Supplementary Table 1. Representative compositions of garnet in the migmatite from the Muju area.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rock type | migmatite | | | | | | | | | | | | | | |
| Sample No. | mj111 | | | |  | mj2510 | | | |  | mj112 | | | | |
| position | core | core | rim | rim |  | core | core | rim | rim |  | core | core | rim | rim |
| SiO2 | 37.72 | 37.55 | 37.48 | 37.17 |  | 36.69 | 36.95 | 37.24 | 36.30 |  | 36.93 | 37.22 | 37.10 | 36.75 |
| TiO2 | 0.00 | 0.00 | 0.00 | 0.00 |  | 0.02 | 0.00 | 0.00 | 0.00 |  | 0.01 | 0.01 | 0.00 | 0.01 |
| Al2O3 | 21.04 | 20.94 | 20.72 | 20.65 |  | 20.85 | 20.71 | 20.37 | 20.65 |  | 20.42 | 20.45 | 20.06 | 20.26 |
| FeO\* | 34.07 | 34.95 | 36.43 | 37.22 |  | 35.94 | 35.93 | 36.20 | 36.36 |  | 36.32 | 36.52 | 36.24 | 35.65 |
| MnO | 0.78 | 0.81 | 1.29 | 1.05 |  | 1.53 | 1.50 | 2.56 | 3.40 |  | 2.33 | 2.31 | 3.54 | 3.99 |
| MgO | 4.41 | 4.57 | 2.79 | 2.78 |  | 2.86 | 2.83 | 1.72 | 1.56 |  | 2.34 | 2.29 | 1.90 | 1.52 |
| CaO | 1.18 | 1.19 | 1.14 | 1.09 |  | 1.17 | 1.13 | 1.19 | 0.77 |  | 1.04 | 1.04 | 1.03 | 1.10 |
| Na2O | 0.00 | 0.01 | 0.01 | 0.00 |  | 0.00 | 0.00 | 0.01 | 0.00 |  | 0.01 | 0.01 | 0.00 | 0.00 |
| Total | 99.21 | 100.02 | 99.87 | 99.96 |  | 99.06 | 99.05 | 99.30 | 99.04 |  | 99.40 | 99.85 | 99.86 | 99.28 |
|  | Fomular based on 24 Oxygens | | | |  | Fomular based on 24 Oxygens | | | |  | Fomular based on 24 Oxygens | | | | |
| Si | 3.033 | 2.997 | 3.033 | 3.009 |  | 2.992 | 3.014 | 3.054 | 2.992 |  | 3.016 | 3.028 | 3.030 | 3.023 |
| Al | 1.992 | 1.968 | 1.750 | 1.968 |  | 2.001 | 1.989 | 1.968 | 2.005 |  | 1.964 | 1.959 | 1.929 | 1.963 |
| Ti | 0.000 | 0.000 | 0.000 | 0.000 |  | 0.001 | 0.000 | 0.000 | 0.000 |  | 0.010 | 0.010 | 0.001 | 0.000 |
| Fe+2 | 2.291 | 2.333 | 2.466 | 2.520 |  | 2.450 | 2.450 | 2.483 | 2.507 |  | 2.481 | 2.484 | 2.475 | 2.452 |
| Mg | 0.529 | 0.544 | 0.377 | 0.335 |  | 0.348 | 0.344 | 0.211 | 0.192 |  | 0.285 | 0.278 | 0.232 | 0.186 |
| Mn | 0.053 | 0.055 | 0.088 | 0.072 |  | 0.105 | 0.103 | 0.178 | 0.237 |  | 0.161 | 0.159 | 0.245 | 0.278 |
| Ca | 0.102 | 0.102 | 0.099 | 0.095 |  | 0.102 | 0.099 | 0.105 | 0.068 |  | 0.091 | 0.090 | 0.090 | 0.097 |
| Na | 0.000 | 0.001 | 0.002 | 0.000 |  | 0.000 | 0.000 | 0.001 | 0.000 |  | 0.002 | 0.002 | 0.000 | 0.000 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| XFe | 0.812 | 0.811 | 0.880 | 0.883 |  | 0.876 | 0.877 | 0.922 | 0.929 |  | 0.897 | 0.899 | 0.914 | 0.929 |
| XAlm | 0.770 | 0.769 | 0.825 | 0.834 |  | 0.815 | 0.818 | 0.834 | 0.835 |  | 0.822 | 0.825 | 0.814 | 0.814 |
| XPyr | 0.178 | 0.179 | 0.113 | 0.111 |  | 0.116 | 0.115 | 0.071 | 0.064 |  | 0.094 | 0.092 | 0.076 | 0.062 |
| XGro | 0.033 | 0.034 | 0.033 | 0.031 |  | 0.034 | 0.033 | 0.035 | 0.023 |  | 0.030 | 0.030 | 0.030 | 0.032 |
| XSps | 0.017 | 0.018 | 0.029 | 0.024 |  | 0.035 | 0.034 | 0.060 | 0.079 |  | 0.053 | 0.053 | 0.081 | 0.092 |

FeO\* = Fe as total FeO, X(Fe) = Fe/(Fe+Mg), X(Alm) = Fe/(Fe+Mg+Ca+Mn), X(Pyr) = Mg/(Fe+Mg+Ca+Mn), X(Gro) = Ca/(Fe+Mg+Ca+Mn), X(Sps) = Mn/(Fe+Mg+Ca+Mn).

