 630 |
| 18TL01-29 | 5.06 | 730 | 18ML-09 | 3.13 | 688 |
| 18TL02-02 | 3.52 | 698 | 18ML-10 | 2.99 | 684 |
| 18TL02-03 | 2.30 | 663 | 18ML-11 | 0.41 | 543 |
| 18TL02-04 | 1.52 | 631 | 18ML-12 | 2.73 | 677 |
| 18TL02-05 | 2.78 | 678 | 18ML-13 | 2.23 | 661 |
| 18TL02-06 | 2.26 | 662 | 18ML-14 | 0.66 | 573 |
| 18TL02-07 | 2.82 | 680 | 18ML-15 | 2.23 | 661 |
| 18TL02-08 | 6.40 | 752 | 18ML-16 | 0.89 | 593 |
| 18TL02-09 | 1.17 | 613 | 18ML-17 | 2.99 | 684 |
| 18TL02-10 | 3.67 | 702 | 18ML-18 | 1.16 | 612 |
| 18TL02-11 | 3.81 | 705 | 18ML-19 | 4.99 | 729 |
| 18TL02-12 | 2.02 | 653 | 18ML-20 | 2.95 | 683 |
| 18TL02-13 | 3.66 | 702 | 18ML-21 | 3.30 | 693 |
| 18TL02-14 | 5.81 | 743 | 18ML-22 | 1.45 | 628 |
| 18TL02-15 | 4.44 | 718 | 18ML-24 | 1.51 | 631 |
| 18TL02-16 | 1.01 | 602 | 18ML-25 | 3.98 | 709 |
| 18TL02-17 | 5.46 | 737 | 18ML-26 | 2.04 | 654 |
| 18TL02-18 | 2.56 | 672 | 18ML-27 | 1.34 | 622 |
| 18TL02-19 | 1.96 | 651 | 18ML-28 | 2.31 | 664 |
| 18TL02-20 | 2.23 | 661 | 18ML-29 | 1.12 | 609 |
| 18TL02-21 | 2.73 | 677 | 18ML-30 | 1.58 | 634 |
| 18TL02-23 | 0.28 | 522 |  |  |  |
| 18TL02-25 | 2.77 | 678 |  |  |  |
| 18TL02-26 | 4.76 | 725 |  |  |  |
| 18TL02-28 | 1.62 | 636 |  |  |  |
| 18TL02-29 | 5.20 | 733 |  |  |  |

**Note:**

18TL01: Daxiezhuang unit

18TL02: Shibu unit

18TL03: Tiqiushan unit

18ML: Malingzhan unit

Ti-in-zircon temperatures are calculated using the equation proposed by Ferry and Watson (2007). The activities of Titanium and Silica are set to 1 and 0.6, respectively.