Supplementary materials for:

**The Early Cretaceous tectonic evolution of the Neo-Tethys: Constraints from zircon U–Pb geochronology and geochemistry of the Liuqiong adakite, Gongga, Tibet**

Yao Zhong a, Wen-Guang Yang a, \*, Li-Dong Zhu a, Long Xie a, Yuan-Jun Mai a, Nan Li a, Yu Zhou a, Hong-Liang Zhang b, Xia Tong a, and Wei-Na Feng c

a Institute of Sedimentary Geology, Chengdu University of Technology, Chengdu 610059, China

b College of Earth Science, Chengdu University of Technology, Chengdu 610059, China

c The 106 Geological Brigade, Sichuan Bureau of Geology and Mineral Resources, Chengdu 611130, China

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Author for Correspondence: Wen-Guang Yang (yangwg1018@gmail.com)

Institute of Sedimentary Geology, Chengdu University of Technology, Chengdu 610059, China

1#, Dongsanlu, Erxianqiao, Chengdu 610059, Sichuan, P.R.China

# Tables

**Table S1** Whole-rock geochemistry of the Early Cretaceous adakite rocks from Liuqiong

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample No. | D0087-DH1 | D0087-DH2 | D0087-DH3 | D0087-DH4 | D0087-DH5 | 20CG21-DH1 | 20CG21-DH2 | 20CG21-DH3 | 20CG21-DH4-1 | 20CG21-DH4-2 | 20CG21-DH5 |
| Rock Type |  | Quartz diorite  |
| SiO2 | 59.46  | 59.69  | 59.74  | 59.40  | 59.47  | 60.68 | 60.11 | 60.69 | 61.03 | 60.98 | 60.98 |
| TiO2 | 0.51  | 0.54  | 0.52  | 0.53  | 0.54  | 0.47 | 0.45 | 0.42 | 0.45 | 0.45 | 0.47 |
| Al2O3 | 16.56  | 16.63  | 16.65  | 16.64  | 16.37  | 16.79 | 16.85 | 16.59 | 16.69 | 16.63 | 16.47 |
| TFe2O3 | 5.44  | 5.52  | 5.54  | 5.63  | 5.68  | 5.06 | 4.98 | 4.60 | 4.86 | 4.87 | 5.12 |
| MnO | 0.11  | 0.13  | 0.13  | 0.12  | 0.13  | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.11 |
| MgO | 4.27  | 4.55  | 4.28  | 4.44  | 4.34  | 3.15 | 3.17 | 2.77 | 2.94 | 2.93 | 3.27 |
| CaO | 5.11  | 4.84  | 5.63  | 5.42  | 5.34  | 4.49 | 4.47 | 4.18 | 3.87 | 3.87 | 4.33 |
| Na2O | 5.81  | 5.59  | 4.91  | 5.47  | 5.67  | 4.70 | 4.91 | 5.44 | 5.07 | 5.07 | 4.97 |
| K2O | 0.57  | 0.50  | 0.47  | 0.40  | 0.38  | 0.49 | 0.60 | 0.68 | 0.72 | 0.72 | 0.49 |
| P2O5 | 0.17  | 0.18  | 0.18  | 0.18  | 0.18  | 0.20 | 0.20 | 0.19 | 0.20 | 0.20 | 0.20 |
| LOI | 1.20  | 1.31  | 1.43  | 1.35  | 1.20  | 3.70 | 3.67 | 4.36 | 4.07 | 4.09 | 3.57 |
| SUM | 99.21  | 99.47  | 99.47  | 99.57  | 99.30  | 99.83 | 99.53 | 100.01 | 99.99 | 99.89 | 99.97 |
| Mg# | 65  | 66  | 64  | 65 | 64  | 59 | 60 | 58  | 59 | 58 | 60 |
| Li | 14.80  | 19.56  | 20.26  | 16.97  | 12.05  | 36.1 | 36.1 | 37.4 | 37.8 | - | 32.5 |
| Be | 0.76  | 0.71  | 0.90  | 0.80  | 0.83  | 0.84 | 0.88 | 0.86 | 0.92 | - | 0.70 |
| Sc | 15.57  | 15.67  | 14.42  | 15.63  | 15.38  | 10.4 | 10.4 | 9.11 | 10.4 | - | 10.9 |
| V | 132.86  | 127.21  | 128.92  | 134.27  | 130.18  | 107 | 106 | 94.1 | 106 | - | 108 |
| Cr | 132.04  | 139.10  | 123.71  | 130.55  | 130.11  | 71.6 | 77.0 | 57.0 | 61.0 | - | 73.0 |
| Co | 17.47  | 16.01  | 17.86  | 18.91  | 16.52  | 11.5 | 11.2 | 8.70 | 11.7 | - | 11.8 |
| Ni | 47.10  | 46.69  | 42.58  | 47.63  | 43.87  | 24.6 | 29.9 | 23.0 | 22.2 | - | 25.9 |
| Cu | 61.32  | 12.95  | 20.23  | 34.73  | 25.10  | 24.3 | 26.5 | 21.7 | 23.3 | - | 17.5 |
| Zn | 65.70  | 61.61  | 72.06  | 69.34  | 65.20  | 55.7 | 54.3 | 47.5 | 53.4 | - | 62.7 |
| Ga | 17.01  | 16.67  | 16.43  | 17.02  | 16.43  | 16.9 | 16.6 | 16.1 | 16.9 | - | 16.8 |