Supplementary Table 2. Representative compositions of biotite in the migmatite and amphibole in the amphibolite from the Muju area.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rock type | migmatite | | | | | | | | | | |  | amphibolite | |
| Sample No. | mj111 | | |  | mj2510 | | |  | mj112 | | |  | mj278 | |
| mineral | Bt | Bt | Bt |  | Bt | Bt | Bt |  | Bt | Bt | Bt |  | Amp | Amp |
| position | inclusion | matrix | matrix |  | inclusion | matrix | matrix |  | core | core | rim |  | rim | rim |
| SiO2 | 37.77 | 37.62 | 37.43 |  | 35.51 | 36.27 | 36.02 |  | 36.07 | 34.10 | 33.67 |  | 44.65 | 45.37 |
| TiO2 | 1.72 | 1.64 | 1.80 |  | 1.33 | 1.50 | 1.32 |  | 1.43 | 0.08 | 0.11 |  | 1.29 | 0.36 |
| Al2O3 | 18.94 | 18.62 | 18.66 |  | 18.23 | 18.85 | 19.54 |  | 18.32 | 21.11 | 21.03 |  | 10.35 | 9.94 |
| FeO\* | 16.44 | 19.82 | 18.54 |  | 20.25 | 20.26 | 20.04 |  | 20.46 | 20.33 | 21.54 |  | 17.87 | 18.08 |
| MnO | 0.03 | 0.08 | 0.06 |  | 0.07 | 0.05 | 0.05 |  | 0.08 | 0.07 | 0.14 |  | 0.29 | 8.76 |
| MgO | 10.17 | 7.93 | 8.90 |  | 8.95 | 8.36 | 8.21 |  | 9.07 | 8.86 | 8.23 |  | 7.37 | 0.34 |
| CaO | 0.00 | 0.00 | 0.00 |  | 0.00 | 0.00 | 0.00 |  | 0.00 | 0.00 | 0.00 |  | 12.35 | 11.89 |
| Na2O | 0.23 | 0.20 | 0.23 |  | 0.22 | 0.23 | 0.32 |  | 0.20 | 0.18 | 0.16 |  | 0.99 | 0.96 |
| K2O | 9.01 | 8.66 | 8.81 |  | 9.50 | 8.88 | 9.02 |  | 9.03 | 9.29 | 9.16 |  | 1.12 | 0.69 |
| Total | 94.31 | 94.56 | 94.43 |  | 94.05 | 94.38 | 94.53 |  | 94.66 | 94.03 | 94.03 |  | 96.28 | 96.39 |
|  | Fomular based on 22 Oxygens | | |  | Fomular based on 22 Oxygens | | |  | Fomular based on 22 Oxygens | | |  | Fomular based on 23 Oxygens | |
| Si | 5.672 | 5.715 | 5.670 |  | 5.507 | 5.562 | 5.515 |  | 5.536 | 5.282 | 5.250 |  | 6.817 | 6.891 |
| Al | 3.348 | 3.332 | 3.328 |  | 3.330 | 3.404 | 3.523 |  | 3.312 | 3.851 | 3.862 |  | 1.861 | 1.778 |
| Ti | 0.194 | 0.188 | 0.250 |  | 0.155 | 0.173 | 0.152 |  | 0.165 | 0.010 | 0.013 |  | 0.148 | 0.041 |
| Fe+2 | 2.064 | 2.518 | 2.349 |  | 2.626 | 2.598 | 2.566 |  | 2.626 | 2.634 | 2.810 |  | 2.282 | 2.296 |
| Mg | 2.277 | 1.795 | 2.010 |  | 2.069 | 1.911 | 1.874 |  | 2.074 | 2.046 | 1.913 |  | 3.698 | 3.917 |
| Mn | 0.004 | 0.010 | 0.008 |  | 0.009 | 0.006 | 0.007 |  | 0.010 | 0.009 | 0.018 |  | 0.038 | 0.044 |
| Ca | 0.000 | 0.000 | 0.000 |  | 0.000 | 0.000 | 0.000 |  | 0.000 | 0.000 | 0.000 |  | 2.020 | 1.935 |
| Na | 0.068 | 0.060 | 0.068 |  | 0.067 | 0.068 | 0.096 |  | 0.060 | 0.054 | 0.047 |  | 0.294 | 0.282 |
| K | 1.726 | 1.678 | 1.703 |  | 1.880 | 1.738 | 1.763 |  | 1.767 | 1.836 | 1.823 |  | 0.217 | 0.134 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| XFe | 0.475 | 0.584 | 0.539 |  | 0.559 | 0.576 | 0.578 |  | 0.559 | 0.563 | 0.595 |  | 0.382 | 0.370 |

FeO\* = Fe as total FeO, X(Fe) = Fe/(Fe+Mg),

Supplementary Table 3. Representative compositions of plagioclase in the migmatite and amphibolite from the Muju area.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rock type | migmatite | | | | | | | | |  | amphibolite | |
| Sample No. | mj111 | | |  | mj2510 | |  | mj112 | |  | mj278 | |
| mineral | Pl | Pl | Pl |  | Pl | Pl |  | Pl | Pl |  | Pl | Pl |
| position | inclusion | matrix | matrix |  | matrix | matrix |  | matrix | matrix |  | matrix | matrix |
| SiO2 | 62.37 | 61.82 | 61.27 |  | 62.62 | 61.52 |  | 61.14 | 61.82 |  | 55.22 | 56.56 |
| TiO2 | 0.00 | 0.00 | 0.01 |  | 0.02 | 0.01 |  | 0.02 | 0.00 |  | 0.01 | 0.00 |
| Al2O3 | 23.10 | 23.70 | 23.60 |  | 23.25 | 23.53 |  | 24.84 | 23.70 |  | 28.39 | 26.64 |
| FeO\* | 0.03 | 0.02 | 0.01 |  | 0.00 | 0.01 |  | 0.00 | 0.02 |  | 0.17 | 0.04 |
| MnO | 0.02 | 0.00 | 0.00 |  | 0.04 | 0.01 |  | 0.01 | 0.00 |  | 0.00 | 0.02 |
| MgO | 0.00 | 0.00 | The |  | 0.00 | 0.01 |  | 0.01 | 0.00 |  | 0.00 | 0.01 |
| CaO | 5.47 | 5.82 | 6.41 |  | 5.94 | 6.20 |  | 5.95 | 5.82 |  | 11.63 | 9.85 |
| Na2O | 7.67 | 8.19 | 8.04 |  | 8.13 | 8.01 |  | 8.30 | 8.19 |  | 5.11 | 6.10 |
| K2O | 0.38 | 0.07 | 0.06 |  | 0.04 | 0.03 |  | 0.06 | 0.07 |  | 0.08 | 0.06 |
| Total | 99.03 | 99.61 | 99.40 |  | 94.66 | 94.03 |  | 100.31 | 99.61 |  | 100.61 | 99.27 |
|  | Fomular based on 32 Oxygens | | |  |  | |  |  | |  |  |  |
| Si | 11.140 | 11.003 | 10.953 |  | 11.090 | 10.991 |  | 10.827 | 11.003 |  | 9.912 | 10.239 |
| Al | 4.859 | 4.968 | 4.969 |  | 4.849 | 4.950 |  | 5.180 | 4.968 |  | 6.003 | 5.678 |
| Ti | 0.000 | 0.000 | 0.001 |  | 0.003 | 0.002 |  | 0.002 | 0.000 |  | 0.001 | 0.001 |
| Fe+2 | 0.005 | 0.003 | 0.002 |  | 0.000 | 0.001 |  | 0.000 | 0.003 |  | 0.026 | 0.007 |
| Mg | 0.000 | 0.000 | 0.000 |  | 0.000 | 0.003 |  | 0.002 | 0.000 |  | 0.001 | 0.001 |
| Mn | 0.003 | 0.000 | 0.000 |  | 0.006 | 0.002 |  | 0.002 | 0.000 |  | 0.000 | 0.002 |
| Ca | 1.046 | 1.110 | 1.227 |  | 1.127 | 1.187 |  | 1.129 | 1.110 |  | 2.238 | 1.909 |
| Na | 2.656 | 2.826 | 2.787 |  | 2.792 | 2.773 |  | 2.849 | 2.826 |  | 1.778 | 2.139 |
| K | 0.086 | 0.015 | 0.014 |  | 0.009 | 0.006 |  | 0.013 | 0.015 |  | 0.017 | 0.014 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| XAb | 0.701 | 0.715 | 0.692 |  | 0.711 | 0.699 |  | 0.714 | 0.715 |  | 0.441 | 0.527 |
| XAn | 0.701 | 0.715 | 0.692 |  | 0.711 | 0.699 |  | 0.714 | 0.715 |  | 0.555 | 0.470 |

FeO\* = Fe as total FeO, X(Ab) = Na/(Na+Ca+K)

Supplementary Table 4. Representative compositions of K–feldspar, Ilmenite and sillimanite in the migmatite from the Muju area.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rock type | migmatite | | |  | migmatite | | |  | migmatite | |
| Sample No. | mj111 | mj2510 | mj112 |  | mj111 | mj2510 | mj112 |  | mj111 | mj2510 |
| mineral | Kfs | Kfs | Kfs |  | Ilm | Ilm | Ilm |  | Sill | Sill |
| position | matrix | matrix | matrix |  | matrix | matrix | matrix |  | matrix | matrix |
| SiO2 | 64.47 | 63.77 | 63.84 |  | 0.23 | 0.07 | 0.23 |  | 36.23 | 37.59 |
| TiO2 | 0.00 | 0.00 | 0.01 |  | 53.65 | 55.36 | 52.66 |  | 0.01 | 0.00 |
| Al2O3 | 18.41 | 18.81 | 17.81 |  | 0.06 | 0.03 | 0.02 |  | 64.56 | 62.22 |
| FeO\* | 0.04 | 0.01 | 0.01 |  | 42.72 | 42.45 | 42.21 |  | 0.24 | 0.10 |
| MnO | 0.00 | 0.01 | 0.00 |  | 3.04 | 1.22 | 2.82 |  | 0.01 | 0.02 |
| MgO | 0.00 | 0.00 | 0.00 |  | 0.01 | 0.03 | 0.01 |  | 0.01 | 0.00 |
| CaO | 0.00 | 0.00 | 0.00 |  | 0.25 | 0.00 | 0.03 |  | 0.00 | 0.02 |
| Na2O | 0.79 | 0.50 | 1.03 |  | 0.00 | 0.00 | 0.00 |  | 0.00 | 0.01 |
| K2O | 16.78 | 16.89 | 16.30 |  | 0.05 | 0.05 | 0.04 |  | 0.00 | 0.01 |
| Total | 100.50 | 99.99 | 99.01 |  | 1000.02 | 99.20 | 98.00 |  | 101.06 | 99.97 |
|  | Fomular based on 32 Oxygens | | |  | Fomular based on 6 Oxygens | | |  | Fomular based on 20 Oxygens | |
| Si | 11.925 | 11.858 | 11.975 |  | 0.012 | 0.003 | 0.012 |  | 3.878 | 4.056 |
| Al | 4.011 | 4.120 | 3.935 |  | 0.004 | 0.002 | 0.001 |  | 8.138 | 7.907 |
| Ti | 0.000 | 0.000 | 0.001 |  | 2.019 | 2.081 | 2.023 |  | 0.001 | 0.000 |
| Fe+2 | 0.006 | 0.002 | 0.002 |  | 1.788 | 1.774 | 1.803 |  | 0.021 | 0.009 |
| Mg | 0.000 | 0.000 | 0.000 |  | 0.001 | 0.002 | 0.000 |  | 0.001 | 0.000 |
| Mn | 0.000 | 0.001 | 0.000 |  | 0.129 | 0.052 | 0.122 |  | 0.001 | 0.002 |
| Ca | 0.000 | 0.000 | 0.000 |  | 0.013 | 0.000 | 0.001 |  | 0.000 | 0.002 |
| Na | 0.284 | 0.179 | 0.376 |  | 0.000 | 0.000 | 0.000 |  | 0.000 | 0.002 |
| K | 3.961 | 4.008 | 3.900 |  | 0.003 | 0.003 | 0.003 |  | 0.000 | 0.002 |
|  |  |  |  |  |  |  |  |  |  |  |
| Xor | 0.93 | 0.96 | 0.91 |  |  |  |  |  |  |  |