| Rb | 9.43  | 9.85  | 8.41  | 6.40  | 6.55  | 9.22 | 10.8 | 11.8 | 13.1 | - | 8.89 |
| Sr | 866.72  | 882.37  | 843.27  | 1001.64  | 876.75  | 913 | 881 | 1027 | 1099 | - | 774 |
| Y | 12.98  | 12.94  | 12.59  | 13.02  | 12.50  | 12.0 | 11.8 | 11.1 | 12.1 | - | 12.3 |
| Zr | 82.62  | 86.40  | 77.89  | 84.19  | 80.71  | 63.4 | 59.2 | 69.0 | 62.4 | - | 65.6 |
| Nb | 2.47  | 2.42  | 2.43  | 2.54  | 2.46  | 2.26 | 2.25 | 2.19 | 2.46 | - | 2.26 |
| Sn | 0.49  | 0.53  | 0.52  | 0.55  | 0.52  | 0.45 | 0.47 | 0.46 | 0.54 | - | 0.57 |
| Cs | 0.43  | 0.82  | 0.67  | 0.45  | 1.00  | 0.70 | 0.92 | 1.01 | 1.12 | - | 0.66 |
| Ba | 125.60  | 127.47  | 84.43  | 123.35  | 107.38  | 158 | 206 | 157 | 174 | - | 145 |
| La | 12.02  | 11.89  | 11.10  | 11.88  | 11.67  | 14.1 | 14.0 | 14.2 | 15.2 | - | 13.9 |
| Ce | 25.91  | 25.67  | 24.26  | 25.67  | 25.80  | 30.5 | 29.9 | 29.9 | 32.0 | - | 30.1 |
| Pr | 3.23  | 3.16  | 3.03  | 3.17  | 3.06  | 3.58 | 3.55 | 3.50 | 3.81 | - | 3.67 |
| Nd | 12.96  | 12.74  | 12.02  | 12.27  | 12.35  | 15.1 | 14.4 | 14.7 | 15.4 | - | 15.0 |
| Sm | 2.67  | 2.57  | 2.58  | 2.80  | 2.66  | 3.00 | 2.83 | 2.76 | 3.00 | - | 3.01 |
| Eu | 0.91  | 0.91  | 0.82  | 0.90  | 0.87  | 0.97 | 0.86 | 0.96 | 0.93 | - | 0.88 |
| Gd | 2.54  | 2.50  | 2.31  | 2.50  | 2.43  | 2.53 | 2.48 | 2.39 | 2.64 | - | 2.58 |
| Tb | 0.40  | 0.40  | 0.38  | 0.41  | 0.39  | 0.35 | 0.38 | 0.36 | 0.37 | - | 0.37 |
| Dy | 2.44  | 2.27  | 2.30  | 2.43  | 2.19  | 2.02 | 2.10 | 1.92 | 2.19 | - | 2.11 |
| Ho | 0.48  | 0.46  | 0.43  | 0.47  | 0.46  | 0.40 | 0.41 | 0.38 | 0.42 | - | 0.41 |
| Er | 1.29  | 1.27  | 1.25  | 1.27  | 1.25  | 1.19 | 1.16 | 1.11 | 1.17 | - | 1.24 |
| Tm | 0.19  | 0.19  | 0.20  | 0.20  | 0.19  | 0.18 | 0.17 | 0.16 | 0.18 | - | 0.19 |
| Yb | 1.21  | 1.27  | 1.25  | 1.24  | 1.21  | 1.15 | 1.17 | 1.11 | 1.21 | - | 1.20 |
| Lu | 0.19  | 0.19  | 0.19  | 0.19  | 0.19  | 0.18 | 0.18 | 0.17 | 0.18 | - | 0.18 |
| Hf | 2.20  | 2.26  | 2.18  | 2.25  | 2.34  | 1.86 | 1.75 | 1.97 | 1.80 | - | 1.94 |
| Ta | 0.19  | 0.18  | 0.19  | 0.17  | 0.17  | 0.15 | 0.15 | 0.15 | 0.15 | - | 0.14 |
| Tl | 0.07  | 0.07  | 0.07  | 0.05  | 0.05  | 0.078 | 0.097 | 0.083 | 0.11 | - | 0.071 |
| Pb | 24.07  | 11.16  | 19.05  | 21.11  | 9.56  | 8.14 | 7.76 | 5.76 | 5.91 | - | 11.7 |
| Th | 2.68  | 2.57  | 2.58  | 2.69  | 2.63  | 3.11 | 2.95 | 3.19 | 3.32 | - | 3.06 |
| U | 0.96  | 0.90  | 0.97  | 0.95  | 0.95  | 1.03 | 1.02 | 1.12 | 1.12 | - | 1.00 |
| δEu | 1.06  | 1.09  | 1.02  | 1.04  | 1.05  | 1.05 | 0.97 | 1.12 | 0.99 | - | 0.94 |
| Sr–Nd isotope compositions |
| 87Rb/86Sr | 0.03  | 0.03  | 0.03  | 0.02  | 0.02  |  |  |  |  |  |  |
| 87Sr/86Sr | 0.705680  | 0.705918  | 0.705889  | 0.705682  | 0.705796  |  |  |  |  |  |  |
| (±2σ) | 0.000005  | 0.000006  | 0.000005  | 0.000005  | 0.000007  |  |  |  |  |  |  |
| (87Sr/86Sr)i | 0.705617  | 0.705853  | 0.705831  | 0.705645  | 0.705753  |  |  |  |  |  |  |
| 147Sm/144Nd | 0.124624  | 0.121720  | 0.129514  | 0.137965  | 0.130149  |  |  |  |  |  |  |
| 143Nd/144Nd | 0.512884  | 0.512890  | 0.512872  | 0.512883  | 0.512876  |  |  |  |  |  |  |
| (±2σ) | 0.000008  | 0.000012  | 0.000036  | 0.000018  | 0.000009  |  |  |  |  |  |  |
| (143Nd/144Nd)i | 0.512769  | 0.512778  | 0.512753  | 0.512756  | 0.512756  |  |  |  |  |  |  |
| εNd(t) | 6.10  | 6.27  | 5.78  | 5.84  | 5.84  |  |  |  |  |  |  |