FeO\* = Fe as total FeO, X(Fe) = Fe/(Fe+Mg), X(Or) = K/(Na+Ca+K)

Supplementary Table 5. The coordinates of the global positioning system for each sample.

|  |  |  |
| --- | --- | --- |
| Sample No. | Rock type | Location |
| MJ0327-8 | Amphibolite | 35°52'54.73"N / 127°46'39.47"E |
| MJ0325-4 | Amphibolite | 35°54'49.72"N / 127°36'16.56"E |
| MJ0325-10 | Migmatite | 35°51'39.61"N / 127°46'08.17"E |
| MJ0325-9 | Leucosome in Migmatite | 35°52'54.73"N / 127°46'39.47"E |

Supplementary Table 6. The SHRIMP zircon age data of the amphibolite, migmatite and leucosome in migmatite from the Muju area.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spot | Pb\* (ppm) | U (ppm) | Th (ppm) | Th/U (ppm) | 207Pb\*/ 206Pb | ±% | 207Pb\*/235U | ±% | 206Pb\*/238U | ±% | Apparent ages(Ma) | | | | position |
| 206Pb/238U | ± | 207Pb/206Pb | ± |
| Type-I amphibolite mj0327-8 | | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MJ3278-9.1 | 32 | 111 | 22 | 0.21 | 0.1151 | 1.31 | 5.4 | 1.8 | 0.340 | 1.3 | 1887 | ±21 | 1882 | ±24 | core |
| MJ3278-3.1 | 161 | 544 | 57 | 0.11 | 0.1146 | 0.41 | 5.4 | 1.0 | 0.344 | 0.9 | 1905 | ±15 | 1874 | ±7 | core |
| MJ3278-11.1 | 236 | 810 | 72 | 0.09 | 0.1145 | 0.41 | 5.4 | 1.1 | 0.339 | 1.0 | 1884 | ±16 | 1873 | ±7 | core |
| MJ3278-13.1 | 123 | 463 | 51 | 0.11 | 0.1146 | 0.54 | 4.9 | 1.2 | 0.310 | 1.0 | 1740 | ±16 | 1873 | ±10 | core |
| MJ3278-6.1 | 84 | 301 | 49 | 0.17 | 0.1145 | 0.65 | 5.2 | 1.2 | 0.326 | 1.1 | 1821 | ±17 | 1872 | ±12 | core |
| MJ3278-4.1 | 182 | 658 | 63 | 0.10 | 0.1143 | 0.41 | 5.1 | 1.0 | 0.321 | 0.9 | 1795 | ±15 | 1869 | ±7 | core |
| MJ3278-2.1 | 51 | 175 | 30 | 0.18 | 0.1143 | 0.76 | 5.3 | 1.3 | 0.339 | 1.1 | 1884 | ±17 | 1868 | ±14 | core |
| MJ3278-16.1 | 58 | 201 | 60 | 0.31 | 0.1136 | 0.88 | 5.3 | 1.5 | 0.337 | 1.2 | 1872 | ±19 | 1858 | ±16 | core |
| MJ3278-1.1 | 155 | 546 | 71 | 0.13 | 0.1135 | 0.42 | 5.2 | 1.0 | 0.331 | 0.9 | 1843 | ±15 | 1857 | ±8 | core |
| MJ3278-12.1 | 54 | 193 | 56 | 0.30 | 0.1135 | 0.87 | 5.1 | 1.4 | 0.325 | 1.2 | 1816 | ±18 | 1857 | ±16 | core |
| MJ3278-15.1 | 45 | 156 | 37 | 0.24 | 0.1134 | 1.05 | 5.3 | 1.6 | 0.339 | 1.2 | 1881 | ±19 | 1854 | ±19 | Core |
| MJ3278-7.1 | 31 | 110 | 39 | 0.37 | 0.1133 | 1.24 | 5.1 | 1.8 | 0.324 | 1.3 | 1810 | ±20 | 1853 | ±22 | Core |
| MJ3278-18.1 | 12 | 42 | 7 | 0.17 | 0.1131 | 2.56 | 5.3 | 3.1 | 0.341 | 1.7 | 1893 | ±28 | 1849 | ±46 | core |
| MJ278-8.1 | 60 | 217 | 55 | 0.26 | 0.1130 | 0.82 | 5.0 | 1.4 | 0.322 | 1.1 | 1797 | ±17 | 1848 | ±15 | core |
| MJ3278-19.1 | 36 | 124 | 10 | 0.08 | 0.1130 | 1.17 | 5.2 | 1.7 | 0.334 | 1.3 | 1859 | ±20 | 1848 | ±21 | core |
| MJ3278-10.1 | 29 | 104 | 12 | 0.12 | 0.1128 | 1.42 | 5.1 | 1.9 | 0.326 | 1.3 | 1820 | ±21 | 1846 | ±26 | core |
| MJ3278-5.1 | 24 | 85 | 9 | 0.11 | 0.1105 | 2.54 | 5.0 | 3.0 | 0.325 | 1.5 | 1814 | ±24 | 1808 | ±46 | core |
| MJ3278-18.2 | 62 | 222 | 25 | 0.11 | 0.1137 | 0.82 | 5.1 | 1.4 | 0.326 | 1.1 | 1860 | ±15 | 1817 | ±18 | rim |
| MJ3278-11.2 | 348 | 1257 | 39 | 0.03 | 0.1142 | 0.35 | 5.1 | 1.0 | 0.322 | 1.0 | 1867 | ±6 | 1801 | ±15 | rim |
| MJ3278-1.2 | 105 | 382 | 33 | 0.09 | 0.1142 | 0.59 | 5.0 | 1.2 | 0.319 | 1.1 | 1867 | ±11 | 1784 | ±16 | rim |
| MJ3278-15.2 | 92 | 343 | 37 | 0.11 | 0.1122 | 0.70 | 4.8 | 1.3 | 0.313 | 1.1 | 1835 | ±13 | 1756 | ±16 | rim |
| MJ3278-17.2 | 213 | 821 | 40 | 0.05 | 0.1135 | 0.45 | 4.7 | 1.1 | 0.303 | 1.0 | 1856 | ±8 | 1704 | ±15 | rim |