**Table S2** Analysis results of zircon U–Pb ages of D0085-N3, D0087-N1 and 20CG21-N5

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sample No. | 232Th | 238U | Th/U | Ratio | Age（Ma） | Con | Ti(ppm) |
| ppm | ppm | 207Pb/206Pb | 2σ/1σ | 207Pb/235U | 2σ/1σ | 206Pb/238U | 2σ/1σ | 207Pb/206Pb | 2σ/1σ | 207Pb/235U | 2σ/1σ | 206Pb/238U | 2σ/1σ |
| D0085-N3-1 | 55 | 147 | 0.37 | 0.05120 | 0.00420 | 0.16000 | 0.01300 | 0.02284 | 0.00040 | 100.0 | 160.0 | 148.0 | 11.0 | 145.5 | 2.5 | 98 | 1.97  |
| D0085-N3-2 | 55 | 146 | 0.38 | 0.04800 | 0.00380 | 0.14400 | 0.01100 | 0.02188 | 0.00036 | 0.0 | 140.0 | 134.4 | 9.5 | 139.5 | 2.3 | 96 | 2.89  |
| D0085-N3-3 | 119 | 230 | 0.52 | 0.04910 | 0.00250 | 0.14940 | 0.00760 | 0.02193 | 0.00027 | 110.0 | 100.0 | 140.5 | 6.7 | 139.9 | 1.7 | 100 | 3.66  |
| D0085-N3-4 | 179 | 294 | 0.61 | 0.05190 | 0.00340 | 0.15440 | 0.00940 | 0.02183 | 0.00033 | 200.0 | 130.0 | 144.9 | 8.3 | 139.2 | 2.1 | 96 | 3.47  |
| D0085-N3-5 | 107 | 255 | 0.42 | 0.04740 | 0.00280 | 0.14510 | 0.00830 | 0.02215 | 0.00030 | 30.0 | 120.0 | 137.5 | 7.2 | 141.2 | 1.9 | 97 | 3.95  |
| D0085-N3-6 | 98 | 198 | 0.50 | 0.05100 | 0.00370 | 0.15010 | 0.00990 | 0.02179 | 0.00037 | 120.0 | 140.0 | 140.6 | 8.7 | 138.9 | 2.3 | 99 | 2.45  |
| D0085-N3-7 | 65 | 169 | 0.39 | 0.05180 | 0.00410 | 0.15500 | 0.01200 | 0.02208 | 0.00037 | 180.0 | 160.0 | 145.0 | 10.0 | 140.8 | 2.3 | 97 | 3.34  |
| D0085-N3-8 | 127 | 269 | 0.47 | 0.04710 | 0.00290 | 0.14360 | 0.00840 | 0.02216 | 0.00034 | 20.0 | 120.0 | 135.4 | 7.5 | 141.3 | 2.2 | 96 | 3.29  |
| D0085-N3-9 | 126 | 273 | 0.46 | 0.05000 | 0.00280 | 0.15180 | 0.00840 | 0.02206 | 0.00029 | 140.0 | 120.0 | 142.5 | 7.4 | 140.6 | 1.8 | 99 | 3.76  |
| D0085-N3-10 | 128 | 246 | 0.52 | 0.05010 | 0.00350 | 0.15200 | 0.01100 | 0.02192 | 0.00038 | 130.0 | 140.0 | 142.2 | 9.5 | 139.8 | 2.4 | 98 | 2.59  |
| D0085-N3-11 | 212 | 325 | 0.65 | 0.04960 | 0.00300 | 0.15030 | 0.00870 | 0.02231 | 0.00036 | 140.0 | 120.0 | 142.6 | 8.0 | 142.3 | 2.3 | 100 | 3.70  |
| D0085-N3-12 | 175 | 306 | 0.57 | 0.04970 | 0.00270 | 0.14860 | 0.00770 | 0.02180 | 0.00028 | 120.0 | 100.0 | 139.9 | 6.7 | 139.0 | 1.8 | 99 | 4.49  |
| D0085-N3-13 | 51 | 150 | 0.34 | 0.04620 | 0.00450 | 0.14300 | 0.01400 | 0.02223 | 0.00047 | -40.0 | 180.0 | 134.0 | 12.0 | 141.7 | 2.9 | 94 | 2.34  |
| D0085-N3-14 | 94 | 261 | 0.36 | 0.05190 | 0.00330 | 0.15700 | 0.01000 | 0.02170 | 0.00034 | 220.0 | 130.0 | 147.9 | 9.0 | 138.4 | 2.1 | 93 | 6.60  |
| D0085-N3-15 | 114 | 249 | 0.46 | 0.04810 | 0.00300 | 0.14500 | 0.00890 | 0.02190 | 0.00033 | 40.0 | 120.0 | 136.3 | 7.9 | 139.6 | 2.1 | 98 | 3.50  |
| D0085-N3-16 | 110 | 279 | 0.40 | 0.04850 | 0.00290 | 0.14930 | 0.00880 | 0.02233 | 0.00029 | 70.0 | 120.0 | 140.3 | 7.8 | 142.4 | 1.8 | 99 | 3.10  |
| D0085-N3-17 | 90 | 209 | 0.43 | 0.05050 | 0.00430 | 0.15500 | 0.01300 | 0.02232 | 0.00044 | 120.0 | 170.0 | 145.0 | 11.0 | 142.3 | 2.8 | 98 | 3.43  |
| D0085-N3-18 | 178 | 325 | 0.55 | 0.04840 | 0.00280 | 0.14590 | 0.00820 | 0.02182 | 0.00030 | 60.0 | 110.0 | 137.4 | 7.2 | 139.2 | 1.9 | 99 | 4.45  |
| D0085-N3-19 | 48 | 146 | 0.33 | 0.05100 | 0.00440 | 0.15600 | 0.01400 | 0.02205 | 0.00047 | 170.0 | 170.0 | 145.0 | 12.0 | 140.6 | 2.9 | 97 | 2.00  |
| D0085-N3-20 | 82 | 232 | 0.35 | 0.04880 | 0.00330 | 0.14610 | 0.00990 | 0.02176 | 0.00031 | 50.0 | 130.0 | 137.1 | 8.7 | 138.8 | 2.0 | 99 | 2.87  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D0087-N1-1 | 163  | 295  | 0.55  | 0.04860  | 0.00270  | 0.14700  | 0.00820  | 0.02190  | 0.00030  | 110.0 | 110.0 | 138.3 | 7.3 | 139.7 | 1.9 | 99 | 5.35  |