Errors are 1-sigma; Pb\* indicates radiogenic portions. Common Pb corrected using 204Pb.

Supplementary Table 6. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spot | Pb\* (ppm) | U (ppm) | Th (ppm) | Th/U (ppm) | 207Pb\*/ 206Pb | ±% | 207Pb\*/235U | ±% | 206Pb\*/238U | ±% | Apparent ages(Ma) | | | | position | |
| 206Pb/238U | ± | 207Pb/206Pb | ± |
| amphibolite MJ0325-4a | | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MJ3254-7.1 | 49 | 199 | 210 | 1.09 | 0.1047 | 0.61 | 4.11 | 2.3 | 0.285 | 2.2 | 1606 | ±37 | 1710 | ±11 | core | |
| MJ3254-5.1 | 272 | 1119 | 702 | 0.65 | 0.1041 | 0.82 | 4.06 | 4.3 | 0.283 | 4.2 | 1599 | ±65 | 1699 | ±15 | core | |
| MJ3254-2.1 | 156 | 650 | 734 | 1.17 | 0.1036 | 0.36 | 3.98 | 4.2 | 0.279 | 4.2 | 1574 | ±70 | 1689 | ±7 | core | |
| MJ3254-1.1 | 185 | 719 | 517 | 0.74 | 0.1032 | 0.31 | 4.26 | 2.1 | 0.300 | 2.1 | 1685 | ±35 | 1682 | ±6 | core | |
| MJ3254-4.1 | 380 | 1486 | 431 | 0.30 | 0.1026 | 1.23 | 4.21 | 3.1 | 0.298 | 2.8 | 1676 | ±43 | 1671 | ±23 | core | |
| MJ3254-3.1 | 129 | 611 | 246 | 0.42 | 0.1025 | 0.39 | 3.48 | 1.6 | 0.246 | 1.5 | 1416 | ±21 | 1670 | ±7 | core | |
| MJ3254-6.1 | 49 | 199 | 179 | 0.93 | 0.1021 | 0.71 | 4.03 | 3.0 | 0.286 | 2.9 | 1623 | ±48 | 1662 | ±13 | core | |

Errors are 1-sigma; Pb\* indicates radiogenic portions. Common Pb corrected using 204Pb.