| D0087-N1-2 | 127  | 285  | 0.45  | 0.04810  | 0.00310  | 0.14720  | 0.00940  | 0.02202  | 0.00031  | 50.0 | 120.0 | 138.2 | 8.2 | 140.4 | 1.9 | 98 | 4.30  |
| D0087-N1-3 | 178  | 302  | 0.59  | 0.05100  | 0.00240  | 0.15500  | 0.00730  | 0.02219  | 0.00025  | 180.0 | 98.0 | 145.4 | 6.4 | 141.5 | 1.6 | 97 | 5.48  |
| D0087-N1-4 | 168  | 304  | 0.55  | 0.04690  | 0.00250  | 0.14130  | 0.00730  | 0.02178  | 0.00029  | 30.0 | 100.0 | 133.5 | 6.5 | 138.9 | 1.8 | 96 | 4.14  |
| D0087-N1-5 | 167  | 321  | 0.52  | 0.04900  | 0.00260  | 0.14920  | 0.00810  | 0.02200  | 0.00030  | 100.0 | 110.0 | 141.1 | 7.3 | 140.3 | 1.9 | 99 | 4.43  |
| D0087-N1-6 | 104  | 224  | 0.46  | 0.04960  | 0.00320  | 0.14920  | 0.00930  | 0.02193  | 0.00031  | 90.0 | 130.0 | 139.9 | 8.2 | 139.8 | 2.0 | 100 | 3.02  |
| D0087-N1-7 | 102  | 181  | 0.56  | 0.04750  | 0.00360  | 0.14900  | 0.01100  | 0.02276  | 0.00035  | -10.0 | 140.0 | 139.0 | 9.5 | 145.1 | 2.2 | 96 | 2.03  |
| D0087-N1-8 | 188  | 330  | 0.57  | 0.04920  | 0.00370  | 0.14400  | 0.01000  | 0.02187  | 0.00039  | 90.0 | 150.0 | 137.5 | 9.4 | 139.5 | 2.4 | 99 | 3.87  |
| D0087-N1-9 | 248  | 412  | 0.60  | 0.05000  | 0.00230  | 0.15400  | 0.00690  | 0.02224  | 0.00023  | 151.0 | 92.0 | 144.6 | 6.1 | 141.8 | 1.5 | 98 | 3.19  |
| D0087-N1-10 | 108  | 244  | 0.44  | 0.04940  | 0.00300  | 0.15040  | 0.00890  | 0.02203  | 0.00033  | 90.0 | 120.0 | 141.1 | 7.9 | 140.4 | 2.1 | 100 | 4.17  |
| D0087-N1-11 | 104  | 195  | 0.53  | 0.05010  | 0.00380  | 0.15800  | 0.01100  | 0.02315  | 0.00032  | 100.0 | 150.0 | 146.8 | 10.0 | 147.5 | 2.0 | 100 | 7.00  |
| D0087-N1-12 | 45  | 131  | 0.35  | 0.05150  | 0.00590  | 0.15800  | 0.01800  | 0.02217  | 0.00057  | 130.0 | 220.0 | 147.0 | 16.0 | 141.3 | 3.6 | 96 | 1.88  |
| D0087-N1-13 | 119  | 227  | 0.52  | 0.04850  | 0.00310  | 0.14580  | 0.00880  | 0.02224  | 0.00033  | 60.0 | 120.0 | 138.1 | 8.0 | 141.8 | 2.1 | 97 | 2.99  |
| D0087-N1-14 | 181  | 218  | 0.83  | 0.04990  | 0.00360  | 0.15300  | 0.01100  | 0.02208  | 0.00030  | 90.0 | 140.0 | 142.7 | 9.5 | 140.8 | 1.9 | 99 | 3.15  |
| D0087-N1-15 | 63  | 183  | 0.35  | 0.05070  | 0.00320  | 0.15440  | 0.00990  | 0.02187  | 0.00035  | 150.0 | 130.0 | 144.3 | 8.8 | 139.5 | 2.2 | 97 | 3.04  |
| ~~D0087-N1-16~~ | ~~125~~  | ~~250~~  | ~~0.50~~  | ~~0.05080~~  | ~~0.00460~~  | ~~0.10050~~  | ~~0.00890~~  | ~~0.02199~~  | ~~0.00042~~  | ~~130.0~~ | ~~170.0~~ | ~~96.4~~ | ~~8.2~~ | ~~140.2~~ | ~~2.7~~ | ~~63~~ | ~~2.89~~  |
| D0087-N1-17 | 65  | 173  | 0.37  | 0.04670  | 0.00330  | 0.14400  | 0.01000  | 0.02228  | 0.00034  | 10.0 | 140.0 | 137.4 | 9.5 | 142.0 | 2.1 | 97 | 1.97  |
| D0087-N1-18 | 43  | 129  | 0.33  | 0.04780  | 0.00410  | 0.14700  | 0.01300  | 0.02224  | 0.00041  | 20.0 | 170.0 | 137.0 | 11.0 | 141.8 | 2.6 | 97 | 2.52  |
| D0087-N1-19 | 61  | 171  | 0.36  | 0.04870  | 0.00390  | 0.14900  | 0.01200  | 0.02215  | 0.00036  | 30.0 | 150.0 | 139.0 | 10.0 | 141.2 | 2.3 | 98 | 2.48  |
| D0087-N1-20 | 125  | 257  | 0.49  | 0.04850  | 0.00300  | 0.14740  | 0.00890  | 0.02206  | 0.00030  | 60.0 | 120.0 | 138.4 | 7.9 | 140.7 | 1.9 | 98 | 3.97  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20CG21-N5-0101001 | 132  | 326  | 0.41  | 0.04885  | 0.00128  | 0.14440  | 0.00409  | 0.02137  | 0.00032  | 139.0  | 65.7  | 137.0  | 3.6  | 136.3  | 2.0  | 99% | 4.89  |
| 20CG21-N5-02 | 72  | 170  | 0.42  | 0.04807  | 0.00244  | 0.14173  | 0.00710  | 0.02167  | 0.00038  | 101.9  | 114.8  | 134.6  | 6.3  | 138.2  | 2.4  | 97% | 3.39  |
| 20CG21-N5-03 | 84  | 220  | 0.38  | 0.04717  | 0.00156  | 0.14007  | 0.00488  | 0.02150  | 0.00032  | 57.5  | 142.6  | 133.1  | 4.3  | 137.2  | 2.0  | 97% | 4.16  |
| 20CG21-N5-04 | 111  | 222  | 0.50  | 0.04575  | 0.00205  | 0.13432  | 0.00580  | 0.02148  | 0.00027  | error |  | 128.0  | 5.2  | 137.0  | 1.7  | 93% | 2.92  |
| 20CG21-N5-05 | 45  | 140  | 0.32  | 0.05046  | 0.00792  | 0.14703  | 0.02120  | 0.02143  | 0.00035  | 216.7  | 325.9  | 139.3  | 18.8  | 136.7  | 2.2  | 98% | 2.00  |
| 20CG21-N5-06 | 91  | 234  | 0.39  | 0.04527  | 0.00163  | 0.13527  | 0.00506  | 0.02165  | 0.00029  | error |  | 128.8  | 4.5  | 138.1  | 1.8  | 93% | 1.93  |
| 20CG21-N5-07 | 77  | 202  | 0.38  | 0.05024  | 0.00184  | 0.14862  | 0.00542  | 0.02154  | 0.00032  | 205.6  | 83.3  | 140.7  | 4.8  | 137.4  | 2.0  | 97% | 2.86  |
| 20CG21-N5-08 | 95  | 229  | 0.42  | 0.04918  | 0.00192  | 0.14556  | 0.00572  | 0.02151  | 0.00033  | 166.8  | 97.2  | 138.0  | 5.1  | 137.2  | 2.1  | 99% | 4.84  |
| 20CG21-N5-09 | 164  | 260  | 0.63  | 0.04946  | 0.00190  | 0.14509  | 0.00554  | 0.02141  | 0.00033  | 168.6  | 90.7  | 137.6  | 4.9  | 136.6  | 2.1  | 99% | 4.76  |
| 20CG21-N5-10 | 114  | 239  | 0.48  | 0.05147  | 0.00179  | 0.15334  | 0.00551  | 0.02153  | 0.00031  | 261.2  | 75.0  | 144.9  | 4.9  | 137.3  | 1.9  | 94% | 4.42  |
| 20CG21-N5-11 | 87  | 237  | 0.37  | 0.04908  | 0.00171  | 0.14660  | 0.00520  | 0.02170  | 0.00035  | 150.1  | 76.8  | 138.9  | 4.6  | 138.4  | 2.2  | 99% | 5.60  |
| 20CG21-N5-12 | 180  | 349  | 0.52  | 0.04826  | 0.00138  | 0.14230  | 0.00441  | 0.02139  | 0.00034  | 122.3  | 73.1  | 135.1  | 3.9  | 136.4  | 2.2  | 99% | 3.19  |
| 20CG21-N5-13 | 132  | 274  | 0.48  | 0.05022  | 0.00177  | 0.14731  | 0.00487  | 0.02136  | 0.00030  | 205.6  | 83.3  | 139.5  | 4.3  | 136.3  | 1.9  | 97% | 3.38  |
| 20CG21-N5-14 | 85  | 207  | 0.41  | 0.05081  | 0.00218  | 0.14815  | 0.00615  | 0.02139  | 0.00034  | 231.6  | 98.1  | 140.3  | 5.4  | 136.4  | 2.1  | 97% | 5.58  |
| 20CG21-N5-15 | 93  | 202  | 0.46  | 0.05174  | 0.00175  | 0.15276  | 0.00518  | 0.02143  | 0.00031  | 272.3  | 77.8  | 144.3  | 4.6  | 136.7  | 2.0  | 94% | 3.20  |
| 20CG21-N5-16 | 109  | 228  | 0.48  | 0.04882  | 0.00200  | 0.14378  | 0.00581  | 0.02145  | 0.00033  | 139.0  | 96.3  | 136.4  | 5.2  | 136.8  | 2.1  | 99% | 6.17  |
| 20CG21-N5-17 | 94  | 210  | 0.45  | 0.05177  | 0.00189  | 0.15381  | 0.00585  | 0.02142  | 0.00033  | 276.0  | 88.0  | 145.3  | 5.1  | 136.6  | 2.1  | 93% | 4.46  |
| 20CG21-N5-18 | 167  | 324  | 0.51  | 0.04768  | 0.00124  | 0.14190  | 0.00381  | 0.02144  | 0.00028  | 83.4  | 61.1  | 134.7  | 3.4  | 136.8  | 1.8  | 98% | 5.73  |
| 20CG21-N5-19 | 87  | 187  | 0.47  | 0.04888  | 0.00198  | 0.14544  | 0.00600  | 0.02149  | 0.00032  | 142.7  | 96.3  | 137.9  | 5.3  | 137.1  | 2.0  | 99% | 1.51  |
| 20CG21-N5-20 | 83  | 211  | 0.39  | 0.04408  | 0.00178  | 0.13128  | 0.00532  | 0.02154  | 0.00030  | error | error | 125.2  | 4.8  | 137.4  | 1.9  | 90% | 4.24  |
| 20CG21-N5-21 | 67  | 196  | 0.34  | 0.05283  | 0.00229  | 0.15608  | 0.00677  | 0.02149  | 0.00034  | 320.4  | 98.1  | 147.3  | 5.9  | 137.0  | 2.1  | 92% | 1.56  |
| 20CG21-N5-22 | 80  | 161  | 0.50  | 0.05006  | 0.00199  | 0.14929  | 0.00612  | 0.02169  | 0.00037  | 198.2  | 92.6  | 141.3  | 5.4  | 138.3  | 2.3  | 97% | 3.74  |
| 20CG21-N5-23 | 99  | 202  | 0.49  | 0.04719  | 0.00182  | 0.14005  | 0.00558  | 0.02144  | 0.00033  | 57.5  | 88.9  | 133.1  | 5.0  | 136.8  | 2.1  | 97% | 3.97  |