Supplementary Table 6. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spot | Pb\* (ppm) | U (ppm) | Th (ppm) | Th/U (ppm) | 207Pb\*/ 206Pb | ±% | 207Pb\*/235U | ±% | 206Pb\*/238U | ±% | Apparent ages(Ma) | | | | position |
| 206Pb/238U | ± | 207Pb/206Pb | ± |
| migmatite MJ0325-10 | | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MJ510-10.1 | 286 | 542 | 55 | 0.10 | 0.2258 | 1.43 | 19.13 | 3.4 | 0.615 | 3.1 | 3088 | ±76 | 3023 | ±23 | core |
| MJ510-26.1 | 629 | 1412 | 11 | 0.01 | 0.2054 | 1.28 | 14.69 | 4.2 | 0.519 | 4.0 | 2694 | ±87 | 2870 | ±21 | core |
| MJ510-15.1 | 82 | 183 | 120 | 0.68 | 0.1785 | 2.15 | 12.80 | 7.2 | 0.520 | 6.9 | 2700 | ±153 | 2639 | ±36 | core |
| MJ510-25.1 | 83 | 204 | 217 | 1.10 | 0.1652 | 1.29 | 10.85 | 3.5 | 0.476 | 3.2 | 2511 | ±67 | 2510 | ±22 | core |
| MJ510-19.1 | 44 | 108 | 76 | 0.72 | 0.1648 | 0.60 | 10.67 | 2.3 | 0.470 | 2.2 | 2482 | ±45 | 2505 | ±10 | core |
| MJ510-14.1 | 68 | 168 | 100 | 0.62 | 0.1638 | 0.58 | 10.62 | 2.9 | 0.470 | 2.8 | 2484 | ±58 | 2495 | ±10 | core |
| MJ510-8.1 | 136 | 342 | 340 | 1.03 | 0.1601 | 1.09 | 10.23 | 2.9 | 0.463 | 2.7 | 2454 | ±55 | 2457 | ±18 | core |
| MJ510-17.1 | 50 | 135 | 71 | 0.55 | 0.1602 | 0.53 | 9.60 | 1.0 | 0.435 | 0.9 | 2326 | ±17 | 2457 | ±9 | core |
| MJ510-2.1 | 467 | 1223 | 610 | 0.52 | 0.1562 | 0.20 | 9.57 | 3.5 | 0.444 | 3.5 | 2370 | ±69 | 2415 | ±3 | core |
| MJ510-9.1 | 124 | 337 | 99 | 0.30 | 0.1466 | 0.37 | 8.66 | 2.5 | 0.429 | 2.5 | 2299 | ±48 | 2307 | ±6 | core |
| MJ510-18.1 | 303 | 930 | 310 | 0.34 | 0.1413 | 0.27 | 7.40 | 2.1 | 0.380 | 2.1 | 2076 | ±37 | 2244 | ±5 | core |
| MJ510-4.1 | 20 | 56 | 78 | 1.43 | 0.1366 | 1.09 | 7.66 | 4.5 | 0.407 | 4.3 | 2199 | ±81 | 2185 | ±19 | core |
| MJ510-7.1 | 383 | 1203 | 514 | 0.44 | 0.1306 | 0.43 | 6.67 | 3.1 | 0.371 | 3.1 | 2033 | ±53 | 2106 | ±8 | core |
| MJ510-1.1 | 133 | 410 | 150 | 0.38 | 0.1297 | 0.34 | 6.78 | 2.6 | 0.379 | 2.5 | 2071 | ±45 | 2094 | ±6 | core |
| MJ510-20.1 | 123 | 412 | 53 | 0.13 | 0.1286 | 1.97 | 6.15 | 2.1 | 0.347 | 0.7 | 1919 | ±11 | 2079 | ±35 | core |
| MJ510-30.1 | 54 | 165 | 55 | 0.34 | 0.1285 | 0.73 | 6.69 | 4.2 | 0.378 | 4.1 | 2066 | ±73 | 2077 | ±13 | core |
| MJ510-23.1 | 60 | 188 | 128 | 0.70 | 0.1283 | 0.52 | 6.54 | 2.8 | 0.370 | 2.7 | 2029 | ±47 | 2074 | ±9 | core |
| MJ510-24.1 | 231 | 732 | 15 | 0.02 | 0.1283 | 0.31 | 6.49 | 4.1 | 0.367 | 4.1 | 2015 | ±71 | 2074 | ±5 | core |
| MJ510-21.1 | 125 | 384 | 215 | 0.58 | 0.1265 | 0.42 | 6.59 | 1.6 | 0.378 | 1.6 | 2066 | ±28 | 2050 | ±7 | core |
| MJ510-3.1 | 121 | 388 | 47 | 0.12 | 0.1250 | 0.38 | 6.23 | 2.7 | 0.362 | 2.7 | 1990 | ±46 | 2029 | ±7 | core |
| MJ510-27.1 | 222 | 687 | 185 | 0.28 | 0.1249 | 0.28 | 6.49 | 1.5 | 0.377 | 1.5 | 2061 | ±26 | 2027 | ±5 | core |
| MJ510-32.2 | 197 | 613 | 136 | 0.23 | 0.1242 | 0.33 | 6.41 | 1.7 | 0.374 | 1.6 | 2050 | ±29 | 2017 | ±6 | core |
| MJ510-29.1 | 192 | 594 | 161 | 0.28 | 0.1238 | 0.34 | 6.41 | 2.7 | 0.375 | 2.7 | 2055 | ±48 | 2012 | ±6 | core |
| MJ510-31.1 | 128 | 445 | 12 | 0.03 | 0.1189 | 0.44 | 5.49 | 3.2 | 0.335 | 3.2 | 1861 | ±51 | 1940 | ±8 | rim |
| MJ510-5.2 | 82 | 282 | 235 | 0.86 | 0.1158 | 0.56 | 5.44 | 3.0 | 0.341 | 2.9 | 1890 | ±48 | 1892 | ±10 | rim |
| MJ510-13.2 | 99 | 338 | 4 | 0.01 | 0.1146 | 0.49 | 5.42 | 1.0 | 0.343 | 0.9 | 1901 | ±15 | 1874 | ±9 | rim |
| MJ510-11.1 | 84 | 295 | 15 | 0.05 | 0.1142 | 0.93 | 5.21 | 1.5 | 0.331 | 1.2 | 1842 | ±20 | 1867 | ±17 | rim |
| MJ510-1.2 | 118 | 408 | 10 | 0.03 | 0.1137 | 0.43 | 5.26 | 2.1 | 0.335 | 2.1 | 1865 | ±34 | 1860 | ±8 | rim |
| MJ510-6.2 | 300 | 1021 | 14 | 0.01 | 0.1136 | 0.50 | 5.36 | 1.7 | 0.342 | 1.6 | 1897 | ±26 | 1858 | ±9 | rim |
| MJ510-22.1 | 81 | 289 | 3 | 0.01 | 0.1132 | 0.48 | 5.10 | 2.5 | 0.327 | 2.4 | 1823 | ±39 | 1852 | ±9 | rim |
| MJ510-12.1 | 110 | 377 | 5 | 0.01 | 0.1132 | 0.87 | 5.30 | 2.4 | 0.339 | 2.2 | 1884 | ±36 | 1851 | ±16 | rim |
| MJ510-19.2 | 91 | 322 | 5 | 0.02 | 0.1126 | 0.47 | 5.12 | 2.2 | 0.330 | 2.2 | 1837 | ±35 | 1843 | ±9 | rim |
| MJ510-3.2 | 98 | 337 | 3 | 0.01 | 0.1126 | 0.81 | 5.28 | 2.2 | 0.340 | 2.1 | 1887 | ±34 | 1841 | ±15 | rim |
| MJ510-4.2 | 103 | 371 | 6 | 0.02 | 0.1124 | 0.43 | 5.03 | 2.0 | 0.324 | 2.0 | 1811 | ±31 | 1839 | ±8 | rim |