**Table S3** The Lu-Hf isotope compositions of the zircons of D0085-N3, D0087-N1 and 20CG21-N5

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spot No. | Age（Ma） | 176Yb/177Hf | 176Lu/177Hf | 176Hf/177Hf | 2σ | (176Hf/177Hf)i | *ε*Hf(0) | *ε*Hf(t) | TDM1（Ma） | TDM2（Ma） | TDMC（Ma） | *f*Lu/Hf |
| D0085-N3-1 | 145.5 | 0.024454 | 0.000813 | 0.283115 | 0.000018 | 0.283113 | 11.7 | 14.7 | 192 | 224 | 224 | -0.98 |
| D0085-N3-2 | 139.5 | 0.033089 | 0.001124 | 0.283114 | 0.000016 | 0.283111 | 11.6 | 14.6 | 195 | 228 | 228 | -0.97 |
| D0085-N3-3 | 139.9 | 0.026415 | 0.000896 | 0.283088 | 0.000019 | 0.283086 | 10.7 | 13.8 | 231 | 285 | 286 | -0.97 |
| D0085-N3-4 | 139.2 | 0.026366 | 0.000882 | 0.283069 | 0.000017 | 0.283067 | 10.0 | 13.1 | 258 | 329 | 329 | -0.97 |
| D0085-N3-5 | 141.2 | 0.031514 | 0.001059 | 0.283094 | 0.000018 | 0.283091 | 10.9 | 13.9 | 224 | 274 | 274 | -0.97 |
| D0085-N3-6 | 138.9 | 0.019183 | 0.000719 | 0.283066 | 0.000016 | 0.283065 | 10.0 | 13.0 | 260 | 334 | 334 | -0.98 |
| D0085-N3-7 | 140.8 | 0.029257 | 0.001010 | 0.283130 | 0.000019 | 0.283127 | 12.2 | 15.2 | 172 | 191 | 191 | -0.97 |
| D0085-N3-8 | 141.3 | 0.038780 | 0.001289 | 0.283100 | 0.000019 | 0.283096 | 11.1 | 14.1 | 217 | 262 | 262 | -0.96 |
| D0085-N3-9 | 140.6 | 0.041648 | 0.001387 | 0.283135 | 0.000019 | 0.283132 | 12.4 | 15.4 | 166 | 181 | 181 | -0.96 |
| D0085-N3-10 | 139.8 | 0.028208 | 0.001025 | 0.283104 | 0.000019 | 0.283101 | 11.3 | 14.3 | 209 | 250 | 251 | -0.97 |
| D0085-N3-11 | 142.3 | 0.028718 | 0.000966 | 0.283080 | 0.000017 | 0.283078 | 10.4 | 13.5 | 242 | 304 | 304 | -0.97 |
| D0085-N3-12 | 139.0 | 0.044031 | 0.001465 | 0.283093 | 0.000019 | 0.283089 | 10.9 | 13.9 | 227 | 278 | 278 | -0.96 |
| D0085-N3-13 | 141.7 | 0.027662 | 0.000957 | 0.283070 | 0.000017 | 0.283067 | 10.1 | 13.1 | 258 | 328 | 328 | -0.97 |
| D0085-N3-14 | 138.4 | 0.029916 | 0.001048 | 0.283065 | 0.000016 | 0.283062 | 9.9 | 12.9 | 265 | 340 | 340 | -0.97 |
| D0085-N3-15 | 139.6 | 0.026726 | 0.000919 | 0.283052 | 0.000016 | 0.283050 | 9.4 | 12.5 | 283 | 368 | 369 | -0.97 |
| D0085-N3-16 | 142.4 | 0.024148 | 0.000848 | 0.283108 | 0.000016 | 0.283105 | 11.4 | 14.4 | 203 | 241 | 241 | -0.97 |
| D0085-N3-17 | 142.3 | 0.020958 | 0.000734 | 0.283089 | 0.000014 | 0.283088 | 10.8 | 13.8 | 228 | 282 | 282 | -0.98 |
| D0085-N3-18 | 139.2 | 0.032338 | 0.001125 | 0.283074 | 0.000016 | 0.283071 | 10.2 | 13.2 | 253 | 319 | 320 | -0.97 |
| D0085-N3-19 | 140.6 | 0.026410 | 0.000922 | 0.283115 | 0.000017 | 0.283113 | 11.7 | 14.7 | 192 | 224 | 224 | -0.97 |