Errors are 1-sigma; Pb\* indicates radiogenic portions. Common Pb corrected using 204Pb.

Supplementary Table 6. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spot | Pb\* (ppm) | U (ppm) | Th (ppm) | Th/U (ppm) | 207Pb\*/ 206Pb | ±% | 207Pb\*/235U | ±% | 206Pb\*/238U | ±% | Apparent ages(Ma) | | | |  |
| 206Pb/238U | ± | 207Pb/206Pb | ± | position |
| Leucosome in migmatite mj0325-9 | | |  | |  |  |  |  |  |  |  |  |  |  |  |
| MJ259-1.1 | 104 | 338 | 187 | 0.57 | 0.12396 | 0.46 | 6.14 | 1.30 | 0.3591 | 1.22 | 1978 | ±21 | 2014 | ±8 | core |
| MJ259-16.1 | 43 | 143 | 44 | 0.32 | 0.12330 | 0.49 | 5.96 | 1.46 | 0.3505 | 1.37 | 1937 | ±23 | 2004 | ±9 | core |
| MJ259-7.1 | 128 | 413 | 257 | 0.64 | 0.12281 | 0.29 | 6.13 | 0.90 | 0.3620 | 0.85 | 1992 | ±15 | 1997 | ±5 | core |
| MJ259-11.1 | 101 | 316 | 148 | 0.48 | 0.12269 | 0.36 | 6.30 | 1.23 | 0.3727 | 1.17 | 2042 | ±21 | 1996 | ±6 | core |
| MJ259-14.1 | 69 | 221 | 90 | 0.42 | 0.12239 | 0.40 | 6.16 | 0.91 | 0.3648 | 0.82 | 2005 | ±14 | 1991 | ±7 | core |
| MJ259-15.1 | 92 | 298 | 303 | 1.05 | 0.12134 | 0.39 | 6.00 | 0.89 | 0.3584 | 0.80 | 1975 | ±14 | 1976 | ±7 | core |
| MJ259-12.1 | 221 | 739 | 198 | 0.28 | 0.11802 | 0.30 | 5.67 | 0.83 | 0.3486 | 0.77 | 1928 | ±13 | 1926 | ±5 | core |
| MJ259-13.2 | 518 | 1855 | 210 | 0.12 | 0.11476 | 0.90 | 5.14 | 1.61 | 0.3250 | 1.34 | 1814 | ±21 | 1876 | ±16 | rim |
| MJ259-9.2 | 601 | 2028 | 37 | 0.02 | 0.11453 | 0.19 | 5.45 | 0.77 | 0.3450 | 0.75 | 1910 | ±12 | 1872 | ±3 | rim |
| MJ259-10.2 | 743 | 2374 | 52 | 0.02 | 0.11430 | 0.18 | 5.74 | 0.76 | 0.3640 | 0.74 | 2001 | ±13 | 1869 | ±3 | rim |
| MJ259-1.2 | 530 | 1828 | 30 | 0.02 | 0.11421 | 0.19 | 5.31 | 0.77 | 0.3374 | 0.75 | 1874 | ±12 | 1867 | ±3 | rim |
| MJ259-8.2 | 665 | 2258 | 38 | 0.02 | 0.11420 | 0.18 | 5.39 | 0.77 | 0.3426 | 0.75 | 1899 | ±12 | 1867 | ±3 | rim |
| MJ259-6.2 | 610 | 2038 | 62 | 0.03 | 0.11414 | 0.19 | 5.48 | 0.77 | 0.3482 | 0.75 | 1926 | ±12 | 1866 | ±3 | rim |
| MJ259-12.2 | 542 | 1796 | 67 | 0.04 | 0.11412 | 0.20 | 5.53 | 0.77 | 0.3513 | 0.75 | 1941 | ±13 | 1866 | ±4 | rim |
| MJ259-21.2 | 605 | 2056 | 41 | 0.02 | 0.11412 | 0.19 | 5.39 | 0.76 | 0.3428 | 0.74 | 1900 | ±12 | 1866 | ±3 | rim |
| MJ259-3.2 | 777 | 2572 | 43 | 0.02 | 0.11402 | 0.18 | 5.53 | 0.76 | 0.3515 | 0.74 | 1942 | ±12 | 1865 | ±3 | rim |
| MJ259-5.2 | 691 | 2228 | 39 | 0.02 | 0.11389 | 0.18 | 5.67 | 0.77 | 0.3612 | 0.75 | 1988 | ±13 | 1862 | ±3 | rim |
| MJ259-4.2 | 592 | 1952 | 103 | 0.05 | 0.11377 | 0.20 | 5.54 | 0.78 | 0.3531 | 0.76 | 1949 | ±13 | 1861 | ±4 | rim |
| MJ259-7.2 | 384 | 1273 | 25 | 0.02 | 0.11380 | 0.21 | 5.51 | 0.78 | 0.3510 | 0.75 | 1939 | ±13 | 1861 | ±4 | rim |
| MJ259-19.2 | 586 | 1953 | 53 | 0.03 | 0.11383 | 0.19 | 5.48 | 0.77 | 0.3492 | 0.74 | 1931 | ±12 | 1861 | ±3 | rim |
| MJ259-11.2 | 735 | 2524 | 39 | 0.02 | 0.11362 | 0.20 | 5.31 | 0.78 | 0.3390 | 0.75 | 1882 | ±12 | 1858 | ±4 | rim |

Errors are 1-sigma; Pb\* indicates radiogenic portions. Common Pb corrected using 204Pb.

Supplementary Table 7. The result of zircon Lu-Hf analysis of the amphibolites from the Muju area.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample | Age(Ma) | 176Yb/177Hf | 176Lu/177Hf | 176Hf/177Hf | 2σ | (176Hf/177Hf)i | εHf(*t*) | TDM1(Ma) | fLu/Hf, |
| Type-I amphibolite (MJ0327-8) | | |  |  |  |  |  |  |  |
| MJ0327\_1 | 1866 | 0.009885 | 0.000264 | 0.28175 | 0.000031 | 0.28174 | 5.21 | 2065 | -0.99 |
| MJ0327\_2 | 1866 | 0.012350 | 0.000353 | 0.28175 | 0.000040 | 0.28174 | 5.10 | 2070 | -0.99 |
| MJ0327\_3 | 1866 | 0.011550 | 0.000349 | 0.28178 | 0.000035 | 0.28177 | 6.10 | 2032 | -0.99 |
| MJ0327\_4 | 1866 | 0.009150 | 0.000247 | 0.28174 | 0.000022 | 0.28173 | 4.66 | 2086 | -0.99 |
| MJ0327\_5 | 1866 | 0.018630 | 0.000457 | 0.28175 | 0.000026 | 0.28173 | 4.75 | 2083 | -0.99 |
| MJ0327\_6 | 1866 | 0.017730 | 0.000495 | 0.28176 | 0.000031 | 0.28174 | 5.06 | 2072 | -0.99 |
| MJ0327\_7 | 1866 | 0.024930 | 0.000645 | 0.28177 | 0.000030 | 0.28175 | 5.47 | 2057 | -0.98 |
| MJ0327\_8 | 1866 | 0.008105 | 0.000222 | 0.28171 | 0.000030 | 0.28170 | 3.77 | 2119 | -0.99 |
| MJ0327\_9 | 1866 | 0.010260 | 0.000281 | 0.28173 | 0.000027 | 0.28172 | 4.44 | 2094 | -0.99 |
| MJ0327\_10 | 1866 | 0.016604 | 0.000406 | 0.28177 | 0.000025 | 0.28175 | 5.67 | 2048 | -0.99 |
| MJ0327\_11 | 1866 | 0.007638 | 0.000211 | 0.28176 | 0.000028 | 0.28175 | 5.63 | 2049 | -0.99 |
| MJ0327\_12 | 1866 | 0.013000 | 0.000355 | 0.28176 | 0.000029 | 0.28175 | 5.41 | 2058 | -0.99 |
| MJ0327\_13 | 1866 | 0.012910 | 0.000335 | 0.28172 | 0.000026 | 0.28171 | 3.98 | 2112 | -0.99 |
| Type-II amphibolite (MJ0325-4) | | |  |  |  |  |  |  |  |
| MJ3254-1 | 1683 | 0.052360 | 0.001372 | 0.28188 | 0.000036 | 0.28183 | 4.22 | 1953 | -0.96 |
| Mj3254-2 | 1683 | 0.053900 | 0.001102 | 0.28151 | 0.000043 | 0.28148 | -8.36 | 2439 | -0.97 |
| MJ3254-3 | 1683 | 0.056320 | 0.001509 | 0.28167 | 0.000031 | 0.28162 | -3.32 | 2250 | -0.95 |
| MJ3254-4 | 1683 | 0.058260 | 0.001451 | 0.28155 | 0.000045 | 0.28150 | -7.40 | 2409 | -0.96 |
| MJ3254-5 | 1683 | 0.055000 | 0.001212 | 0.28135 | 0.000037 | 0.28131 | -14.27 | 2670 | -0.96 |
| MJ3254-6 | 1683 | 0.068200 | 0.001500 | 0.28138 | 0.000042 | 0.28133 | -13.42 | 2645 | -0.95 |

εHf(t) = ((176Hf/177Hf)sample–(176Lu/177Hf)sample × (eλt–1)/(176Hf/177Hf)CHUR,0–(176Lu/177Hf)CHUR× (eλt–1) –1) × 10,000

T(DM1) = 1/λ × ln[1+(176Hf/177Hf)sample – (176Hf/177Hf)DM/(176Lu/177Hf)sample – (176Lu/177Hf)DM]

T(DM2) = THf – (THf – t) × (*f*CC – *fS / f*CC – *fDM)*

*f*Lu/Hf = ((176Lu/177Hf)sample/(176Lu/177Hf)CHUR)-1

t(Ma) = zircon crystallization age, λ = decay constant