| D0085-N3-20 | 138.8 | 0.028377 | 0.000986 | 0.283102 | 0.000017 | 0.283099 | 11.2 | 14.2 | 212 | 255 | 255 | -0.97 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| D0087-N1-1 | 139.7 | 0.035198 | 0.001209 | 0.283040 | 0.000017 | 0.283037 | 9.0 | 12.0 | 301 | 396 | 397 | -0.96 |
| D0087-N1-2 | 140.4 | 0.029512 | 0.001046 | 0.283099 | 0.000018 | 0.283096 | 11.1 | 14.1 | 216 | 262 | 262 | -0.97 |
| D0087-N1-3 | 141.5 | 0.032016 | 0.001160 | 0.283103 | 0.000018 | 0.283100 | 11.2 | 14.2 | 212 | 254 | 254 | -0.97 |
| D0087-N1-4 | 138.9 | 0.024354 | 0.000859 | 0.283117 | 0.000016 | 0.283115 | 11.7 | 14.8 | 190 | 220 | 220 | -0.97 |
| D0087-N1-5 | 140.3 | 0.028436 | 0.001069 | 0.283104 | 0.000016 | 0.283102 | 11.3 | 14.3 | 209 | 250 | 250 | -0.97 |
| D0087-N1-6 | 139.8 | 0.029946 | 0.001153 | 0.283100 | 0.000020 | 0.283097 | 11.1 | 14.2 | 215 | 260 | 260 | -0.97 |
| D0087-N1-7 | 145.1 | 0.009332 | 0.000334 | 0.283098 | 0.000015 | 0.283097 | 11.1 | 14.1 | 214 | 260 | 260 | -0.99 |
| D0087-N1-8 | 139.5 | 0.031669 | 0.001027 | 0.283080 | 0.000018 | 0.283077 | 10.4 | 13.4 | 244 | 306 | 306 | -0.97 |
| D0087-N1-9 | 141.8 | 0.024927 | 0.000906 | 0.283110 | 0.000015 | 0.283108 | 11.5 | 14.5 | 200 | 236 | 236 | -0.97 |
| D0087-N1-10 | 140.4 | 0.026857 | 0.000919 | 0.283077 | 0.000016 | 0.283075 | 10.3 | 13.4 | 246 | 310 | 311 | -0.97 |
| D0087-N1-11 | 147.5 | 0.037225 | 0.001237 | 0.283067 | 0.000023 | 0.283064 | 10.0 | 13.0 | 263 | 335 | 336 | -0.96 |
| D0087-N1-12 | 141.3 | 0.028472 | 0.000964 | 0.283024 | 0.000022 | 0.283021 | 8.4 | 11.5 | 323 | 433 | 433 | -0.97 |
| D0087-N1-13 | 141.8 | 0.018202 | 0.000624 | 0.283105 | 0.000017 | 0.283103 | 11.3 | 14.4 | 206 | 246 | 247 | -0.98 |
| D0087-N1-14 | 140.8 | 0.022700 | 0.000832 | 0.283092 | 0.000022 | 0.283089 | 10.8 | 13.9 | 226 | 277 | 278 | -0.98 |
| D0087-N1-15 | 139.5 | 0.027883 | 0.000938 | 0.283071 | 0.000023 | 0.283069 | 10.1 | 13.1 | 256 | 325 | 325 | -0.97 |
| D0087-N1-17 | 142.0 | 0.026761 | 0.000933 | 0.283096 | 0.000020 | 0.283093 | 11.0 | 14.0 | 221 | 269 | 269 | -0.97 |
| D0087-N1-18 | 141.8 | 0.030955 | 0.001074 | 0.283107 | 0.000022 | 0.283104 | 11.4 | 14.4 | 205 | 244 | 244 | -0.97 |
| D0087-N1-19 | 141.2 | 0.028823 | 0.001012 | 0.283116 | 0.000019 | 0.283113 | 11.7 | 14.7 | 192 | 223 | 223 | -0.97 |
| D0087-N1-20 | 140.7 | 0.031730 | 0.001092 | 0.283093 | 0.000022 | 0.283090 | 10.9 | 13.9 | 225 | 275 | 276 | -0.97 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20CG21-N5-01 | 136.3  | 0.032024 | 0.001418 | 0.283111 | 0.000016 | 0.283107 | 11.5 | 14.4 | 201 | 239 | 239 | -0.96 |
| 20CG21-N5-02 | 138.2  | 0.018636 | 0.000830 | 0.283148 | 0.000014 | 0.283145 | 12.8 | 15.8 | 146 | 151 | 151 | -0.98 |
| 20CG21-N5-03 | 137.2  | 0.029747 | 0.001281 | 0.283111 | 0.000015 | 0.283108 | 11.5 | 14.5 | 200 | 238 | 238 | -0.96 |
| 20CG21-N5-04 | 137.0  | 0.019975 | 0.000903 | 0.283105 | 0.000013 | 0.283103 | 11.3 | 14.3 | 207 | 249 | 249 | -0.97 |
| 20CG21-N5-05 | 136.7  | 0.017765 | 0.000816 | 0.283087 | 0.000017 | 0.283085 | 10.7 | 13.6 | 232 | 290 | 290 | -0.98 |
| 20CG21-N5-06 | 138.1  | 0.034232 | 0.001482 | 0.283073 | 0.000017 | 0.283069 | 10.2 | 13.1 | 257 | 326 | 326 | -0.96 |
| 20CG21-N5-07 | 137.4  | 0.029930 | 0.001336 | 0.283103 | 0.000016 | 0.283100 | 11.3 | 14.2 | 212 | 255 | 255 | -0.96 |
| 20CG21-N5-08 | 137.2  | 0.030741 | 0.001357 | 0.283121 | 0.000018 | 0.283117 | 11.9 | 14.8 | 187 | 216 | 216 | -0.96 |
| 20CG21-N5-09 | 136.6  | 0.026885 | 0.001195 | 0.283153 | 0.000017 | 0.283150 | 13.0 | 15.9 | 139 | 141 | 141 | -0.96 |
| 20CG21-N5-10 | 137.3  | 0.022846 | 0.001059 | 0.283067 | 0.000017 | 0.283064 | 10.0 | 12.9 | 262 | 337 | 337 | -0.97 |
| 20CG21-N5-11 | 138.4  | 0.018555 | 0.000865 | 0.283063 | 0.000019 | 0.283061 | 9.8 | 12.8 | 266 | 343 | 343 | -0.97 |
| 20CG21-N5-12 | 136.4  | 0.036593 | 0.001619 | 0.283107 | 0.000018 | 0.283103 | 11.4 | 14.3 | 209 | 250 | 250 | -0.95 |
| 20CG21-N5-13 | 136.3  | 0.022323 | 0.000998 | 0.283093 | 0.000018 | 0.283090 | 10.9 | 13.8 | 225 | 277 | 278 | -0.97 |
| 20CG21-N5-14 | 136.4  | 0.034362 | 0.001502 | 0.283118 | 0.000018 | 0.283114 | 11.8 | 14.7 | 191 | 223 | 223 | -0.96 |
| 20CG21-N5-15 | 136.7  | 0.025852 | 0.001191 | 0.283060 | 0.000025 | 0.283057 | 9.7 | 12.7 | 273 | 353 | 353 | -0.96 |
| 20CG21-N5-16 | 136.8  | 0.036148 | 0.001567 | 0.283156 | 0.000022 | 0.283152 | 13.1 | 16.0 | 137 | 137 | 137 | -0.95 |
| 20CG21-N5-17 | 136.6  | 0.019573 | 0.000881 | 0.283145 | 0.000024 | 0.283143 | 12.7 | 15.7 | 150 | 158 | 158 | -0.97 |
| 20CG21-N5-18 | 136.8  | 0.032216 | 0.001387 | 0.283113 | 0.000017 | 0.283109 | 11.6 | 14.5 | 198 | 234 | 234 | -0.96 |
| 20CG21-N5-19 | 137.1  | 0.022810 | 0.001008 | 0.283116 | 0.000015 | 0.283113 | 11.7 | 14.7 | 192 | 224 | 225 | -0.97 |
| 20CG21-N5-20 | 137.4  | 0.030794 | 0.001354 | 0.283090 | 0.000019 | 0.283087 | 10.8 | 13.7 | 231 | 285 | 285 | -0.96 |
| 20CG21-N5-21 | 137.0  | 0.014453 | 0.000667 | 0.283117 | 0.000017 | 0.283116 | 11.8 | 14.7 | 188 | 220 | 220 | -0.98 |
| 20CG21-N5-22 | 138.3  | 0.026947 | 0.001191 | 0.283076 | 0.000018 | 0.283073 | 10.3 | 13.2 | 251 | 317 | 317 | -0.96 |
| 20CG21-N5-23 | 136.8  | 0.023695 | 0.001050 | 0.283072 | 0.000018 | 0.283069 | 10.1 | 13.1 | 255 | 326 | 326 | -0.97 |

# Figures

**Fig. S1** Concordia plots of zircon standards (91500 and GJ-1)

**Fig. S2** Hf isotopic ratios of zircon standards (91500 and Ple)



**Fig. S1**



**Fig. S2**